NPR
College of Engineering
and Technology
(AN AUTONOMOUS INSTITUTION)
NBA Accredited (B.E. - CSE, ECE, EEE & Mechanical Engg.) | Accredited by NAAC with 'A' Grade
Recognized by UGC under s (f) | ISO 9001:2015 Certified | Approved by All India Council for Technical Education, New Delhi
Affiliated to Anna University, Chennai
Natham, Dindigul (Dist.) - 624 401, Tamil Nadu.

B.Tech – ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

REGULATIONS - 2023

CHOICE BASED CREDIT SYSTEM (CBCS)

CURRICULUM AND SYLLABUS

Chairperson-Board of Studies,
Department of Artificial Intelligence & Data Science,
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I - Department Vision

To develop AI professionals of international relevance to meet the industry and societalneeds with future technologies.

II - Department Mission

M1: To collaborate with industry and provide the state-of-the-art infrastructural facilities, with a conducive teaching-learning ambience.

M2: To instill in the students the knowledge for world class technical competence, entrepreneurial skill and a spirit of innovation in the area of Artificial Intelligence and Data Science to solve real world problems.

M3: To encourage students to pursue higher education and research.

M4: To inculcate right attitude and discipline and develop industry ready professionals for serving the society.

III - Program Name: B.Tech –Artificial Intelligence and Data Science

IV - Program Educational Objectives

Graduates of Artificial Intelligence and Data science will be able to

1. Utilize their proficiencies in the fundamental knowledge of basic sciences, mathematics, Artificial Intelligence, data science, and statistics to build systems that require management and analysis of large volumes of data.
2. Advance their technical skills to pursue pioneering research in the field of AI and Data Science and create disruptive and sustainable solutions for the welfare of ecosystems.
3. Think logically, pursue lifelong learning and collaborate with an ethical attitude in a Multidisciplinary team
4. Design and model AI-based solutions to critical problem domains in the real world.
5. Exhibit innovative thoughts and creative ideas for an effective contribution towards the economy building.

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V - Program Outcomes

Engineering Graduates will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems anddesign system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineeringactivities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

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11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

VI - Program Specific Outcomes

At the end of the program students will be able to

PSO 1: Develop and implement AI-based processes for effective decision-making in diverse domains, including business and governance, by integrating domain-specific knowledge andadvanced techniques.

PSO 2: Utilize data analysis to derive actionable insights and foresights, enabling the solution of complex business and engineering problems.

PSO 3: Apply theoretical knowledge of AI and Data Analytics, along with practical tools and techniques, to address societal problems, demonstrating proficiency in data analytics, visualization, and project coordination skills.

VII - Mapping of PEOs, POs, and PSO - Tabular Format

POs PEOs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
I	✓	✓	-	-	-	-	-	-	-	-	-	-	✓	✓	✓
II	✓	✓	✓	✓	✓	-	✓	✓	-	-	-	-	-	✓	-
III	-	-	-	✓	-	-	-	✓	✓	✓	✓	✓	-	✓	✓
IV	-	-	✓	✓	-	✓	-	-	-	-	-	-	✓	✓	✓
V	-	✓	✓	✓	-	✓	-	-	-	-	-	-	-	✓	✓

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VIII - Program Scope

- Graduates of the Artificial Intelligence and Data Science program are poised to embark on careers that span diverse domains including machine learning, data analysis, predictive modeling, natural language processing, and research and development.
- They can find opportunities across an array of industries such as technology, finance, healthcare, e-commerce, manufacturing, entertainment, and research institutions.
- The program empowers students with the essential technical skills and knowledge to construct intelligent algorithms, dissect complex datasets, harness predictive models, and contribute to breakthroughs in AI-driven innovation

IX - Program Specific Criteria

Foundational Technical Expertise: The curriculum must encompass essential domains within Artificial Intelligence and Data Science, encompassing machine learning, statistics, data analysis, pattern recognition, neural networks, natural language processing, and data visualization.

Mathematical and Scientific Proficiency: The program should establish a robust mathematical base, covering calculus, linear algebra, probability, and statistics. Relevant scientific principles such as physics and basic principles of chemistry may also be included.

Data Structure Design: The curriculum should incorporate comprehensive courses on data structure design, encompassing foundational structures like arrays, linked lists, trees, and graphs. Students should acquire an adept understanding of structure characteristics, analysis of algorithms, and effective design principles.

Machine Learning & Deep Learning: The curriculum should delve into the realms of machine learning and deep learning, encompassing topics such as supervised and unsupervised learning, neural networks, model optimization, and natural language processing. Students should develop proficiency in algorithm selection, model training, and the application of advanced learning techniques."

Database Design and Management: The program should feature comprehensive modules on database design, management systems, and data modeling. Students should grasp concepts like relational databases, normalization, query optimization, and data integrity, enabling them to adeptly create and manage efficient data storage solutions.

Big Data Technology: The curriculum should encompass comprehensive coverage of big data technologies, exploring concepts like data storage, processing frameworks, distributed computing, and data analytics. Students should develop a robust understanding of handling vast datasets, utilizing distributed systems, and implementing scalable data processing solutions.

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Natural Language Processing: The curriculum should feature in-depth modules on Natural Language Processing (NLP), covering topics such as text preprocessing, sentiment analysis, language modeling, and machine translation. Students should acquire a comprehensive understanding of linguistic structures, feature extraction, and advanced NLP techniques.

Professional Skills and Ethics: The AI and Data Science program should prioritize the cultivation of professional competencies, encompassing effective communication, collaborative teamwork, analytical problem-solving, critical reasoning, and a strong emphasis on ethical considerations. Students should internalize the ethical obligations inherent to their roles and grasp the broader societal implications of their AI and data-related endeavors.

Continuous Improvement and Assessment: The AI and Data Science program should establish a framework for continuous improvement and evaluation of student learning outcomes. This entails consistent scrutiny of the curriculum, solicitation of input from industry experts, alumni, and students, and the integration of emerging technologies and evolving industry dynamics.

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X - Proposed Curriculum I Semester to VIII Semester

Semester – I

S. No.	Course Code	Course Title	Curricular Category	Period Per Week			Total Contact Periods	Credits
				L	T	P		
1	23IP100	Induction Programme	-	-	-	-	-	0
THEORY								
2	23HS101	Professional English -I	HSMC	3	0	0	3	3
3	23MA101	Matrices and Calculus	BSC	3	1	0	4	4
4	23PH101	Engineering Physics	BSC	3	0	0	3	3
5	23CY101	Engineering Chemistry	BSC	3	0	0	3	3
6	23GE102	Problem Solving and Python Programming	ESC	3	0	0	3	3
7	23GE103	தமிழரமரபு /Heritage of Tamils	HSMC	1	0	0	1	1
PRACTICALS								
8	23GE111	Problem Solving and Python Programming Laboratory	ESC	0	0	4	4	2
9	23BS111	Physics and Chemistry Laboratory	BSC	0	0	4	4	2
10	23GE112	English Laboratory -I	EEC	0	0	2	2	1
			Total	16	1	10	27	22

Semester – II

S. No.	CourseCode	Course Title	Curricular Category	Period Per Week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1	23HS201	Professional English-II	HSMC	2	0	0	2	2
2	23MA201	Statistics and Numerical Methods	BSC	3	1	0	4	4
3	23PH203	Physics for Information Science	BSC	3	0	0	3	3
4	23BE201	Basic Electrical and Electronics Engineering	ESC	3	0	0	3	3
5	23CS901	Digital Principles and Computer Organization	ESC	3	0	2	5	4
6	23AD201	Data Structures Design	PCC	3	0	0	3	3
7	23GE201	தமிழரும் தொழில்நுட்பமும் /Tamil's and Technology	HSMC	1	0	0	1	1
8		NCC Credit Course Level-1#	-	2	0	0	2	2#
PRACTICALS								
9	23GE211	Engineering Practices Laboratory	ESC	0	0	3	3	1.5
10	23AD211	Data Structures Design Laboratory	PCC	0	0	3	3	1.5
11	23GE212	English Laboratory -II	EEC	0	0	2	2	1
			Total	18	1	10	29	24

#NCC Credit Course level -1 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.

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Semester – III

S. No.	Course Code	Course Title	Curricular Category	Period Per Week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1	23MA302	Discrete Mathematics	BSC	3	1	0	4	4
2	23AD301	Fundamentals of Data Science andAnalytics	PCC	3	0	2	5	4
3	23AD302	Database Design and Management	PCC	3	0	0	3	3
4	23AD303	Algorithmic Problem Solving Techniques	PCC	3	0	2	5	4
5	23AD304	System Software and Operating Systems	PCC	3	0	2	5	4
6	23AD305	Intelligent Systems	PCC	3	0	0	3	3
PRACTICALS								
7	23AD311	Database Design and Management Laboratory	PCC	0	0	3	3	1.5
8	23AD312	Intelligent Systems Laboratory	PCC	0	0	3	3	1.5
9		Value added Course-I $	EEC	0	0	2	2	1$
			Total	18	1	14	33	25

$ Value added Course-I is offered to all the students. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA

Semester – IV

S. No.	Course Code	Course Title	Curricular Category	Period Per Week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1	23MA401	Statistics for Artificial Intelligence and Data Science	BSC	3	1	0	4	4
2	23AD401	Data Exploration and Visualization	PCC	3	0	2	5	4
3	23AD402	Machine Learning	PCC	3	0	2	5	4
4	23CS906	Robotic Process Automation	PCC	2	0	2	4	3
5	23AD404	Networking Essentials	PCC	3	0	0	3	3
6	23CS905	Cloud Computing	PCC	2	0	2	4	3
7	23GE901	Environmental Sciences and Sustainability	BSC	2	0	0	2	2
8		Value added Course-II $	EEC	0	0	2	2	1$
9		NCC Credit Course Level-2 #	-	2	0	0	2	3#
			Total	18	1	10	26	23

$ Value added Course-II is offered to all the students. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA

#NCC Credit Course level -2 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.

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Semester – V

S. No.	Course Code	Course Title	Curricular Category	Period Per Week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1	23AD501	Deep Learning	PCC	3	0	2	5	4
2	23AD502	Data and InformationSecurity	PCC	3	0	0	3	3
3	23CS903	Embedded Systems and IoT	PCC	3	0	2	5	4
4		Open Elective – I~	OEC	3	0	0	3	3~
5		Professional Elective I	PEC	2	0	2	4	3
6		Professional Elective II	PEC	2	0	2	4	3
7		Mandatory Course *	MC	3	0	0	3	0*
PRACTICALS								
8	23AD511	Summer Internship-I	EEC	0	0	0	0	2
			Total	19	0	8	27	22

*Mandatory Course are Non-credit Courses (Students shall select one course from the list given under Mandatory Courses)
~Open Elective -I shall be chosen from the list of Open Electives offered by other Programmes.

Semester – VI

S. No.	Course Code	Course Title	Curricular Category	Period Per Week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1	23AD901	Big Data Analytics	PCC	2	0	2	4	3
2	23AD601	Advanced Python	PCC	2	0	2	4	3
3	23AD602	Natural Language Processing	PCC	3	0	2	5	4
4		Professional Elective III	PEC	2	0	2	4	3
5		Professional Elective IV	PEC	2	0	2	4	3
6		Open Elective – II~	OEC	3	0	0	3	3~
PRACTICALS								
7	23AD611	Mini Project	EEC	0	0	4	4	2
			Total	14	0	14	28	21

~Open Elective -II shall be chosen from the list of Open Electives offered by other Programmes.

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Semester – VII

S. No.	Course Code	Course Title	Curricular Category	Period Per Week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1	23GE709	Human Values and Ethics for AI	HSMC	2	0	0	2	2
2		Elective -Management[&]	HSMC	3	0	0	3	3[&]
3		Open Elective – III[~]	OEC	3	0	0	3	3[~]
4		ProfessionalElective V	PEC	2	0	2	4	3
5		ProfessionalElective VI	PEC	2	0	2	4	3
PRACTICALS								
6	23AD711	Summer Internship-II	EEC	0	0	0	0	2
7	23AD712	Research Paper Writing & Publication	EEC	0	0	2	2	1
			Total	**12**	**0**	**6**	**18**	**17**

&Elective -Management shall be chosen from the Elective Management Courses

~Open Elective -II shall be chosen from the list of Open Electives offered by other Programmes

Semester –VIII

S. No.	Course Code	Course Title	Curricular Category	Period Per Week			Total Contact Periods	Credits
				L	T	P		
PRACTICALS								
1	23AD811	Project Work	EEC	0	0	20	20	10
			Total	**0**	**0**	**20**	**20**	**10**

XI – ELECTIVE MANAGEMENT COURSES

S. No.	Course Code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
1.	23GE701	Principles of Management	HSMC	3	0	0	3	3
2.	23GE702	Total Quality Management	HSMC	3	0	0	3	3
3.	23GE703	Engineering Economics and Financial Accounting	HSMC	3	0	0	3	3
4.	23GE704	Human Resource Management	HSMC	3	0	0	3	3
5.	23GE705	Knowledge Management	HSMC	3	0	0	3	3
6.	23GE706	Industrial Management	HSMC	3	0	0	3	3

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XII – MANDATORY COURSES

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	23MC901	English for Communication (Swayam)	MC	3	0	0	3	0
2.	23MC902	Introduction to Women and Gender Studies	MC	3	0	0	3	0
3.	23MC903	Disaster Risk Reduction and Management	MC	3	0	0	3	0
4.	23MC904	History of Science and Technology in India	MC	3	0	0	3	0
5.	23MC905	Political and Economic Thought for a Humane Society	MC	3	0	0	3	0
6.	23MC906	Well Being with Traditional Practices-Yoga, Ayurveda and Siddha	MC	3	0	0	3	0
7.	23MC907	State, Nation Building and Politics in India	MC	3	0	0	3	0
8.	23MC908	Industrial Safety	MC	3	0	0	3	0
9.	23MC909	Indian Constitution	MC	3	0	0	3	0
10.	23MC910	Elements of Literature	MC	3	0	0	3	0

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XIII – PROFESSIONAL ELECTIVE COURSES: VERTICALS

Vertical I for AIDS I	Vertical II Full Stack Development for IT	Vertical III Cloud Computing and Data Center Technologies	Vertical IV Cyber Security and Data Privacy	Vertical V Creative Media	Vertical VI Emerging Technologies	Vertical VII for AIDS II
Knowledge Engineering	Web Technologies	Distributed Computing	Ethical Hacking	Augmented Reality/Virtual Reality	Augmented Reality/Virtual Reality	Bio-inspired Optimization Techniques
Recommender Systems	App Development	Virtualization	Digital and Mobile Forensics	Multimedia and Animation	Neural Networks and Deep Learning	App Development
Reinforcement Learning	Cloud Services Management	Cloud Services Management	Social Network Security	Video Creation and Editing	Cyber Security	Health Care Analytics
Soft Computing	UI and UX Design	Data Warehousing	Modern Cryptography	UI and UX Design	Quantum Computing	Cyber Security
Text and Speech Analysis	Software Testing and Automation	Storage Technologies	Engineering Secure Software Systems	Digital marketing	Cryptocurrencyand Blockchain Technologies	Optimization Techniques
Business Analytics	Web Application Security	Software Defined Networks	Cryptocurrency and Blockchain Technologies	Multimedia Data Compression and Storage	Game Development	Game Theory
Image and video analytics	DevOps	Stream Processing	Network Security	Game Development	3D Printing and Design	Cognitive Science
Computer Vision	Principles of Programming Languages	Security and Privacy in Cloud	Security and Privacy in Cloud	Visual Effects	Autonomous Systems and Drones	Machine Intelligence for Medical Image Analysis

Registration of Professional Elective Courses from Verticals:

Professional Elective Courses will be registered in Semesters V and VI. These courses are listed in groups called verticals that represent a particular area of specialisation / diversified group. Students are permitted to choose all the Professional Electives from a particular vertical or from different verticals. Further, only one Professional Elective course shall be chosen in a semester horizontally (row-wise). However, two courses are permitted from the same row, provided one course is enrolled in Semester V and another in semester VI.

The registration of courses for B.E./B.Tech (Honours) or Minor degree shall be done from Semester V to VIII. The procedure for registration of courses explained above shall be followed for the courses of B.E/B.Tech (Honours) or Minor degree also. For more details on B.E./B.Tech (Honours) or Minor degree refer to the Regulations 2021, Clause 4.10(Amendments)

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Professional Elective Courses

Vertical - I: VERTICALS FOR AIDS I

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	23PAD09	Knowledge Engineering	PEC	2	0	2	4	3
2.	23PAD06	Recommender Systems	PEC	2	0	2	4	3
3.	23PAD16	Reinforcement Learning	PEC	2	0	2	4	3
4.	23PAD08	Soft Computing	PEC	2	0	2	4	3
5.	23PAD07	Text and Speech Analysis	PEC	2	0	2	4	3
6.	23PAD01	Business Analytics	PEC	2	0	2	4	3
7.	23PAD04	Image and Video Analytics	PEC	2	0	2	4	3
8.	23PAD902	Computer Vision	PEC	2	0	2	4	3

Vertical 2: FULL STACK DEVELOPMENT FOR IT

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	23PIT01	Web Technologies	PEC	2	0	2	4	3
2.	23PIT02	App Development	PEC	2	0	2	4	3
3.	23PIT03	Cloud Services Management	PEC	2	0	2	4	3
4.	23PIT04	UI and UX Design	PEC	2	0	2	4	3
5.	23PIT05	Software Testing and Automation	PEC	2	0	2	4	3
6.	23PIT06	Web Application Security	PEC	2	0	2	4	3
7.	23PIT07	DevOps	PEC	2	0	2	4	3
8.	23PIT08	Principles of Programming Languages	PEC	2	0	2	4	3

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Vertical 3: CLOUD COMPUTING AND DATA CENTER TECHNOLOGIES

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	23CS902	Distributed Computing	PEC	2	0	2	4	3
2.	23PCS01	Virtualization	PEC	2	0	2	4	3
3.	23PIT03	Cloud Services Management	PEC	2	0	2	4	3
4.	23PCS02	Data Warehousing	PEC	2	0	2	4	3
5.	23PCS03	Storage Technologies	PEC	3	0	0	3	3
6.	23PCS04	Software Defined Networks	PEC	2	0	2	4	3
7.	23PCS05	Stream Processing	PEC	2	0	2	4	3
8.	23PCS06	Security and Privacy in Cloud	PEC	2	0	2	4	3

Vertical 4: CYBER SECURITY AND DATA PRIVACY

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	23PCS07	Ethical Hacking	PEC	2	0	2	4	3
2.	23PCS08	Digital and Mobile Forensics	PEC	2	0	2	4	3
3.	23PCS09	Social Network Security	PEC	2	0	2	4	3
4.	23PCS10	Modern Cryptography	PEC	2	0	2	4	3
5.	23PCS11	Engineering Secure Software Systems	PEC	2	0	2	4	3
6.	23PCS12	Cryptocurrency and Blockchain Technologies	PEC	2	0	2	4	3
7.	23PCS13	Network Security	PEC	2	0	2	4	3
8.	23PCS06	Security and Privacy in Cloud	PEC	2	0	2	4	3

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Vertical 5: CREATIVE MEDIA

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	23PCS14	Augmented Reality/Virtual Reality	PEC	2	0	2	4	3
2.	23PCS15	Multimedia and Animation	PEC	2	0	2	4	3
3.	23PCS16	Video Creation and Editing	PEC	2	0	2	4	3
4.	23PIT04	UI and UX Design	PEC	2	0	2	4	3
5.	23PCS17	Digital marketing	PEC	2	0	2	4	3
6.	23PCS20	Multimedia Data Compressionand Storage	PEC	2	0	2	4	3
7.	23PCS19	Game Development	PEC	2	0	2	4	3
8.	23PCS18	Visual Effects	PEC	2	0	2	4	3

Vertical 6: EMERGING TECHNOLOGIES

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	23PCS14	Augmented Reality/VirtualReality	PEC	2	0	2	4	3
2.	23PAD05	Neural Networks and Deep Learning	PEC	2	0	2	4	3
3.	23PCS21	Cyber Security	PEC	2	0	2	4	3
4.	23PCS22	Quantum Computing	PEC	2	0	2	4	3
5.	23PCS12	Cryptocurrency and BlockchainTechnologies	PEC	2	0	2	4	3
6.	23PCS19	Game Development	PEC	2	0	2	4	3
7.	23PCS23	3D Printing and Design	PEC	2	0	2	4	3
8.	23PAD14	Autonomous Systems and Drones	PEC	2	0	2	4	3

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Vertical 7: VERTICALS FOR AIDS II

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	23PAD12	Bio-Inspired Optimization Techniques	PEC	3	0	0	3	3
2.	23PIT02	App Development	PEC	2	0	2	4	3
3.	23PAD03	Health Care Analytics	PEC	3	0	0	3	3
4.	23PCS21	Cyber Security	PEC	2	0	2	4	3
5.	23PAD10	Optimization Techniques	PEC	2	0	2	4	3
6.	23PAD11	Game Theory	PEC	2	0	2	4	3
7.	23PAD13	Cognitive Science	PEC	2	0	2	4	3
8.	23PAD15	Machine Intelligence for Medical Image Analysis	PEC	2	0	2	4	3

XIV OPEN ELECTIVES

S. No.	Course Code	Course Title	Category	Periods Per Week			Contact Periods	Credits
				L	T	P		
1.	23OCE01	Cartography & GIS	OEC	3	0	0	3	3
2.	23OCE02	Environment, Health & Safety	OEC	3	0	0	3	3
3.	23OCE03	Environment Impact Assessment	OEC	3	0	0	3	3
4.	23OCE04	Industrial waste water management	OEC	3	0	0	3	3
5.	23OCE05	Remote sensing concepts	OEC	3	0	0	3	3
6.	23OEC01	Antenna Fundamentals	OEC	3	0	0	3	3
7.	23OEC02	Consumer Electronics	OEC	3	0	0	3	3
8.	23OEC03	Display Devices Fundamentals	OEC	3	0	0	3	3
9.	23OEC04	Basics of Embedded Systems	OEC	3	0	0	3	3
10.	23OEC05	Basics of Nano Electronics	OEC	3	0	0	3	3
11.	23OEC06	Fundamentals of Image Processing	OEC	3	0	0	3	3
12.	23OEC07	Internet of Things	OEC	3	0	0	3	3
13.	23OEC08	Sensors and Actuators	OEC	3	0	0	3	3
14.	23OEC09	Wearable Devices	OEC	3	0	0	3	3
15.	23OEC10	Wireless Sensor Networks	OEC	3	0	0	3	3
16.	23OEE01	AI with Mat lab	OEC	3	0	0	3	3
17.	23OEE02	Applied Soft Computing	OEC	3	0	0	3	3
18.	23OEE03	Electric Vehicle Technology	OEC	3	0	0	3	3
19.	23OEE04	Electrical Safety	OEC	3	0	0	3	3

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20.	23OEE05	E-waste Management	OEC	3	0	0	3	3
21.	23OEE06	Industrial Automation	OEC	3	0	0	3	3
22.	23OEE07	Power Plant Instrumentation	OEC	3	0	0	3	3
23.	23OEE08	Principles of Robotics	OEC	3	0	0	3	3
24.	23OEE09	Sensors and Transducers	OEC	3	0	0	3	3
25.	23OEE10	Solar and Wind Energy Resources	OEC	3	0	0	3	3
26.	23OME01	Energy Conservation and Management	OEC	3	0	0	3	3
27.	23OME02	Energy Technology	OEC	3	0	0	3	3
28.	23OME03	Engineering Graphics Design	OEC	3	0	0	3	3
29.	23OME04	Foundation of Robotics	OEC	3	0	0	3	3
30.	23OME05	Industrial Design & Rapid Prototyping Techniques	OEC	3	0	0	3	3
31.	23OME06	Industrial Management	OEC	3	0	0	3	3
32.	23OME07	Industrial Safety and Hazard Management	OEC	3	0	0	3	3
33.	23OME08	Introduction to Industrial Automation Systems	OEC	3	0	0	3	3
34.	23OME09	Introduction to non- destructive testing	OEC	3	0	0	3	3
35.	23OME10	Mechatronics	OEC	3	0	0	3	3
36.	23OME11	Nanomaterials and applications	OEC	3	0	0	3	3
37.	23OME12	Nano Technology	OEC	3	0	0	3	3
38.	23OME13	Operations Management	OEC	3	0	0	3	3
39.	23OME14	Production Planning and Control	OEC	3	0	0	3	3
40.	23OME15	Quality Engineering	OEC	3	0	0	3	3
41.	23OME16	Sustainable Manufacturing	OEC	3	0	0	3	3
42.	23OMA01	Algebra and Number Theory	OEC	3	0	0	3	3
43.	23OMA02	Graph Theory	OEC	3	0	0	3	3
44.	23OMA03	Linear Algebra	OEC	3	0	0	3	3
45.	23OMA04	Operations Research	OEC	3	0	0	3	3
46.	23OMA05	Queuing and Reliability Modelling	OEC	3	0	0	3	3
47.	23OMA06	Resource Management Techniques	OEC	3	0	0	3	3
48.	23OHS01	English for Competitive Examinations	OEC	3	0	0	3	3
49.	23OHS02	Project Report Writing	OEC	3	0	0	3	3

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XV – SUMMARY OF CURRICULUM COMPONENTS WITH CREDITS

COURSE COMPONENTS	CREDITS PER SEMESTER								TOTAL CREDITS	CREDIT WEIGHTAGE
	I	II	III	IV	V	VI	VII	VIII		
HSMC	4	3					5		12	7.32
BSC	12	7	4	6					29	17.68
ESC	5	8.5							13.5	8.23
PCC		4.5	21	17	11	10			63.5	38.72
PEC					6	6	6		18	10.98
OEC					3	3	3		9	5.49
EEC	1	1			2	2	3	10	19	11.59
TOTAL	**22**	**24**	**25**	**23**	**22**	**21**	**17**	**10**	**164**	**100**

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Course Name: 23HS101 PROFESSIONAL ENGLISH - I

Prerequisite	Program Name	Sem	Category	L	T	P	C
NIL	B.E./B.TECH. – COMMON TO ALL BRANCHES	I	HSMC	3	0	0	3

II - Course Objectives

1.	To improve the communicative competence of learners.
2.	To learn to use basic grammatic structures in suitable contexts.
3.	To acquire lexical competence and use them appropriately in a sentence and understand their meaning in a text.
4.	To help learners use language effectively in professional contexts.
5.	To develop learners' ability to read and write complex texts, summaries, articles, blogs, definitions, essays and user manuals.

III - Course Content

Preamble:

This course is designed to impart required levels of Communication Skills in Reading and Writing and Proficiency in English language in writing necessary for different professional contexts.

Unit – I	INTRODUCTION TO EFFECTIVE COMMUNICATION	9 Periods

Fundamentals of Communication- effective communication- seven C's of effective communication **Reading** - Reading brochures (technical context), telephone messages / social media messages relevant to technical contexts and emails. **Writing** - Writing emails / letters. **Grammar** – Simple Tenses (Present / Past /Future); Question types: Wh/ Yes or No/- Question Tags. **Vocabulary** – Synonyms (word -meaning-sentence making); (One word substitution; Abbreviations & Acronyms (as used in technical contexts) – Silent letters

Unit – II	NARRATION AND SUMMATION	9 Periods

Reading - Reading biographies, travelogues, newspaper reports, Excerpts from literature, and travel & technical blogs. **Writing** - Guided writing-- Paragraph writing Short Report on an event (field trip etc.) **Grammar** –Progressive tenses (Present / Past /Future); Subject-Verb Agreement; Prepositions. **Vocabulary** - Wordforms (prefixes& suffixes); Phrasal verbs.

Unit – III	DESCRIPTION OF A PROCESS / PRODUCT	9 Periods

Reading – Reading advertisements, gadget reviews; user manuals. **Writing** - Writing definitions; instructions; and Product /Process description. **Grammar** - Imperatives; Adjectives; Degrees of comparison; Perfect Tenses (Present / Past /Future); **Vocabulary** - Compound Nouns, Homonyms; and Homophones.

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Unit – IV	CLASSIFICATION AND RECOMMENDATIONS	9 Periods
Reading – Newspaper articles; Journal reports –and Non-Verbal Communication (tables, pie charts etc,) Note-making. **Writing** –Writing recommendations; Transferring information from non-verbal (chart, graph etc, to verbal mode), Transcoding, **Grammar** – Perfect continuous tenses (Present / Past /Future); Articles; Pronouns - Possessive & Relative pronouns. **Vocabulary** - Collocations; Fixed / Semi fixed expressions – Idioms and Phrases		
Unit – V	EXPRESSION	9 Periods
Reading – Reading editorials; and Opinion Blogs; **Writing** – Essay Writing (Descriptive or narrative). **Grammar**– Punctuation; Simple, Compound & Complex Sentences. **Vocabulary** - Cause & Effect Expressions – Content vs Functionwords – British & American vocabulary (spelling and word changes)		

Text Books:	[1] English for Engineers & Technologists Orient Blackswan Private Ltd. Department of English, Anna University, (2023 edition)
	[2] English for Science & Technology Cambridge University Press, 2021. Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN.Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.
Reference Books:	[1] Ashraf Rizvi, "Effective Technical Communication", 2nd Edition, McGraw-Hill India, 2017.
	[2] A Course Book On Technical English By Lakshminarayanan, Scitech Publications (India)Pvt. Ltd.
	[3] English For Technical Communication (With CD) By Aysha Viswamohan, Mcgraw HillEducation, ISBN : 0070264244.
	[4] Effective Communication Skill, Kulbhusan Kumar, RS Salaria, Khanna Publishing House
	[5] Learning to Communicate – Dr. V. Chellammal, Allied Publishing House, New Delhi,2003.
MOOC/Web Platforms:	https://onlinecourses.nptel.ac.in/noc23_hs115/preview

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IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	To use appropriate words in a professional context and communicate in a professional context.	Apply (K3)
CO2	To gain understanding of basic grammatic structures and use them in right context.	Understand (K2)
CO3	To read and infer the denotative and connotative meanings of technical texts and use technical words in describing products with appropriate definitions.	Apply (K3)
CO4	To write definitions, descriptions, narrations and essays on various topics.	Create (K6)
CO5	To express their opinions effectively in both oral and written medium of communication.	Create (K6)

(Action verb of each CO to be matched with the next mapping table)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	-	-	-	-	-	-	-	-	3	3	-	2	-	-	-
CO-2	-	-	-	-	-	-	-	-	3	3	-	2	-	-	-
CO-3	-	-	-	-	-	-	-	-	3	3	-	2	-	-	-
CO-4	-	-	-	-	-	-	-	-	3	3	-	2	-	-	-
CO-5	-	-	-	-	-	-	-	-	3	3	-	2	-	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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Course Name: 23MA101 MATRICES AND CALCULUS

Prerequisite	Program Name	Sem	Category	L	T	P	C
NIL	B.E./B.TECH. COMMON TO ALL BRANCHES	I	BSC	3	1	0	4

II - Course Objectives

1.	To develop the use of matrix algebra techniques that is needed by engineers for practical applications.
2.	To familiarize the student with functions of several variables. This is needed in many branches of engineering.
3.	To familiarize the students with integral calculus and various techniques of integration.
4.	To make the students understand the concepts of vector calculus and applications.
5.	To acquaint the student with mathematical tools needed in evaluating ordinary differential equations and their applications.

III - Course Content

Preamble:
This course introduces basic concepts and techniques of multivariable calculus, matrices, and ordinary differential equations and highlights their applications in various field of engineering such as Design Engineering, Electric Circuit Theory, Cryptography, Resistor conversion, Robotics etc

Unit – I	MATRICES	12 Periods

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley – Hamilton theorem – Diagonalization of matrices by orthogonal transformation – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms.

Unit – II	FUNCTIONS OF SEVERAL VARIABLES	12 Periods

Partial differentiation – Homogeneous functions and Euler's theorem – Total derivative – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor's series for functions of two variables – Applications: Maxima and minima of functions of two variables and Lagrange's method of undetermined multipliers.

Unit – III	INTEGRAL CALCULUS AND MULTIPLE INTEGRALS	12 Periods

Definite integrals – Properties – Problems- Double and Triple integrals – Cartesian, polar coordinates – change of order of integration – Applications: Area between curves, Volume of integrals.

Unit – IV	VECTOR CALCULUS	12 Periods

Gradients - Divergence - Curl – Directional derivative - Irrotational and Solenoidal vector fields– Vector Integration (Line integral, Surface integral, Volume integral, Simple Problems only) – Green's theorem in plane, Gauss divergence theorem and Stoke's Theorem (excluding proof) – Simple applications involving cubes and rectangular parallelopipeds.

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Unit – V	ORDINARY DIFFERENTIAL EQUATIONS	12 Periods
Higher order linear differential equations with constant coefficients – Method of variation of parameters. Homogenous equation of Euler's and Legendre's type – System of simultaneous linear differential equations with constant coefficients.		

Text Books:	[1] Kreyszig.E, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016. [2] Grewal.B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition, 2018. [3] James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 8th Edition, New Delhi, 2015. [For Units II & IV - Sections 1.1, 2.2, 2.3, 2.5, 2.7 (Tangents problems only), 2.8, 3.1 to 3.6, 3.11, 4.1, 4.3, 5.1 (Area problems only), 5.2, 5.3, 5.4 (excluding net change theorem), 5.5, 7.1 - 7.4 and 7.8].
Reference Books:	[1] Anton. H, Bivens. I and Davis. S, " Calculus ", Wiley, 10th Edition, 2016. [2] Bali. N., Goyal. M. and Watkins. C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009. [3] Jain. R.K. and Iyengar. S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 5th Edition, 2016. [4] Narayanan. S. and ManicavachagomPillai. T. K.,"Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2009. [5] Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2016. [6] Srimantha Pal and Bhunia. S.C, "Engineering Mathematics " Oxford University Press, 2015. [7] Thomas. G. B., Hass. J, and Weir. M.D, "Thomas Calculus", 14th Edition, Pearson India, 2018.
MOOC/Web Platforms:	https://nptel.ac.in/courses/122104018 https://archive.nptel.ac.in/courses/111/106/111106146/ https://onlinecourses.nptel.ac.in/noc21_ma16/preview https://digimat.in/nptel/courses/video/111105122/L01.html

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IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Use the matrix algebra methods for solving practical problems.	Apply (K3)
CO2	Able to use differential calculus ideas on several variable functions.	Apply (K3)
CO3	Apply integral calculus and multiple integral tools in solving various application problems.	Apply (K3)
CO4	Understand the concepts of Gradient, divergence and curl of a vector point function and related applications.	Understand (K2)
CO5	Apply various techniques in solving ordinary differential equations.	Apply (K3)

(Action verb of each CO to be matched with the next mapping table)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	1	1	-	-	-	-	2	-	2	3	-	-	-
CO-2	3	3	1	1	-	-	-	-	2	-	2	3	-	-	-
CO-3	3	3	1	1	-	-	-	-	2	-	2	3	-	-	-
CO-4	3	3	1	1	-	-	-	-	2	-	2	3	-	-	-
CO-5	3	3	-	-	-	-	-	-	2	-	-	2	-	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23PH101 ENGINEERING PHYSICS

Prerequisite	Program Name	Sem	Category	L	T	P	C
NIL	B.E./B.TECH. COMMON FOR CIVIL, CSE, EEE, MECH, IT AND AI&DS	I	BSC	3	0	0	3

II – Course Objectives

1.	To instill the essentials of properties of matter.
2.	To gain knowledge of electromagnetic waves and its applications.
3.	To amplify the information on optical fiber for communication purposes.
4.	To describe the principles of quantum mechanics and their various applications.
5.	To provide the fundamental understanding of crystals and their numerous crystal formations.

III – Course Content

Preamble:

The aim of the Engineering Physics Program is to offer students a solid background in the fundamentals of Physics and to impart that knowledge in engineering disciplines. The program is designed to develop scientific attitudes and enable the students to correlate the concepts of Physics with the core programmes.

Unit – I	PROPERTIES OF MATTER	9 Periods

Elasticity – stress – strain – Hooke 's law- S-S diagram – factors affecting elastic modulus and tensile strength – Torsion pendulum – moment of inertia of a body – young's modulus – cantilever method, uniform and non-uniform bending – I-shaped girders – Poisson's ratio.

Unit – II	ELECTROMAGNETIC FIELD AND WAVES	9 Periods

The Maxwell's equations – wave equation; plane electromagnetic waves in vacuum, conditions on the wave field – properties of electromagnetic waves – energy and momentum in EM waves: intensity, waves from localized sources, momentum and radiation pressure – smart phone reception.

Unit – III	LASER AND FIBER OPTICS	9 Periods

LASER- interaction of light radiation with materials – Einstein's coefficients – Nd:YAG, CO_2, quantum dot laser – LIDAR.

Fiber optics: modes of propagation of light – numerical aperture and acceptance angle – fiber optical communication system – fiber optic displacement sensors.

Unit – IV	QUANTUM PHYSICS	9 Periods

Comparison between classical and quantum theory – Compton scattering:experimental description-uncertainty principle – physical significance of wave function – Schrödinger's wave equation – time dependent and time independent equations – particle in a box – quantum confinement.

Unit – V	CRYSTAL PHYSICS	9 Periods

Crystallography – unit cell, primitive cell – crystal systems, Bravais lattices, Miller indices – inter-planar distances – coordination number and packing factor for SC, BCC, FCC, HCP structures- diamond & NaCl Crystal structure – crystal defect and dislocation. Crystal growth techniques: Bridgman method.

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Books for study & Reference:	[1] Tipler Mosca, Physics For Scientists and Engineers 6th Edition, 2015 [2] Gaur R.K. and Gupta S.L, Engineering Physics, Dhanpat Rai Publications, 2013. [3] Bhattacharya D.K. & Poonam T., Engineering Physics, Oxford University Press, 2015. [4] S. O. Pillai, Solid State Physics, New Age International Private Limited, 10th edition,2022 [5] Marikani A, Engineering Physics, PHI, New Delhi, 2013.
MOOC/Web Platforms:	https://onlinecourses.nptel.ac.in/noc20_mm13/preview https://www.noaa.gov/jetstream/satellites/electromagnetic-waves https://fractory.com/fibre-lasers-explained/ https://www.livescience.com/33816-quantum-mechanics-explanation.html https://archive.nptel.ac.in/courses/115/104/115104109/

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Choose the correct materials based on their qualities for any intended applications and learn the basics of elasticity and its engineering-related applications.	Apply (K3)
CO2	Express their knowledge in electromagnetic waves.	Understand (K2)
CO3	Infer the characteristics of laser for various Engineering applications and expand the understanding of optical fibers use in communications.	Understand (K2)
CO4	Apply quantum theory's sophisticated physics notions to the matter's characterization.	Apply (K3)
CO5	Know the fundamentals of crystal formations and growth methods.	Understand (K2)

(Action verb of each CO to be matched with the next mapping table)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ Pos	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	2	3	3	-	-	2	-	-	-	-	3	-	-	-
CO-2	3	2	3	2	-	-	2	-	-	-	-	3	-	-	-
CO-3	3	3	3	3	-	-	-	-	-	-	-	3	-	-	-
CO-4	3	3	3	2	-	-	3	-	-	-	-	2	-	-	-
CO-5	3	2	3	3	-	-	-	-	-	-	-	1	-	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I -Course Name: 23CY101 ENGINEERING CHEMISTRY

Prerequisite	Program Name	Sem	Category	L	T	P	C
NIL	B.E./B.TECH. COMMON TO ALL BRANCHES	I	BSC	3	0	0	3

II - Course Objectives

1.	To inculcate sound understanding of water quality parameters and water treatment techniques.
2.	To impart knowledge on the basic principles and preparatory methods of nanomaterials.
3.	To introduce the basic concepts and applications of polymers and composites.
4.	To facilitate the understanding of different types of fuels, their preparation, properties and combustion characteristics.
5.	To familiarize the students with the operating principles, working processes and applications of energy conversion and storage devices.

III - Course Content

Preamble:

The objective of this course is to bestow the better understanding of basic concepts of chemistry and its applications in Engineering and Technology. This course provides exposure on properties of water and its treatment methods. It also imparts knowledge on properties and application of nano-materials in data storage devices. This course also highlights preparation, properties and applications of polymers and composite materials. It also imparts knowledge on fuel types and applications of energy conversion and storage devices.

Unit – I	WATER AND ITS TREATMENT	9 Periods

Water: sources and impurities, water quality parameters: colour, odour, turbidity, pH, hardness, alkalinity, TDS, COD and BOD, flouride and arsenic. Municipal water treatment: primary treatment and disinfection (UV, Ozonation, break-point chlorination). Desalination of brackish water: reverse osmosis. Boiler troubles: scale and sludge, boiler corrosion, caustic embrittlement, priming & foaming. Treatment of boiler feed water: internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) and external treatment: ion exchange demineralisation and zeolite process.

Unit – II	NANO CHEMISTRY	9 Periods

Basics: distinction between molecules, nanomaterials and bulk materials; size-dependent properties (optical, electrical, mechanical and magnetic); types of nanomaterials: definition, properties and uses of – nanoparticle, nanocluster, nanorod, nanowire and nanotube. Preparation of nanomaterials: sol-gel, solvothermal, laser ablation, chemical vapour deposition, electrochemical deposition and electro spinning. Applications of nanomaterials in medicine, agriculture, energy, electronics and catalysis.

Unit – III	POLYMERS AND COMPOSITES	9 Periods

Introduction: classification of polymers – natural and synthetic; thermoplastic and thermosetting. Functionality – preparation properties and uses of PVC, teflon, nylon 6,6 and epoxy resins. Composites: introduction: definition & need for composites; constitution: matrix materials (Polymer matrix, metal matrix and ceramic matrix) and reinforcement (fiber, particulates, flakes and whiskers). Properties and applications of: metal matrix composites (MMC), ceramic matrix composites and polymer matrix composites. Hybrid composites - definition and examples.

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Unit – IV	FUELS AND COMBUSTION	9 Periods
Fuels: introduction, classification of fuels; coal and coke: analysis of coal (proximate and ultimate), carbonization, manufacture of metallurgical coke (Otto Hoffmann method). Petroleum and diesel: manufacture of synthetic petrol (Bergius process), knocking - octane number, diesel oil - cetane number; power alcohol and biodiesel. Combustion of fuels: introduction: calorific value - higher and lower calorific values, theoretical calculation of calorific value; ignition temperature: spontaneous ignition temperature, explosive range; flue gas analysis - ORSAT Method. CO_2 emission and carbon foot print.		
Unit – V	ENERGY STORAGE DEVICES	9 Periods
Nuclear energy: light water nuclear power plant, breeder reactor. Solar energy conversion: principle, working and applications of solar cells; recent developments in solar cell materials. Wind energy; geothermal energy; batteries: types of batteries, primary battery – dry cell, secondary battery -lead acid storage battery and lithium-ion-battery; electric vehicles-working principles; fuel cells: H_2-O_2 fuel cell, super capacitors		

Total : 45 Periods

Text Books:	[1] P. C. Jain and Monica Jain, "Engineering Chemistry",Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 17th Edition, 2018. [2] Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd, New Delhi, 6th Edition 2012. [3] S.S. Dara, "A text book of Engineering Chemistry", S. Chand Publishing, 12th Edition, 2018.
Reference Books:	[1] B. S. Murty, P. Shankar, Baldev Raj, B. B. Rath and James Murday, "Text book of nanoscience and nanotechnology", Universities Press-IIM Series in Metallurgy and Materials Science, 2018. [2] O.G. Palanna, "Engineering Chemistry" McGraw Hill Education (India) Private Limited, 2nd Edition, 2017. [3] Friedrich Emich, "Engineering Chemistry", Scientific International PVT, LTD, New Delhi, 2nd Edition,2017. [4] Shikha Agarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi, 2nd Edition, 2019. [5] O.V. Roussak and H.D. Gesser, Applied Chemistry-A Text Book for Engineers and Technologists, Springer Science Business Media, New York, 2nd Edition, 2013. [6] Gowariker V.R., Viswanathan N.V. and Jayadev Sreedhar, "Polymer Science", New Age International P (Ltd.,) Chennai, 4thEdition, 2021.
MOOC/Web Platforms:	https://nptel.ac.in/courses

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IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Summarize the water related problems in boilers and their treatment techniques.	Remember (K1)
CO2	Discuss the applications of nanomaterials in medicine, agriculture, energy, electronics and catalysis.	Understand (K2)
CO3	Discuss the types, properties and applications of polymers and composites.	Apply (K3)
CO4	Summarize the fuels used for engineering processes and applications of fuels.	Understand (K2)
CO5	Summarize the principles and generation of energy in batteries, nuclear reactors, solar cells, wind mills and fuel cells.	Apply (K3)

(Action verb of each CO to be matched with the next mapping table)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	2	1	1	-	-	-	3	-	-	-	-	2	-	-	-
CO-2	2	1	1	-	-	-	3	-	-	-	-	2	-	-	-
CO-3	2	1	1	-	-	-	3	-	-	-	-	2	-	-	-
CO-4	2	1	1	-	-	-	1	-	-	-	-	2	-	-	-
CO-5	3	2	2	-	-	-	3	-	-	-	-	3	-	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23GE102 PROBLEM SOLVING AND PYTHON PROGRAMMING

Prerequisite	Program Name	Sem	Category	L	T	P	C
Computer Basics	B.E/B.Tech. – Common to AI & DS,CIVIL,MECH	I	ESC	3	0	0	3

II - Course Objectives

1	To understand the basics of algorithmic problem solving
2	To learn to solve problems using Python conditionals and loops.
3	To define Python functions and use function calls to solve problems
4	To use Python data structures - lists, tuples, dictionaries to represent complex data.
5	To do input/output with files in Python

III - Course Content

Preamble: Python is an open-sourced programming language that combines the features of *C* and *Java*. It has exceptional procedural as well as object-oriented capabilities. Having said this, always remember that everything in Python is an **object**.

Unit – I	COMPUTATIONAL THINKING AND PROBLEM SOLVING	9 Periods

Fundamentals of Computing – Identification of Computational Problems -Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.

Unit – II	DATA TYPES, EXPRESSIONS, STATEMENTS	9 Periods

Python interpreter and interactive mode,debugging; values and types: int, float, boolean, string , and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

Unit – III	CONTROL FLOW, FUNCTIONS, STRINGS	9 Periods

Conditionals:Boolean values and operators, conditional (if), alternative (if-else),chained conditional (if-elif-else);Iteration: state, while, for, break, continue, pass; Fruitful functions: return values,parameters, local and global scope, function composition, recursion; Strings: string slices,immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

Unit – IV	LISTS, TUPLES, DICTIONARIES	9 Periods

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: simple sorting, histogram, Students marks statement, Retail bill preparation.

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Unit – V	FILES, MODULES, PACKAGES	9 Periods
Files and exceptions: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file, Voter's age validation, Marks range validation (0-100).		

Total : 45 Periods

Text Books:	1.Allen B. Downey, "Think Python: How to Think like a Computer Scientist", 2nd Edition, O'Reilly Publishers, 2016. 2.Karl Beecher, "Computational Thinking: A Beginner's Guide to Problem Solving and Programming", 1st Edition, BCS Learning & Development Limited, 2017.
Reference Books:	1.Paul Deitel and Harvey Deitel, "Python for Programmers", Pearson Education, 1st Edition, 2021. 2.G Venkatesh and Madhavan Mukund, "Computational Thinking: A Primer for Programmers and Data Scientists", 1st Edition, Notion Press, 2021. 3.John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data", Third Edition, MIT Press, 2021 4.Eric Matthes, "Python Crash Course, A Hands - on Project Based Introduction to Programming", 2nd Edition, No Starch Press, 2019. 5.Martin C. Brown, "Python: The Complete Reference", 4th Edition, Mc-Graw Hill, 2018.
MOOC/Web Platforms:	Introduction to C (w3schools.com) https://www.python.org/

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the concepts of computational thinking and algorithmic problem-solving techniques	Understand (K2)
CO2	Develop simple python programs for applying the concepts of datatypes, expressions, and python statements	Apply (K3)
CO3	Develop Python programs for solving real-time computational problems by using conditionals, looping, functions, and strings.	Apply (K3)
CO4	Understand the concepts of compound data using Python lists, tuples, and dictionaries	Understand (K2)
CO5	Develop python programs for solving computational problems by using modules, files, and python packages	Apply (K3)

(Action verb of each CO to be matched with the next mapping table)

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V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	2	2	-	-	-	-	-	-	-	2	-	-	2	3
CO-2	3	3	3	2	2	-	-	-	-	-	2	3	3	-	3
CO-3	3	3	3	2	2	-	-	-	-	-	2	3	3	2	3
CO-4	3	2	2	-	-	-	-	-	-	-	2	-	-	2	3
CO-5	3	3	3	2	3	-	-	-	-	-	2	3	3	2	3

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23GE103 தமிழர் மரபு /HERITAGE OF TAMILS

Prerequisite	Program Name	Sem	Category	L	T	P	C
Nil	B.E./B.TECH. COMMON TO ALL BRANCHES	I	HSMC	1	0	0	1

II - Course Content

Unit – I	LANGUAGE AND LITERATURE	3 Periods
Language Families in India - Dravidian Languages – Tamil as a Classical Language - Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.		
Unit – II	HERITAGE - ROCK ART PAINTINGS TO MODERN ART –SCULPTURE	3 Periods
Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.		
Unit – III	FOLK AND MARTIAL ARTS	3 Periods
Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.		
Unit – IV	THINAI CONCEPT OF TAMILS	3 Periods
Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.		
Unit – V	CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE	3 Periods
Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.		

Total : 15 Periods

Text Cum Books:	[1] தமிழகவரலாறுமக்களும்பண்பாடும்கே.கே. பிள்ளை (வெளியீடு–தமிழ்நாடுபாடநூல்மற்றும்கல்வியியல்பணிகள்கழகம்). [2] கணினித்தமிழ்முனைவர்இலசுந்தரம் (விகடன்பிரசுரம்). [3] கீழடி–வைகைநதிக்கரையில்சங்ககாலநகரநாகரிகம் (தொல்லியல்துறைவெளியீடு) [4] பொருநை–ஆற்றங்கரைநாகரிகம். (தொல்லியல்துறைவெளியீடு) [5] Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print) [6] Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
Reference Books:	[1] Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D.Thirunavukkarasu) (Published by: International Institute of Tamil Studies). [2] The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies)

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	[3] Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu) [4] Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author) [5] Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu) [6] Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

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I - Course Name: 23GE111 -PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY

Prerequisite	Program Name	Sem	Category	L	T	P	C
Computer Basics	B.E/B.Tech. – Common to AI & DS, CIVIL,MECH	-	ESC	0	0	4	2

II - Course Objectives

1	To understand the problem solving approaches
2	To learn the basic programming constructs in Python.
3	To practice various computing strategies for Python-based solutions to real world problems.
4	To use Python data structures - lists, tuples, dictionaries.
5	To do input/output with files in Python

III - Course Content

EXPERIMENTS	60 Periods
1. Identification and solving of simple real life or scientific or technical problems, and developing flow charts for the same. (Electricity Billing, Retail shop billing, Sin series, weight of a motorbike, Weight of a steel bar, compute Electrical Current in Three Phase AC Circuit, etc.)	
2. Python programming using simple statements and expressions (exchange the values of two variables, circulate the values of n variables, distance between two points).	
3. Scientific problems using Conditionals and Iterative loops. (Number series, Number Patterns, pyramid pattern)	
4. Implementing real-time/technical applications using Lists, Tuples. (Items present in a library/Components of a car/ Materials required for construction of a building –operations of list & tuples)	
5. Implementing real-time/technical applications using Sets, Dictionaries. (Language, components of an automobile, Elements of a civil structure, etc.- operations of Sets & Dictionaries)	
6. Implementing programs using Functions. (Factorial, largest number in a list, area of shape)	
7. Implementing programs using Strings. (reverse, palindrome, character count, replacing characters)	
8. Implementing programs using written modules and Python Standard Libraries (pandas, numpy. Matplotlib, scipy))	
9. Implementing real-time/technical applications using File handling. (copy from one file to another, word count, longest word)	
10. Implementing real-time/technical applications using Exception handling. (divide by zero error, voter's age validity, student mark range validation)	
11. Exploring Pygame tool.	
12. Developing a game activity using Pygame like bouncing ball, car race etc.	

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Text Books:
[1] Allen B. Downey, "Think Python: How to Think like a Computer Scientist", 2nd Edition,O'Reilly Publishers, 2016.
[2] Karl Beecher, "Computational Thinking: A Beginner's Guide to Problem Solving andProgramming", 1st Edition, BCS Learning & Development Limited, 2017.
Reference Books:
[1] Paul Deitel and Harvey Deitel, "Python for Programmers", Pearson Education, 1st Edition, 2021.
[2] G Venkatesh and Madhavan Mukund, "Computational Thinking: A Primer for Programmersand Data Scientists", 1st Edition, Notion Press, 2021.
[3] John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data", Third Edition, MIT Press,2021.
[4] John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data", Third Edition, MIT Press,2021.
[5] https://www.python.org/
[6] Martin C. Brown, "Python: The Complete Reference", 4th Edition, Mc-Graw Hill, 2018.

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Develop simple python programs for applying the concepts of datatypes, expressions and python statements	Apply (K3)
CO2	Develop Python programs using conditionals, looping, functions and strings for solving real-time computational problems.	Apply (K3)
CO3	Develop python programs using lists, tuples, and dictionaries	Apply (K3)
CO4	Develop python programs for solving problems by using modules, files and python packages	Apply (K3)
CO5	Utilize Python packages for developing real-world software applications	Apply (K3)

(Action verb of each CO to be matched with the next mapping table)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO1	3	2	2	-	2	-	-	2	-	3	2	2	-	2	3
CO2	3	3	3	2	2	-	-	2	-	3	2	3	3	2	3
CO3	3	2	1	2	-	-	-	2	-	3	2	3	3	2	3
CO4	3	2	2	2	2	-	-	-	2	-	2	3	-	2	3
CO5	3	3	3	2	2	-	-	-	2	-	2	3	3	2	3

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I -Course Name: 23BS111 PHYSICS AND CHEMISTRY LABORATORY

Prerequisite	Program Name	Sem	Category	L	T	P	C
NIL	B.E./B.TECH. COMMON FOR CIVIL, CSE, EEE, MECH, IT AND AI&DS	I	BSC	0	0	4	2

II - Course Objectives

1.	To learn the correct usage of several types of physics lab equipment.
2.	To learn, how to gather, present, and understand facts in a simple and succinct manner.
3.	To learn Physics-related problem-solving abilities and experimental data interpretation.
4.	To identify experimental measurement error and the methods used to reduce it
5.	To encourage active participation from the learner in all aspects of the lab exercises.

III - Course Content

Course Preamble:

This course aims to provide practical training in the estimation of physical parameters like band gap, ultrasound velocity, liquid compressibility, thin wire thickness, Young's modulus, and knowledge of the operation of the photoelectric effect, Michelson interferometer, laser, and fibre optics as well as to provide project-based skills development.

PHYSICS LABORATORY: (Any seven experiments to be conducted)

1. Torsional pendulum – Determination of rigidity modulus of wire and moment of inertia of disc.
2. Uniform bending (or) Non-uniform Bending– Determination of young's modulus.
3. Ultrasonic interferometer – determination of the velocity of sound and compressibility of liquids.
4. Laser- Determination of the wave length of the laser using grating.
5. (a) Optical fibre -Determination of Numerical Aperture and acceptance angle
   (b) Compact disc- Determination of width of the groove using laser.
6. Air wedge – Determination of thickness of a thin sheet/wire.
7. Determination of Band gap of a semiconductor.
8. Particle size determination using LASER.
9. Simple harmonic oscillations of cantilever.
10. Acoustic grating- Determination of velocity of ultrasonic waves in liquids.
11. Photoelectric effect
12. Michelson Interferometer.
13. Melde's string experiment
14. Experiment with lattice dynamics kit.

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IV - Course Outcome (Physics Laboratory)

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Apprehend the concepts of interference, diffraction of light and recognize the resonance concept of waves.	Understand (BL 2)
CO2	Apply the principles of operations of optical fibers, semiconductor using simple circuits and interaction of electromagnetic waves and crystalline solids.	Apply (BL 3)
CO3	Measure the elastic moduli and moment of inertia of given materials with the help of suggested procedures.	Apply (BL 3)
CO4	Experiment the relationship between the light and matter & properties of liquids.	Analyze (BL 4)
CO5	Estimate the velocity of sound and compressibility of liquid.	Understand (BL 2)

II - Course Objectives (CHEMISTRY LABORATORY)

1.	To inculcate experimental skills to test basic understanding of water quality parameters, such as, acidity, alkalinity, hardness, DO, chloride and copper.
2.	To induce the students to familiarize with electroanalytical techniques such as, pH metry and potentiometry
3.	To make the student to acquire practical skills conductometry in the determination of impurities in aqueous solutions.
4.	To demonstrate the analysis of metals and alloys.
5.	To demonstrate the synthesis of nanoparticles

III - Course Content

Preamble:

This course aims to provide the students, a basic practical knowledge in chemistry. The objective of this course is to develop intellectual and psychomotor skills of the students by providing hands on experience in quantitative, electrochemical and photo-chemical analysis.

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CHEMISTRY LABORATORY: (Any seven experiments to be conducted)

1. Estimation of HCl using Na_2CO_3 as primary standard and Determination of alkalinity in water sample.
2. Determination of total, temporary & permanent hardness of water by EDTA method.
3. Determination of DO content of water sample by Winkler's method.
4. Determination of chloride content of water sample by argentometric method.
5. Estimation of copper content of the given solution by Iodometry.
6. Determination of strength of given hydrochloric acid using pH meter.
7. Determination of strength of acids in a mixture of acids using conductivity meter.
8. Estimation of iron content of the given solution using potentiometer.
9. Estimation of iron content of the water sample using spectrophotometer.
10. Determination of molecular weight of polyvinyl alcohol using Ostwald viscometer.
11. Pseudo first order kinetics-ester hydrolysis.
12. Corrosion experiment-weight loss method.
13. Phase change in a solid.
14. Conductometric titration of strong acid vs strong base.

Reference Books:	1. Vogel's Textbook of Quantitative Chemical Analysis (8thedition, 2014).
MOOC/Web Platforms:	-

IV - Course Outcome

	On completion of the course, the students will be able to	Bloom's Level Mapped
CO1	Analyse the quality of water samples with respect to their acidity, alkalinity, hardness and DO.	Analyze (K4)
CO2	Determine the amount of metal ions through volumetric and spectroscopic techniques.	Apply (K3)
CO3	Analyse and determine the composition of alloys.	Analyze (K4)
CO4	Learn simple method of synthesis of nanoparticles	Understand (K2)
CO5	Quantitatively analyse the impurities in solution by electroanalytical methods.	Analyze (K4)

(Action verb of each CO to be matched with the next mapping table)

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V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	1	-	-	-	-	-	1	3	2	-	-	-	-	-
CO-2	3	1	-	-	-	-	-	1	2	1	-	-	-	-	-
CO-3	3	3	-	-	-	-	-	2	2	1	-	-	-	-	-
CO-4	3	2	-	-	-	-	-	1	3	2	-	-	-	-	-
CO-5	3	2	-	-	-	-	-	2	1	2	-	-	-	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23GE112 ENGLISH LABORATORY -I

Prerequisite	Program Name	Sem	Category	L	T	P	C
NIL	B.E./B.TECH. COMMON TO ALL BRANCHES	I	EEC	0	0	2	1

II - Course Objectives

1.	To improve the communicative competence of learners
2.	To help learners use language effectively in academic /work contexts
3.	To develop various listening strategies to comprehend various types of audio materialslike lectures, discussions, videos etc.
4.	To build on students' English language skills by engaging them in listening, speaking andgrammar learning activities that are relevant to authentic contexts.
5.	To use language efficiently in expressing their opinions via various media.

III - Course Content

Preamble:
This course is designed to equip students with the necessary skills to listen and speak so as to develop their linguistic and communicative competencies.

Unit – I	INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION	6 Periods

Listening for general information-specific details- conversation: Introduction to classmates - Audio /video (formal & informal); Telephone conversation; Listening to voicemail & messages; Listening and filling a form. Speaking - making telephone calls-Self Introduction; Introducing a friend; -politeness strategies- making polite requests, making polite offers, replying to polite requests and offers- understanding basic instructions (filling out a bank application for example).

Unit – II	NARRATION AND SUMMATION	6 Periods

Listening - Listening to podcasts, anecdotes / stories / event narration; documentaries and interviews with celebrities- Note Taking. Speaking - Narrating personal experiences / events-Talking about current and temporary situations & permanent and regular situations - describing experiences and feelings- engaging in small talk- describing requirements and abilities.

Unit – III	DESCRIPTION OF A PROCESS / PRODUCT	6 Periods

Listening - Listen to product and process descriptions; a classroom lecture; and advertisements about products. Speaking – Picture description- describing locations in workplaces- Giving instruction to use the product- explaining uses and purposes- Presenting a product- describing shapes and sizes and weights- talking about quantities (large & small)-talking about precautions.

Unit – IV	CLASSIFICATION AND RECOMMENDATIONS	6 Periods

Listening – Listening to TED Talks; Listening to lectures - and educational videos. Speaking – Small Talk; discussing and making plans-talking about tasks-talking about progress- talking about positions and directions of movement-talking about travel preparations- talking about transportation.

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Unit – V	EXPRESSION	6 Periods
Listening – Listening to debates/ discussions; different viewpoints on an issue; and panel discussions. Speaking – making predictions - talking about a given topic-giving opinions- understanding a website-describing processes.		

Recommended Software:	[1] Globarena Software
	[2] Open-Source Software and YouTube Videos in Career Lab.
Manual	[1] English Laboratory Manual, Department of English, NPR College of Engineering & Technology College, Dindigul.
MOOC/Web Platforms:	https://www.digitalteacher.in/english-language-lab

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	To listen to and comprehend general as well as complex academic information.	Understand (K2)
CO2	To listen to and understand different points of view in a discussion.	Understand (K2)
CO3	To speak fluently and accurately in formal and informal communicative contexts.	Apply (K3)
CO4	To describe products and processes and explain their uses and purposes clearly and accurately.	Create (K6)
CO5	To express their opinions effectively in both formal and informal discussions.	Create (K6)

(Action verb of each CO to be matched with the next mapping table)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	-	-	-	-	-	-	-	-	3	3	-	2	-	-	-
CO-2	-	-	-	-	-	-	-	-	3	3	-	2	-	-	-
CO-3	-	-	-	-	-	-	-	-	3	3	-	2	-	-	-
CO-4	-	-	-	-	-	-	-	-	3	3	-	2	-	-	-
CO-5	-	-	-	-	-	-	-	-	3	3	-	2	-	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23HS201 PROFESSIONAL ENGLISH - II

Prerequisite	Program Name	Sem	Category	L	T	P	C
23HS101-Professional English - I	B.E./B.TECH. COMMON TO ALL BRANCHES	II	HSMC	2	0	0	2

II - Course Objectives

1.	To engage learners in meaningful language activities to improve their reading and writing skills.
2.	To learn various reading strategies and apply in comprehending documents in professional context.
3.	To help learners understand the purpose, audience, contexts of different types of writing.
4.	To develop analytical thinking skills for problem solving in communicative contexts.
5.	To demonstrate an understanding of job applications and interviews for internship and placements.

III - Course Content

Preamble:
This course is designed to impart required levels of Communication Skills in Reading and Writing and Proficiency in English language in writing necessary for different professional contexts.

Unit – I	**MAKING COMPARISONS**	**6 Periods**
Reading - Reading advertisements, user manuals, brochures; - Discourse markers (connectives & sequence words), Writing –- Compare and Contrast Essay; Grammar – Active & Passive Voice- Impersonal Passive Voice.		
Unit – II	**EXPRESSING CAUSAL RELATIONS**	**6 Periods**
Reading - Reading longer technical texts– Cause and Effect Essays, and Formal Letters / emails of complaint, Writing - Writing responses to complaints – Jumbled sentences. Grammar - Infinitive and Gerunds.		
Unit – III	**CRITICAL THINKING AND PROBLEM SOLVING**	**6 Periods**
Reading - Case Studies, excerpts from literary texts, news reports etc. Writing – Letter to the Editor, Checklists, Drafting of Circulars, Agenda & Minutes of the meeting, Problem solution essay / Argumentative Essay. Grammar – Error correction; If conditional sentences.		
Unit – IV	**REPORTING OF EVENTS**	**6 Periods**
Reading –Newspaper articles; Writing – Accident Report with Recommendations, Survey Report; Grammar – Reported Speech, Modals – Conjunctions- Sentence pattern		
Unit – V	**COHESIVE WRITING**	**6 Periods**
Reading – Company profiles, Statement of Purpose, (SOP), an excerpt of interview with professionals; Writing – Job / Internship application – Cover letter & Resume; Grammar – Numerical adjectives, Relative Clauses.		

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Text Books:	[1] English for Engineers & Technologists (2020 edition) Orient Blackswan Private Ltd. Department of English, Anna University.
	[2] English for Science & Technology Cambridge University Press 2021.
	[3] Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN.Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.
Reference Books:	[1] Ashraf Rizvi, "Effective Technical Communication", 2nd Edition, McGraw-Hill India, 2017.
	[2] Raman. Meenakshi, Sharma. Sangeeta (2019). Professional English. Oxford university press.New Delhi.
	[3] Improve Your Writing ed. V.N. Arora and Laxmi Chandra, Oxford Univ. Press, 2001,New Delhi.
	[4] Learning to Communicate – Dr. V. Chellammal. Allied Publishers, New Delhi, 2003.
	[5] Business Correspondence and Report Writing by Prof. R.C. Sharma & Krishna Mohan, TataMcGraw Hill & Co. Ltd., 2001, New Delhi.
MOOC/Web Platforms:	https://onlinecourses.nptel.ac.in/noc23_hs115/preview

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	To compare and contrast products and ideas in technical texts and write analytical essays.	Apply (K2)
CO2	To identify and report cause and effects in events, industrial processes through technical texts and draft a report with suggestions.	Create (K6)
CO3	To analyze problems in order to arrive at feasible solutions and communicate them in thewritten format.	Analyze (K4)
CO4	To present their ideas and opinions in a planned and logical manner in industrial nature.	Create (K6)
CO5	To draft effective resumes in the context of job application.	Create (K6)

(Action verb of each CO to be matched with the next mapping table)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	-	-	-	-	-	-	-	-	3	3	-	2	-	-	-
CO-2	-	-	-	-	-	-	-	-	3	3	-	2	-	-	-
CO-3	-	-	-	-	-	-	-	-	3	3	-	2	-	-	-
CO-4	-	-	-	-	-	-	-	-	3	3	-	2	-	-	-
CO-5	-	-	-	-	-	-	-	-	3	3	-	2	-	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23MA201 STATISTICS AND NUMERICAL METHODS

Prerequisite	Program Name	Sem	Category	L	T	P	C
NIL	B. E / B. TECH. COMMON FOR CIVIL, MECH AND AI & DS	II	BSC	3	1	0	4

II - Course Objectives

1.	This course aims at providing the necessary basic concepts of a few statistical and numerical methods and give procedures for solving numerically different kinds of problems occurring in engineering and technology.
2.	To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.
3.	To introduce the basic concepts of solving algebraic and transcendental equations.
4.	To introduce the numerical techniques of interpolation in various intervals and numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines.
5.	To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.

III - Course Content

Preamble:
This course is applied to analyse the ground water, pollutants in civil engineering, automatic control systems, fluid mechanics, gas dynamics, heat and mass transfer, thermodynamics, vibrations, data communication, data computing, etc

Unit – I	TESTING OF HYPOTHESIS	12 Periods

Statistical hypothesis – Small sample Tests based on t for single mean and difference of means - F-distributions for single variance and equality of variances – Chi square test for goodness of fit – Independence of attributes - large sample tests based on Normal distribution for single mean and difference of means- proportion.

Unit – II	DESIGN OF EXPERIMENTS	12 Periods

One way and two way classifications - Completely randomized design – Randomized block design – Latin square design.

Unit – III	SOLUTION OF EQUATIONS	12 Periods

Solution of algebraic and transcendental equations - Fixed point iteration method – Newton Raphson method- Solution of linear system of equations –direct method (Gauss elimination method ,Gauss Jordan method) – Iterative methods (Gauss Jacobi and Gauss Seidel methods).

Unit – IV	INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION	12 Periods

Lagrange's and Newton's divided difference interpolations – Newton's forward and backward difference interpolation – Approximation of derivates using interpolation polynomials – Numerical single and double integrations using Trapezoidal and Simpson's 1/3 rules.

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Unit – V	NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS	12 Periods
Single step methods: Taylor's series method - Euler's method - Modified Euler's method - Fourth order Runge-Kutta method for solving first order differential equations - Multi step methods: Milne's and Adams - Bash forth predictor corrector methods for solving first order differential equations.		

Text Books:	[1] Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10th Edition, New Delhi, 2015. [2] Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.
Reference Books:	[1] Burden, R.L and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2016 [2] Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2014. [3] Gerald. C.F. and Wheatley. P.O. "Applied Numerical Analysis" Pearson Education, Asia, New Delhi, 7th Edition, 2007. [4] Gupta S.C. and Kapoor V. K., "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, New Delhi, 12th Edition, 2020. [5] Spiegel. M.R., Schiller. J. and Srinivasan. R.A., "Schaum's Outlines on Probability and Statistics ", Tata McGraw Hill Edition, 4th Edition, 2012. [6] Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", 9th Edition, Pearson Education, Asia, 2010.
MOOC/Web Platforms:	https://onlinecourses.nptel.ac.in/noc21_ma74/preview

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Apply the concept of testing of hypothesis for small and large samples in real life problems.	Apply (K3)
CO2	Apply the basic concepts of classifications of design of experiments in the field of agriculture.	Apply (K3)
CO3	Understand the basic concepts and Techniques of solving algebraic and transcendental equations.	Apply (K3)
CO4	Understand the numerical techniques of interpolation in various intervals and apply the numerical techniques of differentiation and integration for engineering problems.	Understand (K2)
CO5	Solve the ordinary differential equations with initial conditions by using certain techniques with engineering applications.	Analyse (K4)

(Action verb of each CO to be matched with the next mapping table)

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V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	1	1	1	-	-	-	2	-	2	3	-	-	-
CO-2	3	3	1	1	1	-	-	-	2	-	2	3	-	-	-
CO-3	3	3	1	1	1	-	-	-	2	-	2	3	-	-	-
CO-4	2	3	1	1	1	-	-	-	2	-	2	3	-	-	-
CO-5	3	3	1	1	1	-	-	-	2	-	2	3	-	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23PH203 PHYSICS FOR INFORMATION SCIENCE

Prerequisite	Program Name	Sem	Category	L	T	P	C
23PH101-Engineering Physics	B.E. /B.TECH. COMMON FOR CSE, IT AND AI&DS	II	BSC	3	0	0	3

II - Course Objectives

1.	To understanding the fundamental physics of conducting materials, superconductors, and material characteristics.
2.	To impart fundamental knowledge of semiconductor device and electron transport characteristics.
3.	To get expertise in magnetic materials.
4.	To know how superconducting materials with null resistance and optical materials for optoelectronics work.
5.	To learn how nanoelectronic devices operate on a fundamental level.

III - Course Content

Preamble:
Students who complete this course will have a broader understanding of conducting, semiconducting, magnetic, superconducting, optical, and nanomaterials as well as an understanding of how different fields of knowledge are interconnected.

Unit – I	CONDUCTING MATERIALS	9 Periods

Classical free electron theory - electrical and thermal conductivity expression - Wiedemann-Franz law - electrons in metals - motion of a particle in a three-dimensional box - Fermi- Dirac statistics - density of energy states - electron in periodic potential - Kronig-Penney Model (Qualitative) - energy bands in solids - electron effective mass.

Unit – II	SEMICONDUCTING MATERIALS	9 Periods

Intrinsic semiconductors - direct and indirect band gap semiconductors - carrier concentration in intrinsic semiconductors - extrinsic semiconductors - carrier concentration in N-type & P-type semiconductors - variation of carrier concentration with temperature - variation of fermi level with temperature and impurity concentration - carrier transport in Semiconductor: random motion, drift, mobility and diffusion - Hall effect and experiment - Ohmic contacts - Schottky diode.

Unit – III	MAGNETIC MATERIALS	9 Periods

Magnetic dipole moment - atomic magnetic moments - magnetic permeability and susceptibility - magnetic material classification: diamagnetism - paramagnetism - ferromagnetism - antiferromagnetism - ferrimagnetism - ferromagnetism: origin and exchange interaction - domain theory - M versus H behavior - hard and soft magnetic materials - applications - magnetic principle in computer data storage - magnetic hard disc - GMR sensor.

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Unit – IV	SUPERCONDUCTING AND OPTICAL MATERIALS	9 Periods
Super conductivity - type-I and type-II superconductors - properties and applications - classification of optical materials - carrier generation and recombination processes - photo current in a P-N diode - solar cell - LED - Organic LED - optical data storage techniques and devices.		
Unit – V	**NANO DEVICES**	**9 Periods**
Introduction - size dependence of fermi energy - quantum confinement - quantum structures - density of states in quantum well, quantum wire and quantum dot structure - band gap of nanomaterials - tunneling: single electron phenomena and single electron transistor - quantum dot laser - carbon nanotubes: properties and applications.		

Books for study & Reference:	[1] S.O.Pillai, "Solid State Physics, New Academic Science", 2017. [2] V.Raghavan. Materials Science and Engineering: A First Course, Prentice Hall India Learning Private Limited, 2015. [3] A. Marikani, Materials Science, PHI Learning Pvt Ltd, 2017 [4] D.K.Bhattacharya&PoonamTandon., "Physics for Information Science and Electronics Engineering", Oxford Higher Education",2017. [5] Rogers, B., Adams, J. &Pennathur, S., "Nanotechnology: Understanding Small Systems", CRC Press, 2014.
MOOC/Web Platforms:	https://onlinecourses.nptel.ac.in/noc20_ph10/preview https://www.electronics-notes.com/articles/basic_concepts/conductors-semiconductors-insulators/semiconductor-materials-types-groups.php https://advancedmagnetsource.com/types-magnetic-materials/ https://nptel.ac.in/courses/115103108 https://onlinecourses.nptel.ac.in/noc22_ee47/preview

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	To recognize the fundamental ideas behind different free-electron theories and establish the solids' electrical characteristics.	Understand (K2)
CO2	To evaluate the functions of semiconductors and their uses.	Apply (K3)
CO3	To employing quantum principles to examine the mechanisms at work in magnetic materials.	Apply (K3)
CO4	To understand about the uses of superconducting and Optical properties of materials.	Understand (K2)
CO5	To show the fundamentals of how micro- and nano-electronic equipment functions.	Understand (K2)

(Action verb of each CO to be matched with the next mapping table)

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V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-2	3	3	-	3	-	-	-	-	-	-	-	-	-	-	-
CO-3	3	3	-	3	-	-	-	-	-	-	-	-	-	-	-
CO-4	3	3	3	-	2	-	-	-	-	-	-	2	-	-	-
CO-5	3	3	3	-	3	1	1	-	-	-	-	3	-	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23BE201-BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

Prerequisite	Program Name	Sem	Category	L	T	P	C
23PH101-Engineering Physics I	B.E./B.TECH. COMMON FOR CSE, MECH, IT AND AI&DS	II	ESC	3	0	0	3

II - Course Objectives

1.	To introduce the basics of electric circuits and analysis
2.	To import knowledge in the basics of working principles and application of electrical Machines
3.	To introduce analog devices and their characteristics
4.	To educate on the fundamental concepts of digital electronics
5.	To introduce the functional elements and working of measuring instruments

III - Course Content

Preamble:
It is an introductory course which emphasizes the fundamental concepts and overview of Electrical Engineering. The concepts discussed herein are intended to provide clarification on basic electrical engineering for beginners of all engineering graduates.

Unit – I	**ELECTRICAL CIRCUITS**	**9 Periods**
DC Circuits: Circuit Components: Conductor, Resistor, Inductor, Capacitor – Ohm's Law - Kirchhoff's Laws –Independent and Dependent Sources – Simple problems- Nodal Analysis, Mesh analysis with Independent sources only (Steady state) Introduction to AC Circuits and Parameters: Waveforms, Average value, RMS Value, Instantaneous power, real power, reactive power and apparent power, power factor (Simple problems only)		
Unit – II	**ELECTRICAL MACHINES (Qualitative Analysis)**	**9 Periods**
Construction and Working principle- DC Separately and Self excited Generators, EMF equation, Types and Applications. Working Principle of DC motors, Torque Equation, Types and Applications. Construction, working principle and Applications of Transformer, Single phase Induction Motor, Working types and Applications		
Unit – III	**ANALOG ELECTRONICS (Qualitative Analysis)**	**9 Periods**
Semiconductor Materials: Silicon &Germanium – PN Junction Diodes, Zener Diode –Characteristics Applications – Bipolar Junction Transistor-Biasing (CB Characteristics only) JFET, SCR, MOSFET – Types, I-V Characteristics and Applications		
Unit – IV	**DIGITAL ELECTRONICS**	**9 Periods**
Review of number systems, binary codes, , Combinational logic –Half Adder & Full Adder - representation of logic functions-SOP and POS forms, K-map representations - minimization using K maps (Simple Problems only).		
Unit – V	**MEASUREMENTS AND INSTRUMENTATION**	**9 Periods**
Functional elements of an instrument, Standards and calibration, Operating Principle, types -Moving Coil and Moving Iron meters, Measurement of three phase power, Energy Meter, DSO- Block diagram- Data acquisition- Block Diagram.		

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Text Books:	[1] Kothari DP and I.J Nagrath, "Basic Electrical and Electronics Engineering", Second Edition, McGraw Hill Education, 2020 [2]S.K.Bhattacharya "Basic Electrical and Electronics Engineering", Pearson Education, Second Edition, 2017.
Reference Books:	[1] Kothari DP and I.J Nagrath, "Basic Electrical Engineering", Fourth Edition, McGraw Hill Education, 2019. [2] Albert Malvino, David Bates, 'Electronic Principles, McGraw Hill Education; 7th edition, 2017 [3]H.S. Kalsi, 'Electronic Instrumentation and Measurements', Tata McGraw-Hill, New Delhi, 2019
MOOC/Web Platforms:	https://www.classcentral.com/course/swayam-fundamentals-of-electrical-engineering-14074

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Compute the electric circuit parameters for simple problems	Applying (K3)
CO2	Examine the working principle and applications of electrical machines	Understanding (K2)
CO3	Illustrate the characteristics of analog electronic devices	Understanding (K2)
CO4	Examine the basic concepts of digital electronics	Analyzing (K4)
CO5	Apply the concepts of principles of measuring instruments for real time applications	Applying (K2)

(Action verb of each CO to be matched with the next mapping table)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	2	2	1	-	-	-	1	-	-	-	2	2	-	-	-
CO-2	2	2	1	-	-	-	1	-	-	-	2	2	-	-	-
CO-3	2	1	1	-	-	-	1	-	-	-	2	2	-	-	-
CO-4	2	2	1	-	-	-	1	-	-	-	2	2	-	-	-
CO-5	2	2	1	-	-	-	1	-	-	-	2	2	-	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23CS901-DIGITAL PRINCIPLES AND COMPUTER ORGANIZATION

Prerequisite	Program Name	Sem	Category	L	T	P	C
NIL	B.E./B.TECH. COMMON FOR CSE, IT AND AI&DS	II	ESC	3	0	2	4

II - Course Objectives

1.	To analyze and design combinational circuits.
2.	To analyze and design sequential circuits.
3.	To understand the basic structure and operation of a digital computer.
4.	To study the design of data path unit, control unit for processor and to familiarize with the hazards.
5.	To understand the concept of various memories and I/O interfacing.

III - Course Content

Unit – I	COMBINATIONAL LOGIC	9 Periods
Combinational Circuits – Karnaugh Map - Analysis and Design Procedures – Binary Adder – Subtractor – Decimal Adder - Magnitude Comparator – Decoder – Encoder – Multiplexers - Demultiplexers		
Unit – II	**SYNCHRONOUS SEQUENTIAL LOGIC**	**9 Periods**
Introduction to Sequential Circuits – Flip-Flops – operation and excitation tables, Triggering of FF, Analysis and design of clocked sequential circuits – Design – Moore/Mealy models, state minimization, state assignment, circuit implementation - Registers – Counters		
Unit – III	**COMPUTER FUNDAMENTALS**	**9 Periods**
Functional Units of a Digital Computer: Von Neumann Architecture – Operation and Operands of Computer Hardware Instruction – Instruction Set Architecture (ISA): Memory Location, Address and Operation – Instruction and Instruction Sequencing – Addressing Modes, Encoding of Machine Instruction – Interaction between Assembly and High Level Language		
Unit – IV	**PROCESSOR**	**9 Periods**
Instruction Execution – Building a Data Path – Designing a Control Unit – Hardwired Control, Microprogrammed Control – Pipelining – Data Hazard – Control Hazards		
Unit – V	**MEMORY AND I/O**	**9 Periods**
Memory Concepts and Hierarchy – Memory Management – Cache Memories: Mapping and Replacement Techniques – Virtual Memory – DMA – I/O – Accessing I/O: Parallel and Serial Interface – Interrupt I/O – Interconnection Standards: USB, SATA		

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PRACTICAL EXERCISES:	30 Periods
1. Verification of Boolean theorems using logic gates. 2. Design and implementation of combinational circuits using gates for arbitrary functions. 3. Implementation of 4-bit binary adder/subtractor circuits. 4. Implementation of code converters. 5. Implementation of BCD adder, encoder and decoder circuits. 6. Implementation of functions using Multiplexers. 7. Implementation of the synchronous counters. 8. Implementation of a Universal Shift register. 9. Simulator based study of Computer Architecture	

Text Books:	1.M. Morris Mano, Michael D. Ciletti, "Digital Design : With an Introduction to the Verilog HDL, VHDL, and System Verilog", Sixth Edition, Pearson Education, 2018. 2. David A. Patterson, John L. Hennessy, "Computer Organization and Design, The Hardware/Software Interface", Sixth Edition, Morgan Kaufmann/Elsevier, 2020
Reference Books:	1.Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Naraig Manjikian, "Computer Organization and Embedded Systems", Sixth Edition, Tata McGraw-Hill, 2012. 2. William Stallings, "Computer Organization and Architecture – Designing for Performance", Tenth Edition, Pearson Education, 2016. 3. M. Morris Mano, "Digital Logic and Computer Design", Pearson Education, 2016.

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Design various combinational digital circuits using logic gates	Apply (K3)
CO2	Describe the operation and construction of various flip flops.	Understand (K2)
CO3	Design sequential circuits and analyze the design procedures.	Apply (K3)
CO4	State the fundamentals of computer systems and analyze the execution of an instruction.	Understand (K2)
CO5	Analyze different types of control design and identify hazards.	Analyze (K4)
CO6	Identify the characteristics of various memory systems and I/O communication.	Understand (K2)
CO7	Design and implementation of combinational circuits.	Apply (K3)
CO8	Design and implementation of sequential circuits.	Apply (K3)

(Action verb of each CO to be matched with the next mapping table)

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V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO-1	3	3	3	3	3	-	-	-	-	-	-	2	-	-
CO-2	3	3	3	3	1	-	-	-	-	-	-	1	-	-
CO-3	3	3	3	3	3	-	-	-	-	-	-	2	-	-
CO-4	3	3	3	3	1	-	-	-	-	-	-	1	-	-
CO-5	3	3	3	3	3	-	-	-	-	-	-	2	-	-
CO-6	3	3	3	3	1	-	-	-	-	-	-	1	-	-
CO-7	3	3	3	3	3	-	-	-	-	-	-	2	-	-
CO-8	3	3	3	3	3	-	-	-	-	-	-	2	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23AD201- DATA STRUCTURES DESIGN

Prerequisite	Program Name	Sem	Category	L	T	P	C
23GE102-Problem Solving and Python Programming	B.Tech AI&DS	II	PCC	3	0	0	3

II - Course Objectives

1.	To understand the principles underlying Abstract Data Types (ADTs)
2.	To create linear data structures encompassing lists, stacks, and queues.
3.	To comprehend algorithms for sorting, searching, and hashing.
4.	To utilize tree and graph structures.

III - Course Content

Preamble:

- The course of data structures design typically involves the fundamental building blocks of data organization, manipulation, and retrieval that form the backbone of intelligent systems. It outlining the fundamental concepts, goals, and principles that guide the creation and implementation of data structures.
- It sets the stage for understanding why data structures are important, what problems they aim to solve, and the considerations that go into designing them effectively.

Unit I	ABSTRACT DATA TYPES	9 Periods
Abstract Data Types (ADTs) -ADTs and classes-introduction to OOP-classes in Python -inheritance-namespaces-shallow and deep copying - Introduction to analysis of algorithms -asymptotic notations-recursion-analyzing recursive algorithms		
Unit II	LINEAR STRUCTURES	9 Periods
List ADT array-based implementations- linked list implementations-singly linked lists circularly linked lists-doubly linked lists - applications of lists - Stack ADT- Queue ADT double ended queues		
Unit III	SORTING AND SEARCHING	9 Periods
Bubble sort-selection sort-insertion sort-merge sort-quick sort-linear search-binarysearch-hashing-hash functions-collision handling-load factors, rehashing, and efficiency		
Unit IV	TREE STRUCTURES	9 Periods
Tree ADT-Binary Tree ADT-tree traversals-binary search trees-AVL trees-heaps-multiway search trees		
Unit V	GRAPH STRUCTURES	9 Periods
Graph ADT-representations of graph-graph traversals-DAG-topological ordering-shortest paths-minimum spanning trees		
		Total : 45 Periods

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Text Books:	1. Michael T. Goodrich, Roberto Tamassia, and Michael H. Goldwasser, "Data Structures and Algorithms in Python" (An Indian Adaptation), Wiley, 2021 2. Lee, Kent D., Hubbard, Steve,"Data Structures and Algorithms with Python",Springer Edition 2015. 3. Narasimha Karumanchi,"Data Structures and Algorithmic Thinking with Python",Careermonk, 2015.
Reference Books:	1. Rance D. Necaise,,"Data Structures and Algorithms Using Python", John Wiley & Sons, 2011. 2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein,"Introduction to Algorithms", Third Edition, PHI Learning, 2010. 3. Mark Allen Weiss,"Data Structures and Algorithm Analysis in C++", Fourth Edition, Pearson Education, 2014. 4. Aho, Hopcroft, and Ullman, "Data Structures and Algorithms", Pearson Education India,2002.
MOOC/ Web Platforms:	https://www.coursera.org/specializations/data-structures-algorithms https://www.edx.org/learn/data-structures/the-university-of-california-san-diego-data-structures-fundamentals https://www.youtube.com/watch?v=_t2GVaQasRY&list=PLeo1K3hjS3uu_n_a_MIKktGTLYopZ12 https://www.youtube.com/watch?v=UljGkm2ikdY&list=PLrk5tgtnMN6TYBW0-U4YhIRyYEVpqVEnJ

IV- Course Outcome

On completion of the course, the students will be able to		Bloom's LevelMapped
CO1	Understanding of Abstract Data Types (ADTs) and their practical implementations.	Understand (K2)
CO2	Apply the Design and Implementation of Lists, Stacks, and Queues to Address Real-World Challenges	Apply (K3)
CO3	Apply In-Depth Understanding of Sorting, Searching, and Hashing Algorithms for Effective Problem Solving	Apply (K3)
CO4	Apply Profound Understanding of Trees to Effectively Manage Hierarchical and Interconnected Data	Apply (K3)
CO5	Analyze, Synthesize, and Innovate with Graph Structures for Complex Interconnected Data and Network Solutions	Analyze (K4)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	3	-	-	-	-	3	1	2	1	2	3	3
CO2	2	3	1	3	1	-	-	1	1	2	2	1	3	3	3
CO3	2	2	2	1	1	-	-	1	2	3	1	2	1	1	2
CO4	2	2	3	1	-	1	-	1	1	2	1	2	2	2	2
CO5	2	3	2	1	-	1	-	1	2	1	1	2	1	2	1

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23GE201 தமிழரும் தொழில்நுட்பமும் / Tamils and Technology

Prerequisite	Program Name	Sem	Category	L	T	P	C
Nil	B.E./B.TECH. – COMMON TO ALL BRANCHES	II	HSMC	1	0	0	1

II - Course Content

Unit – I	WEAVING AND CERAMIC TECHNOLOGY	3 Periods
Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.		
Unit – II	DESIGN AND CONSTRUCTION TECHNOLOGY	3 Periods
Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period		
Unit – III	MANUFACTURING TECHNOLOGY	3 Periods
Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting, steel -Copper and goldCoins as source of history - Minting of Coins – Beads making-industries Stone beads -Glass beads - Terracotta beads - Shell beads/ bone beats - Archeological evidences - Gem stone types described in Silappathikaram.		
Unit – IV	AGRICULTURE AND IRRIGATION TECHNOLOGY	3 Periods
Dam, Tank, ponds, Sluice, Significance of KumizhiThoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.		
Unit – V	SCIENTIFIC TAMIL & TAMIL COMPUTING	3 Periods
Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.		
		Total : 15 Periods
Text Cum Books:	[1] தமிழக வரலாறு மக்களும் பண்பாடும் கே.கே. பிள்ளை (வெளியீடு–தமிழ்நாடுபாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்). [2] கணினித்தமிழ் முனைவர் இலசுந்தரம் (விகடன்பிரசுரம்). [3] கீழடி–வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு). [4] பொருநை–ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு). [5] Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print) [6] Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.	
Reference Books:	[1] Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D.Thirunavukkarasu) (Published by: International Institute of Tamil Studies). [2] The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies)	

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	[3] Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu) [4] Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author) [5] Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu) [6] Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

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I - Course Code & Name: 23GE211 ENGINEERING PRACTICES LABORATORY

Prerequisite	Program Name	Sem	Category	L	T	P	C
Nil	B.E./B.TECH. – COMMON TO ALL BRANCHES	II	ESC	0	0	3	1.5

II - Course Objectives

1.	Drawing pipe line plan; laying and connecting various pipe fittings used in common household plumbing work; Sawing; planing; making joints in wood materials used in common household wood work.
2.	Wiring various electrical joints in common household electrical wire work.
3.	Welding various joints in steel plates using arc welding work; Machining various simple processes like turning, drilling, tapping in parts; Assembling simple mechanical assembly of common household equipment; Making a tray out of metal sheet using sheet metal work.
4.	Soldering and testing simple electronic circuits; Assembling and testing simple electronic components on PCB.

III - Course Content

Preamble:
Engineering Practices Laboratory – a hands-on learning experience that complements your theoretical knowledge with practical skills essential for success in the field of engineering. This laboratory course is designed to bridge the gap between classroom learning and real-world application, providing a platform to develop crucial engineering skills and gain confidence in working with tools, equipment, and techniques commonly used in engineering practice.

GROUP – A (CIVIL & MECHANICAL)

PART 1	CIVIL ENGINEERING PRACTICES PLUMBING WORK	12 Periods

PLUMBING WORK:
a) Connecting various basic pipe fittings like valves, taps, coupling, unions, reducers, elbows, and other components which are commonly used in households.
b) Preparing plumbing line sketches.
c) Laying pipe connection to the suction side of a pump.
d) Laying pipe connection to the delivery side of a pump.
e) Connecting pipes of different materials: Metal, plastic, and flexible pipes used in household appliances.

WOOD WORK:
a) Sawing,
b) Planing and
c) Making joints like T-Joint, Mortise joint and Tenon joint, and Dovetail joint.

Wood Work Study:
a) Studying joints in door panels and wooden furniture.
b) Studying common industrial trusses using models.

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PART 2	MECHANICAL ENGINEERING PRACTICES	12 Periods

WELDING WORK:
a) Welding of Butt Joints, Lap Joints, and Tee Joints using arc welding.
b) Practicing gas welding.

BASIC MACHINING WORK:
a) (simple) Turning.
b) (simple) Drilling.
c) (simple) Tapping.

ASSEMBLY WORK:
a) Assembling a centrifugal pump.
b) Assembling a household mixer.
c) Assembling an airconditioner.

SHEET METAL WORK:
a) Making of a square tray

GROUP – B (ELECTRICAL AND ELECTRONICS)

PART 3	ELECTRICAL ENGINEERING PRACTICES	11 Periods

a) Introduction to switches, fuses, indicators and lamps - Basic switch board wiring with lamp, fan and three pin sockets
b) Staircase wiring
c) Fluorescent Lamp wiring with introduction to CFL and LED types.
d) Energy meter wiring and related calculations/calibration
e) Study of Iron Box wiring and assembly
f) Study of Fan Regulator (Resistor type and electronic type using Diac/Triac/quadrac)
g) Study of emergency lamp wiring/Water heater

PART 4	ELECTRONIC ENGINEERING PRACTICES	10 Periods

SOLDERING WORK:
a) Soldering simple electronic circuits and checking continuity.
ELECTRONIC ASSEMBLY AND TESTING WORK:
a) assembling and testing electronic components on a small PCB.

ELECTRONIC EQUIPMENT STUDY:
a) Study an element of smart phone.
b) Assembly and dismantle of LED TV.
c) Assembly and dismantle of computer/laptop

Total: 45 Periods

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IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Draw pipe line plan; lay and connect various pipe fittings used in common household plumbing work; Saw; plan; make joints in wood materials used in common household wood work.	Applying (K3)
CO2	Wire various electrical joints in common household electrical wire work.	Applying (K3)
CO3	Weld various joints in steel plates using arc welding work; Machine various simple processes like turning, drilling, tapping in parts; Assemble simple mechanical assembly of common household equipments; Make a tray out of metal sheet using sheet metal work.	Applying (K3)
CO4	Solder and test simple electronic circuits; Assemble and test simple electronic components on PCB.	Applying (K4)

(Action verb of each CO to be matched with the next mapping table)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	2	-	-	1	1	1	-	-	-	-	2	1	1	-
CO-2	3	2	-	-	1	1	1	-	-	-	-	2	1	1	-
CO-3	3	2	-	-	1	1	1	-	-	-	-	2	1	1	-
CO-4	3	2	-	-	1	1	1	-	-	-	-	2	1	1	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23AD211-DATA STRUCTURES DESIGN LABORATORY

Prerequisite	Program Name	Sem	Category	L	T	P	C
23GE102-Problem Solving and Python Programming	B.Tech AI&DS	II	PCC	0	0	3	1.5

II - Course Objectives

1.	To implement ADTs in Python
2.	To design and implement linear data structures -lists, stacks, and queues
3.	To implement sorting, searching and hashing algorithms
4.	To solve problems using tree and graph structures

III LIST OF EXPERIMENTS 45 Periods

1. Implement simple ADTs as Python classes
2. Implement recursive algorithms in Python
3. Implement List ADT using Python arrays
4. Linked list implementations of List
5. Implementation of Stack and Queue ADTs
6. Applications of List, Stack and Queue ADTs
7. Implementation of sorting and searching algorithms
8. Implementation of Hash tables
9. Tree representation and traversal algorithms
10. Implementation of Binary Search Trees
11. Implementation of Heaps
12. Graph representation and Traversal algorithms
13. Implementation of single source shortest path algorithm
14. Implementation of minimum spanning tree algorithms

Text Books:	1. Michael T. Goodrich, Roberto Tamassia, and Michael H. Goldwasser, "Data Structures and Algorithms in Python" (An Indian Adaptation), Wiley, 2021 2. Lee, Kent D., Hubbard, Steve,"Data Structures and Algorithms with Python",Springer Edition 2015. 3. Narasimha Karumanchi,"Data Structures and Algorithmic Thinking with Python",Careermonk, 2015.

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Reference Books:	1. Rance D. Necaise,,"Data Structures and Algorithms Using Python", John Wiley &Sons, 2011. 2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein,"Introduction to Algorithms", Third Edition, PHI Learning, 2010.. 3. Mark Allen Weiss,"Data Structures and Algorithm Analysis in C++", FourthEdition, Pearson Education, 2014. 4. Aho, Hopcroft, and Ullman, "Data Structures and Algorithms", Pearson Education India,2002.
MOOC/ Web Platforms:	https://www.coursera.org/specializations/data-structures-algorithms https://www.edx.org/learn/data-structures/the-university-of-california-san- diego-data-structures-fundamentals https://www.youtube.com/watch?v= t2GVaQasRY&list=PLeo1K3hjS3uu n a MI KktGTLYopZ12 **https://www.youtube.com/watch?v=UljGkm2ikdY&list=PLrk5tgtnMN6TYBW0-U4YhIRyYEVpqVEnJ**

IV- Course Outcome

(Action verb of each CO to be matched with the next mapping table)

On completion of the course, the students will be able to		Bloom'sLevel Mapped
CO1	Analyzing and Applying Fundamental Data Structures and Recursive Algorithms in Python	Apply (K3)
CO2	Design, implement, and analyses linear data structures, such as lists, queues, and stacks, according to the needs of different applications	Create (K6)
CO3	Design, implement, and analyses efficient tree structures to meet requirements such as searching, indexing, and sorting	Create (K6)
CO4	Analyzing Graph Representation Methods and Mastering Traversal Algorithms	Analyze (K4)
CO5	Design, implement, and analyses single source shortest path algorithmand minimum spanning tree algorithms	Create (K6)

V- Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	2	3	3	1	1	-	-	1	2	1	2	1	2	3	3
CO-2	2	3	3	2	1	-	-	2	1	2	2	1	3	2	3
CO-3	2	3	3	2	1	-	-	2	2	3	1	2	2	2	2
CO-4	3	2	2	2	1	1	-	1	1	2	1	2	2	2	2
CO-5	2	3	3	3	1	1	-	2	2	1	1	2	1	2	3

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23GE212 ENGLISH LABORATORY -II

Prerequisite	Program Name	Sem	Category	L	T	P	C
23GE112- English Laboratory - I	B.E./B.TECH. COMMON TO ALL BRANCHES	II	EEC	0	0	2	1

II - Course Objectives

1.	To identify varied group discussion skills and apply them to take part in effective discussionsin a professional context.
2.	To analyze concepts and problems and make effective presentations explaining them clearlyand precisely.
3.	To enhance the Employability and Career Skills of students and acquire professional skills required for workplace / higher education.
4.	To develop their confidence and help them attend interviews successfully.
5.	To make them Employable Graduates and use English language skills effectively in various situations.

III - Course Content

Preamble:
This course is designed to impart necessary skills to listen, speak, read and write in order to obtain better professional communication skills.

Unit – I	ROLE PLAY	6 Periods
Speaking-Role Play Exercises Based on Workplace Contexts, - talking about competition- discussing progress toward goals-talking about experiences- talking about events in life- discussingpast events.		
Unit – II	**TRAVELOGUE**	**6 Periods**
Speaking: Discussing news stories-talking about frequency-talking about travel problems- discussing travel procedures - talking about travel problems- making arrangements-describing arrangements-discussing plans and decisions- discussing purposes and reasons- understanding common technology terms.		
Unit – III	**PROFESSIONAL SPEAKING**	**6 Periods**
Speaking: Self-Introduction-organizing the material - Introducing oneself to the audience – introducing the topic – answering questions – Practicing individual presentation— Presenting the visuals effectively (5-minute presentations).		
Unit – IV	**GROUP DISCUSSION**	**6 Periods**
Introduction to Group Discussion— Participating in group discussions – understanding group dynamics - brainstorming the topic -– questioning and clarifying –GD strategies - improving GD skills through activities.		
Unit – V	**INTERVIEW**	**6 Periods**
Interview etiquette – dress code – body language – Job interviews through telephone/skype -one to one interview & panel interview – FAQs related to job interviews.		

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Recommended Software:	[1] Globarena Software.
	[2] Open-Source Software and YouTube Videos in Career Lab.
Reference Books:	[1] E. Suresh Kumar et al. Communication for Professional Success. Orient Blackswan: Hyderabad, 2015.
	[2] Interact English Lab Manual for Undergraduate Students, OrientBalckSwan: Hyderabad, 2016
	[3] English For Technical Communication (With CD) By Aysha Viswamohan, Mcgraw HillEducation, ISBN : 0070264244.
	[4] Effective Communication Skill, Kulbhusan Kumar, RS Salaria, Khanna Publishing House
	[5] Learning to Communicate – Dr. V. Chellammal, Allied Publishing House, New Delhi,2003.
MOOC/Web Platforms:	https://www.digitalteacher.in/english-language-lab

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Speak effectively in group discussions held in a formal/semi formal contexts.	Create(K6)
CO2	Discuss, analyze and present concepts and problems from various perspectives to arrive atsuitable solutions.	Analyze(K4)
CO3	Make effective presentations in an attractive way using appropriate vocabulary.	Apply(K3)
CO4	Attend job interviews and be successful in them.	Create(K6)
CO5	Develop adequate Soft Skills required for the workplace.	Apply(K3)

(Action verb of each CO to be matched with the next mapping table)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	-	-	-	-	-	-	-	-	3	3	-	3	-	-	-
CO-2	-	-	-	-	-	-	-	-	3	3	-	3	-	-	-
CO-3	-	-	-	-	-	-	-	-	3	3	-	3	-	-	-
CO-4	-	-	-	-	-	-	-	-	3	3	-	3	-	-	-
CO-5	-	-	-	-	-	-	-	-	3	3	-	3	-	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23MA302 DISCRETE MATHEMATICS

Prerequisite	Program Name	Sem	Category	L	T	P	C
NIL	COMMON FOR B. E / B. TECH., CSE/IT, AI & DS	III	BSC	3	1	0	4

II - Course Objectives

1.	To extend student's logical and mathematical maturity and ability to deal with abstraction.
2.	To introduce most of the basic terminologies used in computer science courses andapplication of ideas to solve practical problems.
3.	To understand the basic concepts of combinatorics and graph theory.
4.	To familiarize the applications of algebraic structures.
5.	To understand the concepts and significance of lattices and Boolean algebra which arewidely used in computer science and engineering.

III - Course Content

Preamble:
This course is enabled to apply in programming languages, software development, cryptography, algorithm. The fundamentals of Machine Learning are deeply rooted in discrete mathematics.
Digital image processing uses discrete mathematics to merge images or apply filters.

Unit – I	**LOGIC AND PROOFS**	**12 Periods**
Propositional logic – Propositional equivalences - Predicates and quantifiers – Nested quantifiers – Rules of inference - Introduction to proofs – Proof methods and strategy.		
Unit – II	**COMBINATORICS**	**12 Periods**
Mathematical induction – Strong induction and well ordering – The basics of counting – The pigeonhole principle – Permutations and combinations – Recurrence relations – Solving linear recurrence relations – Generating functions – Inclusion and exclusion principle and itsapplications.		
Unit – III	**GRAPHS**	**12 Periods**
Graphs and graph models – Graph terminology and special types of graphs – Matrix representation of graphs and graph isomorphism – Connectivity – Euler and Hamilton paths.		
Unit – IV	**ALGEBRAIC STRUCTURES**	**12 Periods**
Algebraic systems – Semi groups and monoids - Groups – Subgroups – Homomorphism's – Normal subgroup and cosets – Lagrange's theorem – Definitions and examples of Rings andFields.		
Unit – V	**LATTICES AND BOOLEAN ALGEBRA**	**12 Periods**
Partial ordering – Posets – Lattices as posets – Properties of lattices - Lattices as algebraic systems – Sub lattices – Direct product and homomorphism – Some special lattices – Boolean algebra –Sub Boolean Algebra – Boolean Homomorphism.		

TOTAL : 60 Periods

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Text Books:	[1] Rosen. K.H., "Discrete Mathematics and its Applications", 7th Edition, Tata McGrawHil Pub. Co. Ltd., New Delhi, Special Indian Edition, 2017. [2] Tremblay. J.P. and Manohar. R, "Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw Hil Pub. Co. Ltd, New Delhi, 30th Reprint, 2011
Reference Books:	[1] Grimaldi. R.P. "Discrete and Combinatorial Mathematics: An Applied Introduction",5th Edition, Pearson Education Asia, Delhi, 2013. [2] Koshy. T. "Discrete Mathematics with Applications", Elsevier Publications, 2006. [3] Lipschutz. S. and Mark Lipson., "Discrete Mathematics", Schaum's Outlines, Tata McGraw Hil Pub. Co. Ltd., New Delhi, 3rd Edition, 2010.
MOOC/Web Platforms:	https://www.math.cmu.edu/~mradclif/teaching/127S19/Notes/Logic%20and%20Proof.pdf https://math.libretexts.org/Bookshelves/Combinatorics_and_Discrete_Mathematics http://www.cectl.ac.in/images/pdf_docs/studymaterial/cse/s3/dcs4.pdf https://onlinecourses.nptel.ac.in/noc20_cs82/preview

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	To apply the engineering knowledge to solve the logic of a program.	Apply(K3)
CO2	To understand and analyze the structures of problems on mathematical induction and counting principle.	Understand (K2)
CO3	To apply the fundamentals of graph theory using modern tools in computer networking to manage projects	Apply(K3)
CO4	To apply the notion of groups, rings and fields to design and solve the algebraic structures problems.	Apply(K3)
CO5	To acquire the knowledge of engineering in real life phenomena by solving Lattices and Boolean algebra	Apply(K3)

(Action verb of each CO to be matched with the next mapping table)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	2	-	-	-	-	-	-	-	-	2	-	-	-
CO-2	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-3	-	3	2	-	-	2	-	-	-	3	-	-	-	-	-
CO-4	-	2	2	2	-	-	-	-	-	-	-	-	-	-	-
CO-5	-	2	2	2	-	-	-	-	-	2	-	-	-	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23AD301- FUNDAMENTALS OF DATA SCIENCE AND ANALYTICS

Prerequisite	Program Name	Sem	Category	L	T	P	C
Problem Solving and Python Programming	B.Tech AI&DS	III	PCC	3	0	2	4
Statistics and Numerical Methods		III	PCC	3	0	2	4

II - Course Objectives

1.	To learn the basics of data science, including collecting, cleaning, transforming, and analyzing data.
2.	To use descriptive analytics to understand and summarize datasets, discovering patterns and trends.
3.	To learn to visualize data using different methods and tools, effectively sharing insights
4.	To understand inferential analytics for making conclusions from sample data.
5.	To develop skills in analyzing data and building predictive models with statistical and machine learning algorithms for accurate decision-making.

III - Course Content

Preamble:

This course serves as a foundational gateway into the dynamic realm of extracting meaning from vast datasets and equips learners with the essential toolkit to navigate the complexities of modern data ecosystems. Through a blend of theoretical exploration and hands - on experimentation, students will cultivate proficiency in data manipulation, exploratory data analysis, and predictive modeling, fostering the skills necessary to actionable insights and drive informed decision-making across diverse domains.

Unit – I	INTRODUCTION TO DATA SCIENCE AND ANALYTICS	9 Periods

Significance of data science– Facets of data – Data science process – setting the research goal – retrieving data – cleansing, integrating, and transforming data – exploratory data analysis – build the models – presenting and building applications.

Unit – II	EXPLORATORY DATA ANALYSIS	9 Periods

Frequency Distributions and Outliers - Interpreting Data Distributions - Graphical Representation of Data - Measures of Central Tendency - Measures of Dispersion - Interquartile Range and Quartiles -Variability in Categorical and Ranked Data - Normal Distributions and Z- Scores - Correlation Analysis and Scatter Plots -Linear Regression and Least Squares Regression Line- standard error of estimate – interpretation of r2 – multiple regression equations – regression toward the mean.

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Unit – III	STATISTICAL INFERENCE	10 Periods
Populations, Samples, and Random Sampling -Sampling Distribution and Central Limit Theorem - Hypothesis Testing : Basics of Hypothesis Testing - Null and Alternative Hypotheses - Type I and Type II Errors - Significance Level (Alpha) and P-values - Z-test and its Procedure -Decision Rules, Calculations, and Interpretations - One-tailed and Two-tailed Tests - Estimation Techniques : Point Estimation and Interval Estimation - Confidence Intervals and Level of Confidence-Effect of Sample Size on Estimation		
Unit – IV	**COMPARATIVE ANALYSIS AND INFERENTIAL TECHNIQUES**	**8 Periods**
t-test for one sample – sampling distribution of t- t- test procedure – t-test for two independentsamples – p- value – statistical significance – t-test for two related samples. F-test – ANOVA – Two factor experiments – three f-tests – two-factor ANOVA—Introduction to chi- square tests		
Unit – V	**ADVANCED PREDICTIVE MODELING**	**9 Periods**
Linear Regression - Linear least squares method: Implementation and Interpretation - Goodness of Fit Metrics - Testing Assumptions of a Linear Model - Weighted Resampling Techniques - Multiple Regression - Handling Nonlinear Relationships - Regression using Stats Models Library - Logistic Regression - Estimation of Parameters - Time Series Analysis -Moving Averages and Trends Detection - Handling Missing Values and Outliers - Serial Correlation and Autocorrelation Analysis - Introduction to survival analysis.		

LIST OF EXPERIMENTS **Total Hours: 30 Periods**

Tools: Python, Numpy, Scipy, Matplotlib, Pandas, statmodels, seaborn, plotly, bokeh

1. Working with Numpy arrays
2. Working with Pandas data frames
3. Basic plots using Matplotlib
4. Frequency distributions, Averages, Variability
5. Normal curves, Correlation and scatter plots, Correlation coefficient
6. Regression
7. Z-test
8. T-test
9. ANOVA
10. Building and validating linear models
11. Building and validating logistic models
12. Time series analysis

TOTAL : 75 Periods

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Text Books:	[1] David Cielen, Arno D. B. Meysman, and Mohamed Ali, "Introducing Data Science", Manning Publications, 2016. (First two chapters for Unit I). [2] Robert S. Witte and John S. Witte, "Statistics", Eleventh Edition, Wiley Publications,2017. (Unit II, III & IV). [3] Gareth James, Daniela Witten, Trevor Hastie and Robert Tibshirani, "An Introduction to Statistical Learning with Applications in Python, Springer Publication, 2023 (Unit V).
Reference Books:	[1] Allen B. Downey, "Think Stats: Exploratory Data Analysis in Python", GreenTea Press, 2014. [2] Sanjeev J. Wagh, Manisha S. Bhende, Anuradha D. Thakare, "Fundamentalsof Data Science", CRC Press, 2022. [3] Chirag Shah, "A Hands-On Introduction to Data Science", Cambridge University Press, 2020. [4] Vineet Raina, Srinath Krishnamurthy, "Building an Effective Data Science Practice: A Framework to Bootstrap and Manage a Successful Data Science Practice", Apress, 2021.
MOOC/Web Platforms:	https://nptel.ac.in/courses/106106179 https://www.edx.org/learn/data-science/harvard-university-introduction-to-data-science- with-python https://www.edx.org/learn/data-analytics/boxplay-data-analytics-foundations-a-beginners- guide https://www.coursera.org/professional-certificates/ibm-data-science

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IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Comprehensive understanding of the evolution, Significance, and processes involved in data science and analytics.	Understand (K2)
CO2	Understand and apply statistical techniques for data Analysis.	Apply(K3)
CO3	Apply statistical inference techniques to analyse data and make informed decisions.	Apply(K3)
CO4	Analyze and interpret data using inferential techniques such as t-tests and ANOVA	Analyze(K4)
CO5	Apply Advanced Predictive Modelling Techniques such as regression and time series analysis techniques.	Apply(K3)

(Action verb of each CO to be matched with the next mapping table)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	3	3	1	-	-	-	-	-	-	2	3	2	2
CO-2	2	2	2	2	1	-	-	-	-	-	-	3	1	3	2
CO-3	2	2	2	2	1	-	-	-	-	-	-	2	1	2	3
CO-4	3	3	3	3	1	-	-	-	-	-	-	2	2	1	2
CO-5	3	3	3	3	1	-	-	-	-	-	-	2	3	2	1

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23AD302-DATABASE DESIGN AND MANAGEMENT

Prerequisite	Program Name	Sem	Category	L	T	P	C
Data Structures Design	B.Tech AI&DS	III	PCC	3	0	0	3

II - Course Objectives

1.	To introduce database development life cycle and conceptual modeling
2.	To learn SQL for data definition, manipulation and querying a database.
3.	To learn relational database design using conceptual mapping and normalization
4.	To learn transaction concepts and serializability of schedules
5.	To learn data model and querying in object-relational and No-SQL databases

III - Course Content

Preamble:
Database Design and Management, is meticulously crafted to equip you with the foundational knowledge and practical skills necessary to navigate the complexities of data management. Through a comprehensive exploration of data modeling techniques, database architecture, andoptimization s trategies, Students will gain a deep understanding of the principles and best practices that underpin successful database systems.

Unit – I	CONCEPTUAL DATA MODELING	9 Periods
Database environment – Database system development lifecycle – Requirements collection –Database design — Use Case diagram-Sequence Diagram-Activity Diagram- Deployment Diagram- Entity-Relationship model – Enhanced-ER model – UML class diagrams.		
Unit – II	**RELATIONAL MODEL AND SQL**	**9 Periods**
Relational model concepts — Integrity constraints — SQL Data manipulation – SQL Datadefinition – Views – triggers — SQL programming		
Unit – III	**RELATIONAL DATABASE DESIGN AND NORMALIZATION**	**9 Periods**
ER and EER-to-Relational mapping – Update anomalies – Functional dependencies – Inference rules –Minimal cover – Properties of relational decomposition – Normalization (upto BCNF).		
Unit – IV	**TRANSACTION MANAGEMENT**	**9 Periods**
Transaction concepts – properties – Schedules - Transaction Isolation Levels in DBMS - Serializability – Concurrency Control – Two-phase locking techniques samples: Assumptions and Procedure - Interpretation of p-value and Statistical Significance		

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Unit – V	OBJECT RELATIONAL AND NO-SQL DATABASES	9 Periods
Mapping EER to ODB schema – Object identifier – reference types – row types – UDTs – Sub types and super types – user-defined routines – Collection types – Object Query Language; Introduction to PL/SQL – PL/SQL Architecture No-SQL: CAP theorem – Document- based: MongoDB data model and CRUD operations; Column-based: Hbase data model and CRUD operations		

TOTAL : 45 Periods

Text Books:	[1] Thomas M. Connolly, Carolyn E. Begg, Database Systems – A PracticalApproach to Design, Implementation, and Management, Sixth Edition, Global Edition, Pearson Education, 2015. [2] Ramez Elmasri, Shamkant B. Navathe, Fundamentals of DatabaseSystems, 7th Edition, Pearson, 2017.
Reference Books:	[1] Toby Teorey, Sam Lightstone, Tom Nadeau, H. V. Jagadish, DATABASE MODELING AND DESIGN – Logical Design, Fifth Edition, Morgan KaufmannPublishers, 2011. [2] Carlos Coronel, Steven Morris, and Peter Rob, Database Systems: Design, Implementation, and Management, Ninth Edition, Cengage learning, 2012. [3] Abraham Silberschatz, Henry F Korth, S Sudharshan, Database System Concepts", 7th Edition, Tata Mc Graw Hill, 2019.
MOOC/Web Platforms:	https://archive.nptel.ac.in/courses/106/106/106106093/ https://www.coursera.org/learn/database-design-postgresql https://www.edx.org/certificates/professional-certificate/ibm-sql-nosql-and-relational- database-fundamentals

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the database development life cycle and apply conceptual modeling	Understand (K2)
CO2	Apply SQL and programming in SQL to create, manipulate and query the database	Apply (K3)
CO3	Apply the conceptual-to-relational mapping and normalization todesign relational database.	Apply (K3)
CO4	Determine the serializability of any non-serial schedule using concurrency techniques	Apply (K3)
CO5	Apply the data model and querying in Object-relational and No-SQL databases.	Apply (K3)

(Action verb of each CO to be matched with the next mapping table)

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V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	2	2	3	3	1	-	-	-	-	-	-	1	2	1	2
CO-2	2	2	1	3	2	-	-	-	-	-	-	2	2	1	3
CO-3	2	2	2	1	2	-	-	-	-	-	-	2	1	1	2
CO-4	2	2	2	1	2	-	-	-	-	-	-	2	1	1	2
CO-5	2	2	3	2	2	-	-	-	-	-	-	3	2	1	3

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23AD303-ALGORITHMIC PROBLEM SOLVING TECHNIQUES

Prerequisite	Program Name	Sem	Category	L	T	P	C
Data Structures Design	B.Tech AI&DS	III	PCC	3	0	2	4

II - Course Objectives

1.	To explain the fundamental concepts of algorithm design and analysis.
2.	To illustrate brute force and divide and conquer design techniques.
3.	To explain dynamic programming and greedy techniques for solving various problems.
4.	To apply iterative improvement technique to solve optimization problems.
5.	To examine the limitations of algorithmic power and handling it in different

III - Course Content

Preamble:

The Design and Analysis of Algorithms course is designed to provide a comprehensive understanding of fundamental algorithms, their design principles, and their analysis techniques. This course explores various algorithmic strategies and paradigms, equipping students with the knowledge and skills necessary to develop efficient algorithms for solving complex computational problems.

Unit – I	INTRODUCTION TO ALGORITHM	9 Periods

Notion of an Algorithm – Fundamentals of Algorithmic Problem Solving – Important Problem Types– Fundamentals of the Analysis of Algorithm Efficiency – Analysis Framework - Asymptotic Notations and their properties – Empirical analysis - Mathematical analysis of Recursive and Non-recursive algorithms – Visualization.

Unit – II	BRUTE FORCE AND DIVIDE AND CONQUER	12 Periods

Brute Force – String Matching - Exhaustive Search - Traveling Salesman Problem - Knapsack Problem - Assignment problem. Divide and Conquer Methodology – Multiplication of Large Integers and Strassen's Matrix Multiplication – Closest-Pair and Convex - Hull Problems. Decrease and Conquer: - Topological Sorting-Decrease-by-a-Constant factor Algorithms – Transform and Conquer: Presorting – Heaps and Heap Sort.

Unit – III	DYNAMIC PROGRAMMING AND GREEDY TECHNIQUE	11 Periods

Dynamic programming – Principle of optimality - Coin changing problem – Warshall's and Floyd's algorithms – Optimal Binary Search Trees - Multi stage graph - Knapsack Problem and Memory functions. Greedy Technique – Dijkstra's algorithm - Huffman Trees and codes - 0/1 Knapsack Problem.

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Unit – IV	ITERATIVE IMPROVEMENT	6 Periods
The Simplex Method-The Maximum-Flow Problem – Maximum Matching in Bipartite Graphs- The Stable marriage Problem.		
Unit – V	**LIMITATIONS OF ALGORITHM POWER**	**7 Periods**
Lower - Bound Arguments - P, NP, NP- Complete and NP Hard Problems. Backtracking – N- Queen problem - Hamiltonian Circuit Problem – Subset Sum Problem. Branch and Bound – LIFO Search and FIFO search - Assignment problem – Knapsack Problem – Traveling Salesman Problem - Approximation Algorithms for NP-Hard Problems – Traveling Salesman problem		

LIST OF EXPERIMENTS **Total Hours: 30 Periods**

Tools: Python, Numpy, Scipy, Matplotlib.

1. Implement recursive and non-recursive algorithms and study the order of growth fromlog2n to n!.
2. Divide and Conquer - Strassen's Matrix Multiplication
3. Decrease and Conquer - Topological Sorting
4. Transform and Conquer - Heap Sort
5. Dynamic programming - Coin change Problem, Warshall's and Floyd's algorithms, Knapsack Problem
6. Greedy Technique – Dijkstra's algorithm, Huffman Trees and codes
7. Iterative improvement - Simplex Method
8. Backtracking – N-Queen problem, Subset Sum Problem
9. Branch and Bound - Assignment problem, Traveling Salesman Problem

TOTAL : 75 Periods

Text Books:	[1] Anany Levitin, Introduction to the Design and Analysis of Algorithms, Third Edition, Pearson Education, 2012. [2] Algorithms Design and Analysis', Harsh Bhasin, Oxford university press, 2016
Reference Books:	[1] Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, Computer Algorithms/ C++, Second Edition, Universities Press, 2019. [2] Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivest and Clifford Stein, Introduction to Algorithms, Third Edition, PHI Learning Private Limited, 2012. [3] S. Sridhar, Design and Analysis of Algorithms, Oxford university press, 2014. *4+S.Dasgupta,C.H.Papadimitriou,U.V.Vazirani,``Algorithms'',1st Edition, McGraw Hill Education, 2017
MOOC/Web Platforms:	https://onlinecourses.nptel.ac.in/noc19_cs47 https://www.edx.org/learn/algorithms/stanford-university-algorithms-design- and-analysis https://www.edx.org/learn/algorithms/iitbombay- algorithms https://www.coursera.org/learn/analysis-of-algorithms https://www.youtube.com/watch?v=u5AXxR4GnRY

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IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Analyze the efficiency of recursive and non-recursive algorithms mathematically	Apply (K3)
CO2	Analyze the efficiency of brute force, divide and conquer, decrease and Conquer, Transform and conquer algorithmic techniques.	Apply (K4)
CO3	Implement and analyze the problems using dynamic programming andgreedy algorithmic techniques.	Analyze (K 4)
CO4	Solve the problems using iterative improvement techniques foroptimization.	Analyze (K2)
CO5	Compute the limitations of algorithmic power and solve the problemsusing backtracking and branch and bound techniques.	Analyze (K3)

(Action verb of each CO to be matched with the next mapping table)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	3	1	-	-	-	-	-	-	-	-	3	1	1
CO-2	2	1	1	3	-	-	-	-	-	-	-	-	2	2	1
CO-3	3	2	1	2	-	-	-	-	-	-	-	-	1	2	2
CO-4	3	2	2	2	-	-	-	-	-	-	-	-	2	2	2
CO-5	3	1	2	3	-	-	-	-	-	-	-	-	3	1	2

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23AD304 -SYSTEM SOFTWARE AND OPERATING SYSTEMS

Prerequisite	Program Name	Sem	Category	L	T	P	C
23CS901-Digital Principles and Computer Organization	B.Tech AI&DS	III	PCC	3	0	2	4

II - Course Objectives

1.	To understand the basics and functions of System software and operating systems.
2.	To analyze various memory management schemes
3.	To understand Processes, Threads, Deadlocks and analyze Scheduling algorithms and process synchronization
4.	To be familiar with I/O management and File systems.
5.	To be familiar with the basics of virtual machines and Mobile OS like iOS and Android

III - Course Content

Preamble:
This course delves into the core principles of operating systems, the hidden conductor thatorchestrates the flow of information, manages resources, and provides the essential platform for all our computing endeavors

Unit – I	INTRODUCTION	9 Periods

Computer System - Elements and organization; Role of system software in computer system –System Software Vs. Application Software, Different System Software Operating System Overview - Objectives and Functions - Evolution of Operating System; Operating System Structures–Operating System Services -User Operating System Interface - System Calls – System Programs - System Calls

Unit – II	MEMORY MANAGEMENT	12 Periods

Main Memory - Swapping - Contiguous Memory Allocation – Paging- Segmentation with paging;Virtual Memory - Demand Paging – Copy on Write - Page Replacement - Allocation of Frames – Thrashing- Allocating Kernel Memory-CASE STUDY - Linux Memory Management.

Unit – III	PROCESS MANAGEMENT	11 Periods

Processes - Process Concept - Process Scheduling - Operations on Processes - Inter- process Communication; CPU Scheduling - Scheduling criteria - Scheduling algorithms: Threads - Multithread Models – Threading issues; Process Synchronization - The Critical- Section problem - Semaphore- - Deadlock - Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection, Recovery from deadlock. CASE STUDY - Linux Process Management

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Unit – IV	STORAGE MANAGEMENT	6 Periods
Mass Storage system – Disk Structure - Disk Scheduling and Management; File-System Interface - File concept - Access methods - Directory Structure - Directory organization – File system mounting - File Sharing and Protection; File System Implementation - File System Structure - Directory implementation - Allocation Methods - Free Space Management; I/O Systems – I/O Hardware, Application I/O interface, Kernel I/O subsystem-CASE STUDY – Linux File system.		
Unit – V	VIRTUAL MACHINES AND MOBILE OS	7 Periods
Virtual Machines – Benefits and Features, Building Blocks, Types of Virtual Machines and their Implementations, Virtualization - Mobile OS - iOS and Android OS Generation and System Boot-UEFI and Legacy boot.		

LIST OF EXPERIMENTS **Total Hours: 30 Periods**

Tools: Linux operating system, VM ware.

1. Installation of windows/Linux operating system
2. Illustrate UNIX commands and Shell Programming
3. Process Management using System Calls: Fork, Exit, Getpid, Wait, Close
4. Write C programs to implement the various CPU Scheduling Algorithms
5. Illustrate the inter process communication strategy
6. Implement mutual exclusion by Semaphore
7. Write C programs to avoid Deadlock using Banker's Algorithm
8. Write a C program to Implement Deadlock Detection Algorithm
9. Write C program to implement Threading
10. Implement the paging Technique using C program
11. Write C programs to implement the following Memory Allocation Methods
    a. First Fit b. Worst Fit c. Best Fit
12. Write C programs to implement the various Page Replacement Algorithms
13. Write C programs to Implement the various File Organization Techniques
14. Implement the following File Allocation Strategies using C programs
    a. Sequential b. Indexed c. Linked
15. Write C programs for the implementation of various disk scheduling algorithms

Total: 75 Periods

Text Books:	[1] Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, "OperatingSystem Concepts"‖, 10th Edition, John Wiley and Sons Inc., 2018. [2] Andrew S Tanenbaum, "Modern Operating Systems", Pearson, 5thEdition, 2022 New Delhi. [3] Leland L. Beck, "System Software – An Introduction to Systems Programming", 3rd Edition, Pearson Education Asia, 2006.
Reference Books:	[1] Ramaz Elmasri, A. Gil Carrick, David Levine, " Operating Systems – ASpiral Approach", Tata McGraw Hil Edition, 2010. [2] Wiliam Stalings, "Operating Systems: Internals and Design Principles",

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	Edition, Prentice Hall, 2018. [3] Achyut S.Godbole, Atul Kahate, "Operating Systems", McGraw Hil Education, 2016. [4] D. M. Dhamdhere, "Systems Programming and Operating Systems",Second Revised Edition, Tata McGraw-Hill, 2000.7th
MOOC/Web Platforms:	https://nptel.ac.in/courses/106105214 https://www.coursera.org/specializations/codio-introduction-operating- systems https://www.edx.org/learn/operating-systems/ibm-hardware-and-operating- systems

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Analyze and Understand basic concepts of System Software and various scheduling algorithms and process synchronization.	Understand (K2)
CO2	Explain deadlock prevention and avoidance algorithms	Apply (K3)
CO3	Compare and contrast various memory management schemes.	Apply (K3)
CO4	Explain the functionality of file systems, I/O systems, andVirtualization	Apply (K3)
CO5	Compare iOS and Android Operating Systems	Apply (K3)

(Action verb of each CO to be matched with the next mapping table)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	1	3	3	-	-	-	-	-	-	-	1	2	1	1
CO-2	2	2	1	1	1	-	-	-	-	-	-	1	3	1	1
CO-3	2	1	2	1	-	-	-	-	-	-	-	2	1	1	1
CO-4	2	1	2	2	-	-	-	-	-	-	-	2	1	1	1
CO-5	3	2	2	1	1	-	-	-	-	-	-	2	2	1	1

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23AD305- INTELLIGENT SYSTEMS

Prerequisite	Program Name	Sem	Category	L	T	P	C
23GE102-Problem Solving and Python Programming	B.Tech AI&DS	III	PCC	3	0	0	3
23AD201-Data Structures Design		III	PCC	3	0	0	3

II - Course Objectives

1.	To understand the various characteristics of Intelligent agents.,
2.	To learn the different Problem solving agents in AI
3.	To learn the Game theory and CSP techniques.
4.	To perform logical reasoning
5.	To perform the probabilistic reasoning

III - Course Content

Preamble:
This course introduces the fundamental concepts and principles that are essential for learning the AI Approaches and Intelligent systems.
They are needed to understand how to perform logical and probabilistic reasoning with Intelligent systems.

Unit – I	INTELLIGENT AGENTS	9 Periods

Introduction to AI – Recent Trends in AI – Agents and Environments – concept of rationality – nature of environments – structure of agents- Architectures for Intelligent Agent- Problem solving agents – search algorithms – uninformed search strategies: : BFS, DFS, UCS and IDDFS-Case study

Unit – II	PROBLEM SOLVING	9 Periods

Heuristic search strategies – heuristic functions. Local search and optimization problems – local search in continuous space – search with non-deterministic actions – search in partially observable environments – online search agents and unknown environments-Case Study

Unit – III	GAME PLAYING AND CSP	9 Periods

Game theory – optimal decisions in games – alpha-beta search – Monte- Carlo tree search – Stochastic games – partially observable games. Constraint satisfaction problems – constraint propagation – structure of CSP backtracking search for CSP – local search for CSP – Case Study

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Unit – IV	LOGICAL REASONING	9 Periods
Knowledge-based agents – propositional logic –propositional theorem proving –Propositional model checking – agents based on propositional logic. First-order logic – syntax and semantics – knowledge representation and engineering – inferences in first order logic – forward chaining – backward chaining – resolution-Case study		
Unit – V	**PROBABILISTIC REASONING**	**9 Periods**
Acting under uncertainty – Bayesian inference – naïve Bayes models. Probabilistic reasoning –Bayesian networks – exact inference in BN – approximate inference in BN – causal networks- Utility Based System -Decision Network Case study		

Total: 45 Periods

Text Books:	[1] Stuart Russell and Peter Norvig, "Artificial Intelligence – A ModernApproach", Fourth Edition, Pearson Education, 2021.
Reference Books:	[1] Dan W. Patterson, "Introduction to AI and ES", Pearson Education,2007 [2] Kevin Night, Elaine Rich, and Nair B., "Artificial Intelligence", McGrawHill, 2008 [3] Patrick H. Winston, "Artificial Intelligence", Third Edition, PearsonEducation, 2006 [4] Deepak Khemani, "Artificial Intelligence", Tata McGraw Hill Education,2013. [5] Artificial Intelligence by Example: Develop machine intelligence fromscratch using real artificial intelligence use cases - by Dennis Rothman,2018
MOOC/Web Platforms:	https://nptel.ac.in/courses/106102220 https://www.edx.org/learn/artificial intelligence/columbia-university- artificial-intelligence-ai https://www.coursera.org/professional-certificates/applied-artifical- intelligence-ibm-watson-ai#courses

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IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	To understand the foundational knowledge of Intelligent Systems	Understand (K2)
CO2	Utilize problem-solving techniques to achieve optimal solutions or navigate complex environments	Apply (K3)
CO3	Utilize game playing and CSP approaches to design intelligent systems to solve Problems with optimal decisions and complex constraints.	Apply (K3)
CO4	Utilize logical reasoning to empower intelligent systems and reasoning techniques to solve the Problem	Apply (K3)
CO5	Integrate probabilistic reasoning techniques reasoning under uncertainty in intelligent systems	Apply (K3)

(Action verb of each CO to be matched with the next mapping table)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	1	3	3	1	-	-	-	-	-	-	1	2	1	1
CO-2	2	2	1	1	1	-	-	-	-	-	-	1	3	1	1
CO-3	2	1	2	1	2	-	-	-	-	-	-	2	1	1	1
CO-4	2	1	2	2	2	-	-	-	-	-	-	2	1	1	1
CO-5	3	2	2	1	2	-	-	-	-	-	-	2	2	1	1

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23AD311-DATABASE DESIGN AND MANAGEMENT LABORATORY

Prerequisite	Program Name	Sem	Category	L	T	P	C
23AD211-Data Structures Design Laboratory	B.Tech AI&DS	III	PCC	0	0	3	1.5

II - Course Objectives

1.	To understand the database development life cycle
2.	To learn database design using conceptual modeling, Normalization
3.	To implement database using Data definition, Querying using SQL manipulation and SQL programming
4.	To implement database applications using IDE/RAD tools
5.	To learn querying Object-relational databases

III - LIST OF EXPERIMENTS

LIST OF EXPERIMENTS **Total Hours: 45 Periods**

Tools: Pro SQL, Net Beans, Oracle, Rational rose or star UML,

1. Database Development Life cycle: Problem definition and Requirement analysis Scope and Constraints
2. Draw an Use case diagram, class diagram, sequence diagram, Activity diagram for StockManagement system using Rational rose or Star UML
3. Database design using Conceptual modeling (ER-EER) – top-down approach Mapping conceptual to relational database and validate using Normalization
4. Implement the database using SQL Data definition with constraints, Views
5. Query the database using SQL Manipulation
6. Querying/Managing the database using SQL Programming
   - Stored Procedures/Functions
   - Constraints and security using Triggers
7. Database design using Normalization – bottom-up approach
8. Develop database applications using IDE/RAD tools (Eg., NetBeans, VisualStudio)
9. Database design using EER-to-ODB mapping / UML class diagrams
10. Object features of SQL-UDTs and sub-types, Tables using UDTs, Inheritance, Method definition
11. Write a PL/SQL program to create a trigger before the user changes the value of thesalary of the employee.
12. Querying the Object-relational database using Objet Query language

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Text Books:	[1] Thomas M. Connolly, Carolyn E. Begg, Database Systems – A Practical Approach toDesign, Implementation, and Management, Sixth Edition, Global Edition, Pearson Education, 2015. [2] Ramez Elmasri, Shamkant B. Navathe, Fundamentals of Database Systems, 7thEdition,Pearson, 2017.
Reference Books:	[1] Toby Teorey, Sam Lightstone, Tom Nadeau, H. V. Jagadish, DATABASE MODELINGANDDESIGN – Logical Design, Fifth Edition, Morgan Kaufmann Publishers, 2011. [2] Carlos Coronel, Steven Morris, and Peter Rob, Database Systems: Design, Implementation, and Management, Ninth Edition, Cengage learning, 2012 [3] Abraham Silberschatz, Henry F Korth, S Sudharshan, Database System Concepts", 6th Edition, Tata Mc Graw Hill, 2011.
MOOC/ Web Platforms:	https://archive.nptel.ac.in/courses/106/106/106106093/ https://www.coursera.org/learn/database-design-postgresql https://www.edx.org/certificates/professional-certificate/ibm-sql-nosql-and-relational-database-fundamentals.

IV- Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the database development life cycle	Understand (K2)
CO2	Design relational database using conceptual-to-relational mapping, Normalization	Apply (K3)
CO3	Apply SQL for creation, manipulation and retrieval of data	Apply (K3)
CO4	Develop a database applications for real-time problems	Apply (K3)
CO5	Design and query object-relational databases	Apply (K3)

(Action verb of each CO to be matched with the next mapping table)

V- Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	2	3	3	1	1	-	-	1	2	1	2	1	2	3	3
CO-2	2	3	3	2	1	-	-	2	1	2	2	1	3	2	3
CO-3	2	3	3	2	1	-	-	2	2	3	1	2	2	2	2
CO-4	3	2	2	2	-	-	-	1	1	2	1	2	2	2	2
CO-5	2	3	3	3	-	-	-	2	2	1	1	2	1	2	3

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23AD312- INTELLIGENT SYSTEMS LABORATORY

Prerequisite	Program Name	Sem	Category	L	T	P	C
Problem Solving and PythonProgramming Laboratory	B.Tech AI&DS	III	PCC	0	0	3	1.5
Data Structures Design Laboratory		III	PCC	0	0	3	1.5

II - Course Objectives

1.	To design and implement search strategies
2.	To implement game playing techniques
3.	To implement CSP techniques
4.	To develop systems with logical reasoning
5.	To develop systems with probabilistic reasoning

III - LIST OF EXPERIMENTS

LIST OF EXPERIMENTS **Total Hours: 45 Periods**

1. Implement basic search strategies – 8-Puzzl,8 - Queens problem
2. Implement basic search strategies – Crypt arithmetic
3. Implement A* algorithms
4. Implement Minimax algorithm for game playing (Alpha-Beta pruning)
5. Solve constraint satisfaction problems
6. Implement propositional model checking algorithms
7. Implement forward chaining strategy
8. Implement backward chaining strategy
9. Build naïve Bayes models
10. Implement Bayesian networks and perform inferences
11. Mini-Project

Text Books:	[1] Stuart Russell and Peter Norvig, "Artificial Intelligence – A Modern Approach",Fourth Edition, Pearson Education, 2021.
Reference Books:	[1] Dan W. Patterson, "Introduction to AI and ES", Pearson Education,2007 [2] Kevin Night, Elaine Rich, and Nair B., "Artificial Intelligence", McGraw Hill,2008 [3] Patrick H. Winston, "Artificial Intelligence", Third Edition, Pearson Education, 2006 [4] Deepak Khemani, "Artificial Intelligence", Tata McGraw Hill Education, 2013. [5] Artificial Intelligence by Example: Develop machine intelligence from scratch using real artificial intelligence use cases - by Dennis Rothman, 2018

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MOOC/Web Platforms:	https://nptel.ac.in/courses/106102220 https://www.edx.org/learn/artificial-intelligence/columbia-university-artificial-intelligence-ai https://www.coursera.org/professional-certificates/applied-artifical-intelligence-ibm-watson-ai#courses

IV- Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Design and implement search strategies	Apply (K3)
CO2	Implement game playing techniques	Apply (K3)
CO3	Implement CSP techniques	Apply (K3)
CO4	Develop logical reasoning systems	Apply (K3)
CO5	Develop probabilistic reasoning systems	Apply (K3)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V- Mapping Table Mapping of COs with POs and PSOs

COs/POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO1	2	1	3	3	2	-	-	-	-	-	-	-	3	1	2
CO2	1	2	3	3	2	-	-	-	-	-	-	-	3	1	2
CO3	3	1	3	3	1	-	-	-	-	-	-	-	1	1	2
CO4	2	1	1	1	1	-	-	-	-	-	-	-	2	1	2
CO5	3	1	1	1	1	-	-	-	-	-	-	-	3	1	2

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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Value added Course-I

I - Course Name: 23ADAO1 - Augmented Reality &Virtual Reality (AR &VR)

Prerequisite	Program Name	Sem	Category	L	T	P	C
NIL	B.Tech AI&DS	III	EEC	0	0	2	1

II- Course Objectives

1.	To Understand AR/VR Fundamentals.
2.	To Develop AR Applications with Vuforia.
3.	To Build VR Environments Using Unity.
4.	To Explore SimLab Composer for VR Development
5.	To examine Project-Based Learning.

III- Course Content

Preamble:
Through project-based learning, students will collaborate to explore real-world applications, enhancing their problem-solving and creative skills. By the end of the course, students will be equipped to navigate the evolving landscape of AR and VR, ready to harness these technologies in various industries.

Module - I	INTRODUCTION TO AR/VR AND UNITY BASICS

Introduction to AR/VR- Overview of AR vs. VR-Current trends and applications- Unity Basics- Introduction to the Unity interface- Setting up a new project- Basic Unity components (Game Objects, Components, Scenes)- Creating a Simple Unity Scene- Importing assets- Creating and manipulating Game Objects- Introduction to the Unity Asset Store- Basic Scripting in Unity- Introduction to C# scripting- Writing a simple script to move an object

Module - II	INTRODUCTION TO VUFORIA FOR AR

Setting Up Vuforia in Unity- Installing Vuforia Engine SDK-Configuring Vuforia settings in Unity- Basic AR Setup with Vuforia- Creating an AR Camera- Understanding Image Targets- Working with Image Targets- Adding and configuring Image Targets in Unity- Creating and attaching virtual objects to Image Targets- Testing Vuforia AR Applications- Building and deploying AR applications to mobile devices- Testing Image Targets and interactions.

Module - III	INTRODUCTION TO VR WITH UNITY

Setting Up VR in Unity- Installing XR Plugin Management- Configuring project settings for VR- Basic VR Scene- Setting up a VR camera rig.- Creating a simple VR environment- VR Interactions- Adding basic interactions (grabbing objects)- Using Unity's XR Interaction Toolkit- Optimizing VR Performance- Best practices for performance optimization in VR- Testing VR applications.

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Module -IV	SIM LAB COMPOSER VR BASICS
Introduction to SimLab Composer- Overview of SimLab Composer features- Setting up the workspace- Importing and Preparing Models- Importing models from various formats- Preparing and optimizing models for VR- Creating a VR Experience- Setting up a VR scene in SimLab- Adding interactivity and animations- Exporting and Sharing VR Experiences- Exporting VR projects- Sharing and deploying VR experiences.	
Module - V	**PROJECT DEVELOPMENT AND REVIEW**
Project Planning- Brainstorming session for final project- Defining project scope and objectives- Project Development- Begin developing a small AR or VR project using Unity with Vuforia or SimLab- Applying learned concepts and techniques- Project Development- Continue development with guidance and troubleshooting- Finalizing the project.	
	TOTAL: 30 Periods

IV- Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Identify and discuss current trends and real-world applications of AR and VR technologies.	Understand (K2)
CO2	Summarize the setup and configuration process of Vuforia for AR development.	Apply (K3)
CO3	Describe the setup and optimization techniques for VR environments using Unity.	Apply (K3)
CO4	Design and construct a VR scene using SimLab Composer, integrating interactivity and animations.	Apply (K3)
CO5	Develop a functional AR or VR project using Unity with Vuforia or SimLab Composer.	Apply (K3)

(Action verb of each CO to be matched with the next mapping table)

V-Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	1	1	3	1	1	2	1	1	3	3	3	2	3
CO-2	3	-	-	-	3	-	2	2	-	-	-	2	1	-	1
CO-3	3	1	2	2	3	-	2	-	1	-	2	1	2	2	2
CO-4	3	2	3	2	3	1	1	2	2	-	1	1	2	2	3
CO-5	3	2	3	3	3	2	1	1	2	2	3	2	2	2	3

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23MA401- STATISTICS FOR ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Prerequisite	Program Name	Sem	Category	L	T	P	C
NIL	B.Tech AI&DS	IV	BSC	3	1	0	4

II- Course Objectives

1.	To introduce the basic concepts of probability and random variables.
2.	To introduce the basic concepts of two - dimensional random variables.
3.	To acquaint the knowledge of testing of estimation.
4.	To acquaint the knowledge of non – parametric test.
5.	To introduce the basic concepts of classifications of design of experiments which plays very important roles in the field of agriculture and statistical quality control.

III- Course Content

Preamble: This course is applied to the concept of random variables and non- parametric test in machine learning. An estimation theory applied in measuring empirical data.

Unit – I	**PROBABILITY AND RANDOM VARIABLES**	**12 Periods**

Axioms of probability–Conditional probability–Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.

Unit – II	**TWO- DIMENSIONAL RANDOM VARIABLES**	**12 Periods**

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression – Transformation of random variables.

Unit – III	**ESTIMATION THEORY**	**12 Periods**

Unbiased estimators - Efficiency - Consistency - Sufficiency - Robustness - Method of moments - Method of maximum Likelihood - Interval estimation of Means - Differences between means, variations and ratio of two variances

Unit – IV	**NON- PARAMETRIC TESTS**	**12 Periods**

Introduction - The Sign test - The Signed - Rank test - Rank - sum tests - The U test - The H test - Tests based on Runs - Test of randomness - The Kolmogorov Tests.

Unit – V	**STATISTICAL QUALITY CONTROL**	**12 Periods**

Control charts for measurements ($\bar{x}$ and R charts) – Control charts for attributes (p, c and np charts) – Tolerance limits - Acceptance sampling.

TOTAL : 60 Periods

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Text Books:	1. Johnson. R.A., Miller. I.R and Freund . J.E, " Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 9th Edition, 2016. 2. Veerarajan T., "Probability and Statistic , Random Processes and Queuing Theory", Tata Mc Graw Hill, First Edition, 2018.
Reference Books:	1. Gupta. S.C. and Kapoor. V. K., "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, New Delhi, 12th Edition, 2020. 2. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2014. 3. P.Sivaramakrishna Das , C.Vijayakumari., "Probability and Statistics", Pearson india Education Services Pvt.Ltd , 2nd Edition, 2020.
MOOC/Web Platforms:	https://igppweb.ucsd.edu/~agnew/Courses/Sio223a/sio223a.chap2.pdf http://www.stat.columbia.edu/~liam/teaching/4107-fall05/notes3.pdf https://bcastudyguide.com/unit-6statistical-quality-control/

IV- Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the fundamental knowledge of the concepts of probability and have knowledge of standard distributions which can describe real life phenomenon.	Understand (K2)
CO2	Understand the basic concepts of one and two-dimensional random variables and apply in engineering applications.	Understand (K2)
CO3	Understand the concept of estimation theory.	Understand (K2)
CO4	Apply the concept of non - parametric test.	Apply (K3)
CO5	Apply the notion of sampling distributions and statistical techniques used in engineering and management problems.	Apply (K3)

(Action verb of each CO to be matched with the next mapping table)

V- Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	-	-	-	-	-	-	2	-	-	2	-	-	-
CO-2	3	3	-	-	-	-	-	-	2	-	-	2	-	-	-
CO-3	3	3	-	-	-	-	-	-	2	-	-	2	-	-	-
CO-4	3	3	3	2	-	-	-	-	2	-	-	2	-	-	-
CO-5	3	3	2	2	-	-	-	-	2	-	-	2	-	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23AD401-DATA EXPLORATION AND VISUALIZATION

Prerequisite	Program Name	Sem	Category	L	T	P	C
23GE102 -Problem Solving and Python Programming	B.Tech AI&DS	IV	PCC	3	0	2	4
23AD301-Fundamentals of Data Science and Analytics		IV	PCC	3	0	2	4

II- Course Objectives

1.	To outline an overview of exploratory data analysis.
2.	To implement data visualization using Matplotlib.
3.	To perform univariate data exploration and analysis.
4.	To apply bivariate and multivariate data exploration and analysis.
5.	To use data exploration and visualization techniques for time series data.

III- Course Content

Preamble:

- This course equips with the foundational skills to extract knowledge from data.
- It explores techniques for cleaning, analyzing, and visualizing data to uncover hidden patterns and make data-driven decisions. Throughout the course, students will gain hands-on experience with real-world applications, empowering you to transform data into actionable knowledge.

Unit – I	EXPLORATORY DATA ANALYSIS	9 Periods

EDA fundamentals – Significance of EDA – Making sense of data - Comparing EDA with classical and Bayesian analysis – Software tools for EDA – Visual Aids for EDA- Data transformation techniques-merging database, reshaping and pivoting, Transformation techniques –Grouping Datasets – data aggregation – Pivot tables and cross-tabulations.

Unit – II	VISUALIZING USING MATPLOTLIB	9 Periods

Importing Matplotlib – Simple line plots – Simple scatter plots – visualizing errors – density and contour plots – Histograms – legends – colors – subplots – text and annotation – customization – three dimensional plotting – Geographic Data with Basemap –Advanced visualization tools -Waffle charts- word Clouds-Visualization with Seaborn-case study

Unit – III	UNIVARIATE ANALYSIS	9 Periods

Introduction to Single variable: Distributions and Variables – Numerical Summaries of Level and Spread – Scaling and Standardizing – Inequality – Smoothing Time Series.

Unit – IV	BIVARIATE ANALYSIS AND MULTIVARIATE ANALYSIS	9 Periods

Relationships between Two Variables – Percentage Tables – Analyzing Contingency Tables –Handling Several Batches – Scatterplots and Resistant Lines – Transformations- Introducing a Third Variable – Causal Explanations – Three-Variable Contingency Tables and Beyond – Longitudinal Data

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Unit – V	TIME SERIES ANALYSIS	9 Periods
Fundamentals of TSA – Characteristics of time series data – Data Cleaning – Time-based indexing – Visualizing – Grouping – Resampling. Overview of Tableau and its role in data visualization. Basic Dashboards, Actions and Story Telling in Tableau.		
		TOTAL:45 Periods

PRACTICAL EXERCISES: **30 Periods**

1. Install the data Analysis and Visualization tool: R/ Python /Tableau Public/ Power BI.
2. Perform exploratory data analysis (EDA) on with datasets like email data set. Export all your emails as a dataset, import them inside a pandas data frame, visualize them and get different insights from the data.
3. Working with Numpy arrays, Pandas data frames , Basic plots using Matplotlib.
4. Explore various variable and row filters in R for cleaning data. Apply various plot features in R on sample data sets and visualize.
5. Write a Python program which explains uses of customizing seaborn plots with Aesthetic functions.
6. Perform Time Series Analysis and apply the various visualization techniques.
7. Perform Data Analysis and representation on a Map using various Map data sets with Mouse Rollover effect, user interaction, etc.
8. Build cartographic visualization for multiple datasets involving various countries of the world; states and districts in India etc.
9. Perform EDA on Wine Quality Data Set. Use a case study on a data set and apply the various EDA and visualization techniques and present an analysis report.

Total: 75 Periods

Text Books:	1. Suresh Kumar Mukhiya, Usman Ahmed, Hands-On Exploratory Data Analysis with Python, Packt Publishing, 2020. (Unit 1) 2. Jake Vander Plas, "Python Data Science Handbook: Essential Tools for Working with Data", Oreilly, 1st Edition, 2022. (Unit 2) Catherine Marsh, Jane Elliott, Exploring Data: An Introduction to Data Analysis for Social Scientists, Wiley Publications, 2nd Edition, 2008. (Unit 3,4,5)
Reference Books:	1. Eric Pimpler, Data Visualization and Exploration with R, Geo Spatial Training service, 2017. 2. Claus O. Wilke, "Fundamentals of Data Visualization", O'reilly publications, 2022. 3. Matthew O. Ward, Georges Grinstein, Daniel Keim, "Interactive Data Visualization: Foundations, Techniques, and Applications", 2nd Edition, CRC press, 2015
MOOC/Web Platforms:	https://study.iitm.ac.in/ds/course_pages/BSCS4001.html https://www.coursera.org/learn/datavisualization https://www.edx.org/learn/data-visualization/harvard-university-data-science-visualization

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IV- Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the fundamentals of exploratory data analysis.	Understand (K2)
CO2	Experiment with data visualization using Matplotlib.	Apply (K3)
CO3	Apply univariate data exploration and analysis.	Apply (K3)
CO4	Apply bivariate data exploration and analysis.	Apply (K3)
CO5	Make use of data exploration and visualization techniques for time series data.	Apply (K3)

(Action verb of each CO to be matched with the next mapping table)

V- Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	2	2	2	-	-	-	-	2	3	3	3	2	2	2
CO-2	2	2	2	2	2	-	-	-	3	2	3	1	2	1	2
CO-3	2	3	2	3	2	-	-	-	3	2	1	2	2	2	2
CO-4	2	2	2	3	2	-	-	-	1	2	1	3	1	2	2
CO-5	3	3	2	2	2	-	-	-	3	2	1	2	2	2	2

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23AD402-MACHINE LEARNING

Prerequisite	Program Name	Sem	Category	L	T	P	C
23AD301 - Fundamentals of Data Science and Analytics	B.Tech AI&DS	IV	PCC	3	0	2	4

II- Course Objectives

1.	To understand the basic concepts of machine learning.
2.	To learn to implement supervised machine learning algorithms on standard datasets and evaluate the performance
3.	To experiment the unsupervised machine learning algorithms on standard datasets and evaluate the performance.
4.	To build the graph based learning models for standard data sets.
5.	To compare the performance of different ML algorithms and select the suitable one based on the application

III- Course Content

Preamble:

- This course provides a comprehensive foundation in the principles and methodologies of Machine Learning, empowering to understand how algorithms can learn from data, make data-driven predictions, and ultimately solve complex problems across diverse disciplines.
- This course equips to leverage the power of Machine Learning, transforming data into intelligent systems that solve real-world problems

Unit – I	INTRODUCTION TO MACHINE LEARNING	8 Periods

Introduction and motivation for machine learning; Real time examples of machine learning applications, Introduction to ML workflows: Data collection, preprocessing, model selection, and deployment- Hypothesis spaces, Inductive bias, Generalization, Bias variance trade-off.

Unit – II	SUPERVISED LEARNING	10 Periods

Linear Regression Models: Least squares, single & multiple variables, Bayesian linear regression, gradient descent, Linear Classification Models: Discriminant function – Perceptron algorithm, Probabilistic discriminative model - Logistic regression, Probabilistic generative model – Naive Bayes, Maximum margin classifier- Case Study: Regression Model- Sentiment analysis, fraud detection.

Unit – III	ENSEMBLE TECHNIQUES AND UNSUPERVISED LEARNING	9 Periods

Combining multiple learners: Model combination schemes, Voting, Ensemble Learning - bagging, boosting, stacking, Unsupervised learning: K-means, Instance Based Learning: KNN, Gaussian mixture models and Expectation maximization-Introduction to advanced clustering: DBSCAN-Case Study: Unsupervised learning: Market basket analysis, image segmentation.

Unit – IV	NEURAL NETWORKS	9 Periods

Multilayer perceptron, activation functions, network training – gradient descent optimization – stochastic gradient descent, error back propagation, from shallow networks to deep networks –Unit saturation (aka the vanishing gradient problem) – ReLU, hyperparameter tuning, batch normalization, regularization, dropout. Case Study: Real-world applications: Image classification, speech recognition.

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Unit – V	GRAPHICAL MODELS	9 Periods
Guidelines for machine learning experiments, Cross Validation (CV) and resampling – K-fold CV, bootstrapping, measuring classifier performance, assessing a single classification algorithm and comparing two classification algorithms – t test, McNemar's test, K-fold CV paired t test. Case Study: Best practices for deploying ML models in production environments.		
		TOTAL:45 Periods

PRACTICAL EXERCISES: **30 Periods**

1. For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.
2. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
3. Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.
4. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file and compute the accuracy with a few test data sets.
5. Implement naïve Bayesian Classifier model to classify a set of documents and measure the accuracy, precision, and recall.
6. Write a program to construct a Bayesian network to diagnose CORONA infection using standard WHO Data Set.
7. Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using the k-Means algorithm. Compare the results of these two algorithms.
8. Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions.
9. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select an appropriate data set for your experiment and draw graphs.
10. Applications of dimensionality reduction techniques on any dataset
11. Mini project: Analyze any two supervised / unsupervised machine learning algorithms for any of the following real-time applications:
    (a) Text processing (b) Image processing (c) IoT systems

Total: 75 Periods

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Text Books:	1. Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, Fourth Edition, 2020. 2. Stephen Marsland, "Machine Learning: An Algorithmic Perspective, "Second Edition", CRC Press, 2014
Reference Books:	1. Christopher M. Bishop, "Pattern Recognition and Machine Learning", Springer, 2006. 2. Tom Mitchell, "Machine Learning", McGraw Hill, 3rd Edition, 1997. 3. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, "Foundations of Machine Learning", Second Edition, MIT Press, 2012, 2018. 4. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2016 Sebastain Raschka, Vahid Mirjalili, "Python Machine Learning", Packt publishing, 3rd Edition, 2019
MOOC/Web Platforms:	https://onlinecourses.nptel.ac.in/noc23_cs18 https://www.edx.org/learn/machine-learning/massachusetts-institute-of-technology-machine-learning-with-python-from-linear-models-to-deep-learning https://www.coursera.org/specializations/machine-learning-introduction

IV- Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Gain foundational knowledge of machine learning concepts, applications, theoretical aspects	Understand (K2)
CO2	Apply various supervised learning models for continuous and categorical prediction tasks and evaluate the performance.	Apply (K3)
CO3	Apply ensemble techniques and unsupervised learning to improve model performance and discover hidden patterns in unlabeled data and evaluate the performance.	Apply (K3)
CO4	Design, train, and optimize neural networks to address challenges and improve performance for standard data sets	Apply (K3)
CO5	Design and analyze machine learning experiments using best practices, to evaluate and compare the performance of different ML algorithms and select the suitable one based on the application.	Apply (K3)

(Action verb of each CO to be matched with the next mapping table)

V- Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	2	1	2	1	-	-	-	-	3	-	2	2	2	2	1
CO-2	1	3	3	1	2	-	-	-	2	-	2	1	3	1	1
CO-3	2	1	3	3	2	-	-	-	1	-	1	1	1	2	1
CO-4	2	3	3	2	1	-	-	-	3	-	3	2	1	2	1
CO-5	1	1	3	3	1	-	-	-	3	-	1	3	3	3	2

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23CS906 - ROBOTIC PROCESS AUTOMATION

Prerequisite	Program Name	Sem	Category	L	T	P	C
NIL	B.E./B.TECH. COMMON FOR CSE, IT AND AI&DS	IV	PCC	2	0	2	3

II- Course Objectives

1.	To introduce the fundamental concepts of Robotic Process Automation (RPA) and its evolution in automating business processes.
2.	To enable students to design, sequence, and control automation workflows using RPA tools and techniques
3.	To impart skills in application integration, recording, and data scraping for efficient automation.
4.	To familiarize students with error handling, debugging, and code management for robust RPA solutions.
5.	To equip students with knowledge of bot deployment, orchestration, and maintenance for scalable automation.

III- Course Content

Preamble: Robotic Process Automation (RPA) represents a transformative technology designed to enhance efficiency and accuracy in organizational workflows by automating repetitive and rule-based tasks. By leveraging software robots or "bots," RPA enables the seamless execution of tasks such as data entry, invoice processing, and report generation, minimizing human error and allowing employees to focus on strategic initiatives.

Unit – I	INTRODUCTION TO ROBOTIC PROCESS AUTOMATION	6 Periods

Emergence of Robotic Process Automation (RPA), Evolution of RPA, Differentiating RPA from Automation - Benefits of RPA - Application areas of RPA, Components of RPA, RPA Platforms. Robotic Process Automation Tools

Unit – II	AUTOMATION PROCESS ACTIVITIES	6 Periods

Sequence, Flowchart & Control Flow: Sequencing the Workflow, Activities, Flowchart, Control Flow for Decision making. Data Manipulation: Variables, Collection, Arguments, Data Table, Clipboard management, File operations Controls: Finding the control, waiting for a control, Act on a control, Ui Explorer, Handling Events.

Unit – III	APP INTEGRATION, RECORDING AND SCRAPING	6 Periods

App Integration, Recording, Scraping, Selector, Workflow Activities. Recording mouse and keyboard actions to perform operation, scraping data from website and writing to CSV.

Unit – IV	EXCEPTION HANDLING AND CODE MANAGEMENT	6 Periods

Exception handling, Common exceptions, Logging- Debugging techniques, Error reporting. Code management and maintenance: Project organization, Nesting workflows, Reusability, Templates, Commenting techniques, State Machine, and version control in RPA.

Unit – V	DEPLOYMENT AND MAINTENANCE	6 Periods

Orchestration, Orchestration Server, Control bots, Orchestration Server to deploy bots, License management, Publishing and managing updates. RPA Vendors - Open-Source RPA, Security measures in RPA, Future of RPA

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PRACTICAL EXERCISES: 30 Periods	
1	Setup and Configure a RPA tool and understand the user interface of the tool:
2	Create a Sequence to obtain user inputs display them using a message box.
3	Create a Flowchart to navigate to a desired page based on a condition.
4	Create a State Machine workflow to compare user input with a random number.
5	Build a process in the RPA platform using UI Automation Activities.
6	Create an automation process using key System Activities, Variables and Arguments
7	Also implement Automation using System Trigger
8	Automate login to (web)Email account
9	Recording mouse and keyboard actions.
10	Scraping data from website and writing to CSV
11	Implement Error Handling in RPA platform

Note: The lab instructor is expected to design Problems based on the topics listed. The Examination shall not be restricted to the sample experiments designed.

Total: 60 Periods

Text Books:	1. Alok Mani Tripathi, *Learning Robotic Process Automation*, Packt Publishing (2018), 1sted. 2. Richard Murdoch, *Robotic Process Automation: A Guide for Business Leaders*, Independently Published (2020), 1st ed. 3. Rajesh R and Harish D, *Robotic Process Automation Tools and Techniques*, BPB Publications (2020), 1st ed.
Reference Books:	1. Frank Casale, Introduction to Robotic Process Automation*: A Primer*, Institute for Robotic Process Automation (2016), 1st ed. 2. David Chappell, The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems, Wiley (2020), 1st ed. 3. Debashis Guha, Robotic Process Automation: An Industry Handbook, CRC Press (2021), 1st ed.
MOOC/Web Platforms:	https://nptel.ac.in/courses/108105063 https://academy.uipath.com/learning-plans/automation-developer-professional-training-v2023-10

IV- Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Explain the emergence, evolution, and benefits of RPA in business processes.	Understand (K2)
CO2	Develop and control automated workflows using RPA tools and activities.	Apply (K3)
CO3	Integrate applications, perform data recording and scraping using RPA.	Apply (K3)
CO4	Handle exceptions, debug errors, and manage code in automation projects.	Apply (K3)
CO5	Deploy, manage, and maintain bots in orchestration servers and explore future trends in RPA.	Apply (K3)

(Action verb of each CO to be matched with the next mapping table)

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V- Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	2	-	-	-	2	-	-	-	-	-	-	3	2	-
CO-2	3	3	-	2	-	-	-	-	-	-	-	-	3	3	-
CO-3	-	3	3	-	2	-	-	-	-	-	-	-	3	3	-
CO-4	3	-	3	-	-	-	-	2	-	-	-	-	3	3	-
CO-5	3	-	-	-	2	3	-	-	-	-	-	-	3	2	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23AD404 - NETWORKING ESSENTIALS

Prerequisite	Program Name	Sem	Category	L	T	P	C
NIL	B.Tech AI&DS	IV	PCC	3	0	0	3

II- Course Objectives

1.	To understand the basic layers and its functions in computer networks.
2.	To describe protocols for various functions in the network
3.	To understand the basics of how data flows from one node to another
4.	To analyze the working of various application layer protocols.
5.	To apply security practices for real time applications

III- Course Content

Preamble: Networking Essentials introduces the fundamental concepts and protocols that enable communication between computers and devices in modern digital systems. Covering key topics across the OSI and TCP/IP models, the course explores data transmission, switching, addressing, and core protocols like HTTP, TCP, and DNS. Students gain practical experience through simulation tools such as Cisco Packet Tracer and learn about emerging technologies like 5G, SDN, and IoE. This course builds a strong foundation for careers in networking, cybersecurity, and intelligent systems.

Unit – I	INTRODUCTION AND DATA LINK LAYER	10 Periods

Data Communication -Networks – Network Types- Network Topologies -TCP/IP Protocol suite- OSI Model-: Introduction to Sockets - Data Link Layer – Framing – Flow control – Error control – Data-Link Layer Protocols – HDLC –PPP - Media Access Control Case study: Cisco packet tracer

Unit – II	NETWORKLAYER	9 Periods

Switching: Packet Switching-Circuit switching –Virtual circuit switching Internet protocol - IPV4 - IPV6, ARP, RARP, ICMP, DHCP.

Unit – III	TRANSPORT LAYER	9 Periods

Introduction - Transport-Layer Protocols: UDP – TCP: Connection Management – Flow control - Congestion Control - Congestion avoidance (DECbit, RED) – SCTP – Quality of Service - Network Performance Metrics

Unit – IV	APPLICATION LAYER	8 Periods

Application Layer protocols: HTTP – FTP – Email protocols (SMTP - POP3 - IMAP - MIME) – DNS – SNMP-SOAP (Simple Object Access Protocol)- COAP (Constrained Application Protocol)

Unit – V	NETWORKING TECHNOLOGIES AND SECURITY	9 Periods

Cellular N – 3G, 4G, 5Gand beyond 6G –IDS-Firewalls-DigitalSignatures–EndPointAuthentication-Futuretechnologies-SDN (Software defined network)- Internet of Everything (IoE)-Case Study WANET and MANET

TOTAL:45 **Periods**

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Text Books:	1. James F. Kurose, Keith W. Ross, Computer Networking, A Top-Down Approach Featuring the Internet, Eighth Edition, Pearson Education, 2021. 2. Behrouz A. Forouzan, Data Communications and Networking with TCP/IP Protocol Suite, Sixth Edition TMH, 2022 3. Cryptography and Network Security: Principles and Practice, 6th Edition, William Stallings, 2014, Pearson, ISBN 13:9780133354690
Reference Books:	1. Larry L. Peterson, Bruce S. Davie, Computer Networks: A Systems Approach, Fifth Edition, Morgan Kaufmann Publishers Inc., 2012. 2. William Stallings, Data and Computer Communications, Tenth Edition, Pearson Education, 2013. 3. Nader F. Mir, Computer and Communication Networks, Second Edition, Prentice Hall, 2014. 4. Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, "Computer Networks: An Open Source Approach", McGraw Hill, 2012. 5. Network Security: Private Communications in a Public World, M. Speciner, R. Perlman, C. Kaufman, Prentice Hall, 2002.
MOOC/Web Platforms:	https://onlinecourses.nptel.ac.in/noc25_ee54/preview

IV- Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Explain the basic layers and its functions in computer networks.	Understand (K2)
CO2	Describe protocols for various functions in the network	Understand (K2)
CO3	Understand the basics of how data flows from one node to another	Understand (K2)
CO4	Analyze the working of various application layer protocols.	Apply (K3)
CO5	Apply security practices for real time applications	Apply (K3)

(Action verb of each CO to be matched with the next mapping table)

V- Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	3	1	-	-	-	-	-	-	-	2	3	2	1
CO-2	2	1	1	3	-	-	-	-	-	-	-	2	2	2	2
CO-3	3	2	1	2	-	-	-	-	-	-	-	2	1	3	3
CO-4	3	2	2	2	-	-	-	-	-	-	-	2	2	1	2
CO-5	3	1	2	3	-	-	-	-	-	-	-	2	3	1	3

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23CS905-CLOUD COMPUTING

Prerequisite	Program Name	Sem	Category	L	T	P	C
System software and Operating Systems	B.E./B.TECH. COMMON FOR CSE, IT AND AI&DS	IV	PCC	2	0	2	3

II- Course Objectives

1.	To understand the principles of cloud architecture, models and infrastructure
2.	To understand the concepts of virtualization and virtual machines.
3.	To gain knowledge about virtualization Infrastructure
4.	To explore and experiment with various Cloud deployment environments
5.	To learn about the security issues in the cloud environment.

III- Course Content

Preamble: This course provides a comprehensive understanding of cloud computing concepts, focusing on architecture models, virtualization, storage, deployment environments, and security. It explores foundational topics like cloud service and deployment models, virtualization techniques, and cloud infrastructure design challenges. Additionally, the course covers practical tools and case studies, including Docker, Hadoop, and major cloud platforms, alongside strategies to ensure cloud security and privacy.

Unit – I	CLOUD ARCHITECTURE MODELS AND INFRASTRUCTURE	6 Periods

Cloud Architecture: System Models for Distributed and Cloud Computing – NIST Cloud Computing Reference Architecture – Cloud deployment models – Cloud service models- Cloud Infrastructure– Design Challenges

Unit – II	VIRTUALIZATION BASICS	6 Periods

Virtual Machine – Hypervisor – Key Concepts – Virtualization structure – Virtualization Types: Full Virtualization – Para Virtualization– Hardware Virtualization- Implementation levels of virtualization – Desktop Virtualization – Network Virtualization – Storage Virtualization Case Study: Netflix and Amazon.

Unit – III	CLOUD STORAGE AND DOCKER	6 Periods

Cloud Storage-Storage-as-a-Service-Advantages of Cloud Storage-Cloud Storage Providers- Introduction to Docker – Docker Components – Docker Container – Docker Images and Repositories.

Unit – IV	CLOUD DEPLOYMENT ENVIRONMENT	7 Periods

Cloud deployment -Hadoop-MapReduce-Google App Engine – Amazon AWS – Microsoft Azure; Cloud Software Environments – Eucalyptus- OpenStack.

Unit – V	CLOUD SECURITY	5 Periods

Security and Privacy in Cloud-Specific Attacks: Guest hopping – VM migration attack – hyper jacking. Identity and Access Management (IAM) - IAM Architecture and Practice

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PRACTICAL EXERCISES: **30 Periods**

1. Install Virtualbox/VMware/ Equivalent open-source cloud Workstation with different flavours of Linux or Windows OS on top of windows 8 and above.
2. Install a C compiler in the virtual machine created using a virtual box and execute Simple Programs
3. Install Google App Engine to launch the web applications.
4. Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim.
5. Find a procedure to transfer the files from one virtual machine to another virtual machine.
6. Install Hadoop single node cluster and run simple applications.
7. Creating and Executing a Container Using Docker.

Total 30+30 : 60 Periods

Text Books:	1. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012. 2. James Turnbull, "The Docker Book", O'Reilly Publishers, 2014. 3. Krutz, R. L., Vines, R. D, "Cloud security. A Comprehensive Guide to Secure Cloud Computing", Wiley Publishing, 2010
Reference Books:	1. James E. Smith, Ravi Nair, "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 2005. 2.Tim Mather, Subra Kumaraswamy, and Shahed Latif, "Cloud Security and Privacy: an enterprise perspective on risks and compliance", O'Reilly Media, Inc., 2009.
MOOC/Web Platforms:	https://onlinecourses.nptel.ac.in/noc25_cs11/preview

IV- Course Outcome

On completion of the course, the students will be able to		**Bloom's Level Mapped**
CO1	Understand the design challenges in the cloud.	Understand (K2)
CO2	Apply the concept of virtualization and its types.	Apply (K3)
CO3	Experiment with virtualization of hardware resources and Docker.	Apply (K3)
CO4	Develop and deploy services on the cloud and set up a cloud environment.	Apply (K3)
CO5	Explain security challenges in the cloud environment.	Understand (K2)

(Action verb of each CO to be matched with the next mapping table)

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V- Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	2	1	1	1	-	-	-	2	3	1	3	2	2	1
CO-2	3	1	2	2	1	-	-	-	1	2	1	3	3	2	2
CO-3	2	3	2	3	1	-	-	-	3	1	1	3	2	3	2
CO-4	1	2	3	3	3	-	-	-	3	3	1	2	2	3	2
CO-5	2	3	3	1	3	-	-	-	2	2	1	2	3	2	2

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23GE901 ENVIRONMENTAL SCIENCES AND SUSTAINABILITY

Prerequisite	Program Name	Sem	Category	L	T	P	C
NIL	B.E./B.TECH. COMMON FOR CSE, IT AND AI&DS	IV	BSC	2	0	0	2

II- Course Objectives

1.	To introduce the basic concepts of environment, ecosystems and biodiversity and emphasize on the biodiversity of India and its conservation.
2.	To impart knowledge on the causes, effects and control or prevention measures of environmental pollution.
3.	To study the dynamic processes and understand the features of the earth's interior and surface.
4.	To facilitate the understanding of global and Indian scenario of renewable and nonrenewable resources, causes of their degradation and measures to preserve them.
5.	To inculcate and embrace sustainability practices and develop a broader understanding on green materials, energy cycles and analyze the role of sustainable urbanization.

III- Course Content

Preamble: The objective of this course is intended to make the students to understand the basic concepts of environment, ecology and pollution of the current environmental issues and to participate in various activities on conserving and protecting the environment.

Unit – I	ENVIRONMENT AND BIODIVERSITY	6 Periods

Definition, scope and importance of environment – need for public awareness. Eco-system and energy flow – ecological succession. Types of biodiversity: genetic, species and ecosystem diversity– values of biodiversity, India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: in-situ and ex-situ.

Unit – II	ENVIRONMENTAL POLLUTION	6 Periods

Causes, effects and preventive measures of water, soil, air and noise pollutions. Solid, hazardous and e-waste management. case studies on occupational health and safety management system (OHASMS). Environmental protection - environmental protection acts.

Unit – III	SOCIAL ISSUES AND THE ENVIRONMENT	6 Periods

Water conservation, rain water harvesting, watershed management – Issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies.

Unit – IV	RENEWABLE SOURCES OF ENERGY	6 Periods

Energy management and conservation, new energy sources: need of new sources. Different types new energy sources. Applications of - hydrogen energy, ocean energy resources, tidal energy conversion. Concept, origin and power plants of geothermal energy.

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Unit – V	SUSTAINABILITY PRACTICES	6 Periods
Zero waste and R concept, circular economy, ISO 14000 series, material life cycle assessment, environmental impact assessment. Sustainable habitat: green buildings, green materials, energy efficiency, Sustainable transports. Sustainable energy: non-conventional sources, energy cycles carbon cycle, emission and sequestration, green engineering: sustainable urbanization - socio economical and technological change.		

Total : 30 Periods

Text Books:	1. Anubha Kaushik and C. P. Kaushik's 'Perspectives in Environmental Studies', 6th Edition, New Age International Publishers, 2018. 2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2017. 3. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004. 4. Allen, D. T. and Shonnard, D. R., 'Sustainability Engineering: Concepts, Design and Case Studies', Prentice Hall. 5. Bradley. A.S; Adebayo, A.O., Maria, P. 'Engineering applications in sustainable design and development', Cengage learning. 6. Environment Impact Assessment Guidelines, Notification of Government of India, 2006.
Reference Books:	1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media, 2010. 2. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, Third Edition, 2015. 3. Erach Bharucha'Textbook of Environmental Studies for Under graduate Courses' Orient Blackswan Pvt. Ltd. 2021.
MOOC/Web Platforms:	https://onlinecourses.nptel.ac.in/

IV- Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	To recognize and understand the functions of environment, ecosystems and biodiversity and their conservation	Remember(K1)
CO2	To identify the causes, effects of environmental pollution and natural disasters and contribute to the preventive measures in the society.	Understand (K2)
CO3	To identify the causes, effects of natural disasters and contribute to the preventive measures in the society.	Apply (K3)
CO4	To identify and apply the understanding of renewable and non-renewable resources and contribute to the sustainable measures to preserve them for future generations.	Understand (K2)
CO5	To demonstrate the knowledge of sustainability practices and identify green materials, energy cycles and the role of sustainable urbanization.	Apply (K3)

(Action verb of each CO to be matched with the next mapping table)

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V- Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	2	1	-	-	-	2	3	-	1	-	-	2	-	-	-
CO-2	3	2	-	-	-	3	3	-	1	-	-	2	-	-	-
CO-3	3	1	1	-	-	2	2	-	-	-	-	2	-	-	-
CO-4	3	1	1	1	-	2	2	-	1	-	-	2	-	-	-
CO-5	3	2	1	-	-	2	2	-	1	-	-	1	-	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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Value added Course-II

I - Course Name: 23ADAO2 Data Analytics & AI Tools

Prerequisite	Program Name	Sem	Category	L	T	P	C
NIL	B.Tech AI&DS	IV	EEC	0	0	2	1

II- Course Objectives

1.	To introduce the fundamentals of data analytics and AI-driven tools.
2.	To explore the capabilities of ChatGPT for productivity, coding, and task automation.
3.	To use Power BI for data modeling, dash boarding, and business insights.
4.	To develop data visualizations and comparative analytics using Tableau Public.
5.	To enhance learning through hands-on projects and real-world applications.

III- Course Content

Preamble:
This course provides hands-on training in data analytics tools powered by AI. Students will gain practical experience using ChatGPT for automation and productivity, Power BI for business intelligence, and Tableau for advanced visualizations. By the end of the course, students will be able to build and present insightful analytics projects.

Module - I	AI Foundations and ChatGPT Basics

Overview of AI and Natural Language Processing (NLP)-Introduction to ChatGPT and Large Language Models-Prompt Engineering: Writing effective prompts-Text generation, summarization, and paraphrasing-Role-based prompting, Chain-of-thought, Few-shot techniques-Customizing and formatting ChatGPT outputs

Module - II	Productivity and Coding with ChatGPT

Using ChatGPT for emails, reports, and document drafting-Debugging and code refactoring using AI-Writing automation scripts with ChatGPT assistance-ChatGPT API basics and workflow integration-Ethical considerations and responsible AI use

Module - III	Data Analysis and Visualization with Power BI

Introduction to Business Intelligence and Power BI-Connecting to various data sources (Excel, Databases, Web)-Data transformation using Power Query-Data modeling and defining relationships-Basics of DAX (Data Analysis Expressions)-Creating reports, visualizations, and charts

Module -IV	Advanced Power BI Dashboards

Advanced DAX functions and measures-Building interactive dashboards with slicers, filters-Publishing reports on Power BI Service-Performance optimization and design best practices-Real-world use cases and data storytelling

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Module - V	Tableau Public & Capstone Project
Introduction to Tableau Public and comparison with Power BI-Connecting to data sources and preparing data-Creating charts and interactive dashboards in Tableau-Comparative study: Power BI vs. Tableau in different industries-Mini project development using Power BI or Tableau-Final review and project presentations	
	TOTAL: 30 Periods

IV- Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the basics of AI, NLP, and prompt engineering with ChatGPT.	Understand (K2)
CO2	Apply ChatGPT for productivity enhancement and coding automation tasks.	Apply (K3)
CO3	Use Power BI for data extraction, modeling, and dashboard creation.	Apply (K3)
CO4	Build interactive and optimized dashboards using advanced Power BI features.	Apply (K3)
CO5	Create and present analytics projects using Power BI or Tableau.	Apply (K3)

(Action verb of each CO to be matched with the next mapping table)

V-Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	2	1	-	3	1	2	-	1	2	-	2	2	1	2
CO-2	3	2	2	2	3	-	1	-	1	-	2	1	2	2	2
CO-3	3	2	3	2	3	1	2	-	2	1	2	2	3	2	3
CO-4	3	-	3	3	3	1	-	-	2	1	1	2	3	3	3
CO-5	3	2	3	3	3	2	1	1	3	3	3	3	3	3	3

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23AD501 DEEP LEARNING

Prerequisite	Programme Name	Sem	Category	L	T	P	C
23AD402 - Machine Learning	B.Tech AI&DS	V	PCC	3	0	2	4

II - Course Objectives

1.	To understand and need and principles of deep neural networks.
2.	To understand CNN and RNN architectures of deep neural networks.
3.	To comprehend advanced deep learning models.
4.	To learn the evaluation metrics for deep learning models.

III - Course Content

Preamble: This course introduces the fundamentals of deep learning, starting with core concepts in linear algebra, probability, and optimization. It explores deep network architectures including CNNs, RNNs, and generative models like VAEs and Gans. Emphasis is placed on regularization, hyper parameter tuning, and real-world applications across domains.

Unit – I	INTRODUCTION TO DEEP NETWORKS BASICS	9 Periods

Linear Algebra: Scalars - Vectors - Matrices and tensors; Probability Distributions - Gradient-based Optimization. Deep Networks: Deep feed forward networks; Regularization – Optimization- Issues and Challenges in Deep Learning, Relation and Differences among Deep learning, Neural Networks, Machine Learning, Artificial Intelligence-Explainable AI (XAI) for Deep Neural Networks in Critical Applications

Unit – II	CONVOLUTIONAL NEURAL NETWORKS AND REGULARIZATION TECHNIQUES	9 Periods

Convolution Operation-Sparse Interactions - Parameter Sharing - Equivariance - Pooling - Convolution Variants: Strided - Tiled - Transposed and dilated convolutions; Convolutional Neural Networks Architecture, CNN representations: Nonlinearity Functions - Loss Functions -Optimizers - Gradient Computation. Case study of ImageNet challenge -LeNet, AlexNet, VGG, GoogLeNet, ResNet, InceptionNet, EfficientNet.

Unit – III	RECURRENT NEURAL NETWORKS	9 Periods

Unfolding Graphs - RNN Design Patterns: Acceptor - Encoder –Transducer - Sequence Modeling Conditioned on Contexts - Bidirectional RNN – Deep Recurrent Networks - Recursive Neural Networks - Long Term Dependencies; Leaky Units: Skip connections and dropouts; Gated Architecture: LSTM. Restrictive Boltzmann Machines (RBMs)- Gibbs Sampling

Unit – IV	MODEL EVALUATION AND IMPLICATIONS OF DEEP LEARNING	9 Periods

Performance metrics - Baseline Models - Hyperparameters: Manual Hyperparameter - Automatic Hyperparameter - Grid search -- Random search - Debugging strategies-Case studies on Deep Learning in Healthcare, Weather Forecasting, Business Intelligence, Biometrics.

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Unit – V	DEEP LEARNING OPTIMIZATION AUTOENCODERS	9 Periods
Undercomplete, Regularized, Stochastic encoders/decoders, and Learning strategies-Generative Models: Variational Autoencoders (VAEs), Generative Adversarial Networks (GANs)-Deep Learning Frameworks and Libraries:PyTorch, TensorFlow, Keras, Theano, Caffe- NVIDIA DGX Systems: High-Performance Computing for Deep Learning		

Total: 45 Periods

PRACTICAL EXERCISES: **30 Periods**

1. Solving XOR problem using DNN.
2. Character recognition using CNN.
3. Face recognition using CNN.
4. Language modeling using RNN.
5. Sentiment analysis using LSTM.
6. Parts of speech tagging using Sequence to Sequence architecture.
7. Machine Translation using Encoder-Decoder model.
8. Image augmentation using GANs,
9. Mini-project on real world applications.

Note: The lab instructor is expected to design Problems based on the topics listed. The Examination shall not be restricted to the sample experiments designed.

Total : 45+30 =75 Periods

Text Books:	1. Ian Goodfellow, YoshuaBengio and Aaron Courville, " Deep Learning", MIT Press, 2017. 2. Josh Patterson, Adam Gibson "Deep Learning: A Practitioner's Approach", O'Reilly Media, 2017. 3. Umberto Michelucci "Applied Deep Learning. A Case-based Approach to Understanding Deep Neural Networks" Apress, 2018.
Reference Books:	1. Andrew Glassner, "Deep Learning: A Visual Approach", No Starch Press, 2021. 2. Deep Learning with Python, Francois Chollet, Manning 2017.
MOOC/Web Platforms:	https://onlinecourses.nptel.ac.in/noc20_cs62/preview https://www.coursera.org/specializations/deep-learning https://www.edx.org/learn/deep-learning https://www.youtube.com/c/deeplizard

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IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the core concepts of deep learning, including neural Network architectures, learning mechanisms, and activation functions.	Understand (K2)
CO2	Apply Convolution Neural Network for image processing.	Apply (K3)
CO3	Apply Recurrent Neural Network and its variants for text analysis.	Apply (K3)
CO4	Apply model evaluation for various applications.	Apply (K3)
CO5	Apply autoencoders and generative models for suitable applications.	Apply (K3)

(Action verb of each CO to be matched with the next mapping table)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PSO-1	PSO-2	PSO-3
CO-1	3	2	2	3	1	-	-	-	2	3	1	3	3	3
CO-2	2	2	2	3	3	-	-	-	1	2	2	1	1	3
CO-3	3	3	3	3	3	-	-	-	2	1	1	2	1	3
CO-4	3	3	1	1	1	-	-	-	1	3	1	2	1	1
CO-5	3	2	2	2	3	-	-	-	2	3	2	2	3	3

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23AD502 DATA AND INFORMATION SECURITY

Prerequisite	Programme Name	Sem	Category	L	T	P	C
NIL	B.Tech AI&DS	V	PCC	3	0	0	3

II - Course Objectives

1.	To understand the basics of Information Security
2.	To know the legal, ethical and professional issues in Information Security
3.	To equip the students' knowledge on digital signature.
4.	To prepare the students' knowledge on IP security.
5.	To understand the requirements and application of web security

III - Course Content

Preamble: This course provides foundational knowledge in Information Security, covering key concepts, system components, and security models. It explores threats, attacks, and the legal and ethical aspects of cyber security. Emphasis is placed on security policies and structured development processes like SDLC. The course prepares students to understand and implement effective security measures in digital environments.

Unit – I	INTRODUCTION	9 Periods
History, What is Information Security?, Critical Characteristics of Information, NSTISSC Security Model, Components of an Information System, Securing the Components, Balancing Security and Access, The SDLC, The Security SDLC.		
Unit – II	**SECURITY INVESTIGATION**	**9 Periods**
Need for Security, Business Needs, Threats, Attacks, Legal, Ethical and Professional Issues - An Overview of Computer Security- Access Control Matrix,Policy-Security policies, Confidentiality policies, Integrity policies and Hybrid policies .		
Unit – III	**DIGITAL SIGNATURE AND AUTHENTICATION**	**10 Periods**
Digital Signatures: Concepts, RSA/ECDSA/ EdDSA, Digital Signature Standards (DSS), Authentication: Overview- Requirements Protocols - Kerberos - MFA (Multi-Factor Authentication), PKI & Certificate Management: CAs, Certificate Lifecycle, CRL/OCSP-PKI in HTTPS, VPNs, Email.		
Unit – IV	**IP SECURITY**	**7 Periods**
IP Security:IP Security: Overview- Architecture - ESP, AH Protocols IPSec Modes – Security association – Key management. Case Study: Securing Intra-Campus Communcation Using IPSec in a NPRGI Network.		

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Unit – V	WEB SECURITY	10 Periods
Web Security: Requirements- Secure Sockets Layer- Objectives-Layers -SSL secure communication- Protocols - Transport Level Security. Web Application Security – OWASP Top 10:Introduction to OWASP and its significance - Overview of common web vulnerabilities :SQL Injection- Cross-Site Scripting (XSS)- Broken Authentication -Security Misconfigurations-Cross-Site Request Forgery (CSRF), etc.		

Total: 45 Periods

Text Books:	1. Michael E Whitman and Herbert J Mattord, "Principles of Information Security",Cengage , 7th Edition, 2022. 2. Stallings William. Cryptography and Network Security: Principles and Practice, Seventh Edition, Pearson Education, 2023.
Reference Books:	1. Harold F. Tipton, Micki Krause Nozaki,, "Information Security Management Handbook, Volume 6, 6th Edition, 2016. 2. Stuart McClure, Joel Scrambray, George Kurtz, "Hacking Exposed", McGraw- Hill, Seventh Edition, 2012. 3. Matt Bishop, "Computer Security Art and Science, Addison Wesley Reprint Edition, 2015. 4. Behrouz A Forouzan, Debdeep Mukhopadhyay, Cryptography And network security, 3rd Edition, McGraw-Hill Education, 2015
MOOC/Web Platforms:	https://archive.nptel.ac.in/courses/106/106/106106129/ https://www.ibm.com/docs/en/i/7.4?topic=concepts-ip-security-protocols

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Demonstrate the basics of data and information security	Understand (K2)
CO2	Explain the legal, ethical and professional issues in information security	Understand (K2)
CO3	Explain how digital signatures and authentication methods are used to secure systems.	Understand (K2)
CO4	Summarize various security practices and system security standards.	Understand (K2)
CO5	Describe web security protocols and how they protect online applications.	Understand (K2)

(Action verb of each CO to be matched with the next mapping table)

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V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	2	2	2	1	-	-	-	-	1	2	1	2	2	1	1
CO-2	1	2	2	2	-	-	-	-	1	2	2	2	1	2	2
CO-3	2	2	2	2	-	-	-	-	1	2	1	2	1	2	1
CO-4	2	2	1	1	-	-	-	-	2	1	1	2	2	2	2
CO-5	2	2	2	2	-	-	-	-	1	2	1	2	2	2	1

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23CS903 EMBEDDED SYSTEMS AND IOT

Prerequisite	Programme Name	Sem	Category	L	T	P	C
NIL	B.E/B.Tech. – Common to CSE, IT and AI&DS	V	PCC	3	0	2	4

II - Course Objectives

1.	To provide foundational knowledge of embedded systems, microcontroller architecture, and instruction sets.
2.	To introduce the ARM Cortex processor and its peripheral programming for real-time applications.
3.	To develop hands-on skills in Arduino and Raspberry Pi programming for IoT applications.
4.	To explore various IoT communication protocols such as BLE, ZigBee, LoRa, and their implementation.
5.	To enable students to design and prototype IoT-based solutions for domains like healthcare, smart agriculture, and home automation

III - Course Content

Preamble:
This course introduces the basics of Embedded Systems and IoT, focusing on microcontroller architecture and programming. It covers platforms like 8051, ARM Cortex, Arduino, and Raspberry Pi with hands-on interfacing techniques. Students will apply these concepts to develop real-time applications in domains like healthcare, agriculture, and smart cities.

UNIT–I	INTRODUCTION TO EMBEDDED SYSTEMS AND MICROCONTROLLER	9 Periods

Introduction to Embedded Systems –Structural units in Embedded processor - selection of processor – Overview of 8/16 bit Microprocessors – Microcontroller for an Embedded System- 8051 Microcontroller – Architecture, Addressing Modes, Instruction Set- Memory Interfacing of 8051 – Stacks – Interrupts – Timers/Counters – Serial Ports – Programming.

UNIT–II	ARM PROCESSOR	9 Periods

ARM Processor – Instruction Set Preliminaries – CPU – Programming Input and Output –Supervisor Mode – Exceptions and Trap – Models for programs – Assembly, Linking and Loading – Compilation Techniques – Program Level Performance Analysis.

UNIT–III	ARDUINO PROGRAMMING	9 Periods

Introduction to the Arduino, Types of Arduino – Arduino Toolchain – Arduino Programming Structure – Sketches - Using the Arduino IDE – Arduino Shield - Integration of Sensors and Actuators with Arduino.

UNIT–IV	IOT COMMUNICATION	9 Periods

Introduction to the Concept of IoT Devices – IoT Devices Versus Computers – IoT Configurations – Basic Components- Introduction to the Concept of IoT Devices – IoT Devices Versus Computers – IoT Configurations - Communications, RFID and NFC (Near-Field Communication), Bluetooth, WiFi, LiFi, 6LowPAN, ZigBee, Raspberry Pi – Architecture – Programming – Interfacing – Connecting to the Cloud.

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UNIT–V	EMBEDDED SYSTEM AND IOT APPLICATIONS	9 Periods
Embedded System Design Process – Development of IoT Applications – Home Automation –Smart Agriculture – Smart Cities –Health care monitoring systems, Model Train Controller.		

Total : 45+30 =75 Periods

PRACTICAL EXERCISES:

Experiments using 8051

1. Programming Arithmetic and Logical Operations in 8051.
2. Programming using On-Chip ports in 8051.
3. Programming using Serial Ports in 8051.

Experiments using Processors

4. Introduction to Arduino platform and programming
5. Exploring Communication with IoT Devices Using Bluetooth
6. Introduction to Raspberry PI platform
7. Setup a cloud platform to log the data
8. Setting up an IoT device for cloud-based data logging
9. Interfacing ADC and DAC using ARM
10. Interfacing keyboard using ARM

Text Books:	1. Muhammed Ali Mazidi, Janice Gillispie Mazidi, Rolin D. McKinlay, "The 8051 Microcontroller and Embedded Systems", Pearson Education, Second Edition, 2014 2. Marilyn Wolf, "Computers as Components – Principles of Embedded Computing System Design", 3rd Edition, Morgan Kaufmann, 2012.
Reference Books:	1. Adesh Kumar, Surajit Mondal, Gaurav Verma, and Prashant Mani, "Embedded Devices and Internet of Things", 1st Edition, CRC Press, Boca Raton, Florida, 2024. 2. Arshdeep Bahga, Vijay Madisetti, —Internet of Things – A hands-on approach‖, UniversitiesPress, 2015 3. The 8051 Microcontroller and Embedded Systems by Kenneth J. Ayala, 2nd Edition, 2004, Cengage Learning. 4. Raj Kamal, 'Embedded System-Architecture, Programming, Design', Mc Graw Hill, 2013. 5.Lyla B.Das, Embedded Systems: An Integrated Approach, Pearson Education, 2013
MOOC/Web Platforms:	• https://onlinecourses.nptel.ac.in/noc20_cs14/preview Embedded Systems Design, Prof. Anupam Basu, IIT Kharagpur • https://onlinecourses.nptel.ac.in/noc22_cs53/preview Introduction To Internet Of Things, Prof. Sudip Misra, IIT Kharagpur

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IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Explain the architecture and features of 8051.	Understand (K 2)
CO2	Apply ARM processor architecture and programming concepts.	Apply (K3)
CO3	Develop Arduino-based IoT applications using sensors, actuators, and communication interfaces	Apply (K3)
CO4	Use IoT communication protocols with Raspberry Pi for device connectivity and cloud integration.	Apply (K3)
CO5	Design and evaluate real-time embedded and IoT-based solutions for smart agriculture, healthcare, smart cities, and industrial automation.	Analyze (K4)

(Action verb of each CO to be matched with the next mapping table)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO - 1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	3	2	2	-	-	-	-	-	2	2	3	3	3
CO-2	3	3	3	2	2	-	-	-	-	-	2	2	3	3	3
CO-3	3	3	3	2	2	-	-	-	-	-	2	2	3	3	3
CO-4	3	3	3	2	2	-	-	-	-	-	2	2	3	3	3
CO-5	3	3	3	2	2	-	-	-	-	-	2	2	3	3	3

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23AD511 Summer Internship-I

Prerequisite	Programme Name	Sem	Category	L	T	P	C
NIL	B.Tech AI&DS	V	EEC	0	0	0	2

II- Course Objectives

1.	Gain exposure **to** AI & Data Science–based industries, research labs, and startups.
2.	Understand basic industry practices, workflows, tools, and professional ethics.
3.	Apply foundational knowledge of data analytics and machine learning to real-world problems.
4.	Develop teamwork, communication, and problem-solving skills in a professional environment.
5.	Prepare structured technical documentation and presentations related to internship work.

III – Guidelines **TOTAL: 4 Weeks**

1. Students shall undergo the internship only in approved companies/organizations relevant to their domain.
2. A minimum duration of 4 weeks is mandatory; attendance must be certified by the industry mentor.
3. Students shall submit an Internship Request/ Bonafide Letter approved by the principal through department before starting.
4. Students shall complete the internship before the starting of the classes for VII Semester and may attend for 1 week after reopening with proper permission from the principal if required.
5. Students shall strictly follow the company's code of conduct, working Periods, and confidentiality rules.
6. Any change in internship location/duration must receive prior approval from the department.
7. On completion, students must submit the following:
    - Completion certificate
    - Internship report
    - Presentation
8. Evaluation will be based on industry feedback, report quality, viva-voce, and presentation.

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IV- Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Identify AI&DS industry practices, tools, technologies, and organizational processes.	Understand (K 2)
CO2	Apply basic data preprocessing, analytics, and machine learning techniques.	Apply (K3)
CO3	Execute assigned tasks effectively by following professional and ethical practices.	Apply (K3)
CO4	Demonstrate teamwork, communication, and time-management skills.	Analyze (K4)
CO5	Prepare and present a well-structured internship report.	Analyze (K4)

(Action verb of each CO to be matched with the next mapping table)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	2	2	-	-	2	-	-	-	-	-	-	2	2	2	
CO-2	3	3	2	2	3	-	-	-	-	-	-	-	3	2	2
CO-3	2	2	2	-	-	2	2	3	3	2	-	-	-	-	-
CO-4	-	-	-	-	-	-	-	-	3	3		2	-	-	-
CO-5	-	-	-	-	-	-	-	-	2	3		2	-	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name:23AD901 - Big Data Analytics

Prerequisite	Program Name	Sem	Category	L	T	P	C
Nil	B.Tech. – AI&DS	VI	PCC	2	0	2	3

II - Course Objectives

1	Students will learn to trace the evolution of Big Data platforms, and identify Components used in modern Big Data applications.
2	Students will compare different NoSQL database types (e.g. key-value, document, graph, column- family) and apply schema design strategies.
3	Students will develop and test data processing jobs using MapReduce and Spark frameworks.
4	Students will manage data storage effectively using HDFS and modern file systems.
5	Students will use tools such as HBase, Hive, Pig, Flink, and NiFi to build scalable data analytics and processing pipelines.

III - Course Content

Preamble: To successfully learn this course, students are expected to have a solid foundation in Data Structures, Database Management Systems, Operating Systems, and Computer Networks. They should be familiar with basic programming concepts in C/Python/Java, along with knowledge of SQL queries and object-oriented programming principles. A prior understanding of cloud computing basics, probability and statistics, and problem-solving skills will help in grasping analytical and distributed processing concepts.

Unit – I	FOUNDATIONS OF BIG DATA AND EMERGING TRENDS	6 Periods

Introduction to Big Data – Definition, Characteristics (Volume, Velocity, Variety, Veracity, Value)-Convergence of Key Trends: IoT, AI, Cloud, Edge Computing-Types of Data: Structured, Semi-structured, Unstructured-Real-world Applications of Big Data in Healthcare, Finance, Retail, and Smart Cities-Web and Social Media Analytics – Sentiment Analysis, Clickstream Analytics- Introduction to Big Data Platforms – Hadoop Ecosystem Overview-Introduction to Edge and Fog Computing in Big Data-Role of Generative AI in Big Data Analysis

Unit – II	NoSQL DATABASES AND DATA MODELS	6 Periods

Introduction to NoSQL: Concepts, Types, Use Cases-Key-Value Stores, Document Databases, Column-family, Graph Databases-Modern NoSQL Systems: MongoDB, Neo4j, Amazon DynamoDB-Schema Evolution and Schemaless Design Principles-Data Replication and Consistency: CAP Theorem-Introduction to Time-Series Databases and Use in Real-time Analytics-Overview of Apache Cassandra: Data Model and Use Cases-Introduction to Database Sharding and Horizontal Scalability

Unit – III	DATA PROCESSING WITH HADOOP AND SPARK	6 Periods

MapReduce Programming Model – Concepts, Workflows-Job Execution in Hadoop YARN- Advanced Data Processing: Apache Spark Overview and Comparison with MapReduce-RDDs and DataFrames in Spark – Basic Transformations and Actions-Spark SQL and Integrating with Hive- Testing and Debugging with MRUnit and Spark Testing Tools-Fault Tolerance and Job Scheduling in Distributed Systems-Introduction to PySpark and Real-time Data Processing with Spark Streaming

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Unit – IV	BIG DATA STORAGE	6 Periods
Data Formats: JSON, XML, Avro, Parquet, ORC-Hadoop Distributed File System (HDFS) – Architecture, Data Flow, Fault Tolerance-Compression Techniques and Performance Optimization in Hadoop-Serialization in Hadoop – Avro and Protocol Buffers-Introduction to Delta Lake and Lakehouse Architecture-HDFS vs Cloud Storage Systems – AWS S3, Google Cloud Storage-Hadoop and Cassandra Integration – Use Cases and Performance Trade-offs- Introduction to Iceberg and Apache Arrow for Efficient Data Analytics.		
Unit – V	**BIG DATA TOOLS AND FRAMEWORKS**	**6 Periods**
Apache HBase: Architecture, Data Model, Client API, Use Cases-Hive: HiveQL – DDL, DML, Querying, UDFs-Apache Pig: Grunt Shell, Pig Latin, Complex Data Types, Scripts-Introduction to Apache Flink – Real-time Stream Processing-Data Integration Tools – Apache NiFi, Apache Airflow-Big Data Visualization – Integrating with Power BI, Tableau-Overview of Kubernetes and Docker for Big Data Deployments-Ethics and Privacy in Big Data Analytics		

Total: 30 Periods

PRACTICAL EXERCISES:

1. Download and install Hadoop in pseudo-distributed mode; run startup scripts and explore configuration files.
2. Perform file management tasks in Hadoop: add, retrieve, and delete files/directories using HDFS commands.
3. Implement Matrix Multiplication using Hadoop MapReduce.
4. Run a Word Count MapReduce program to understand the MapReduce paradigm.
5. Install Hive and create tables to run practice queries including joins and partitions.
6. Install HBase and Thrift; perform basic CRUD operations using HBase shell and REST API.
7. Use Apache Sqoop to import data from a MySQL database into Hadoop and export data back to MySQL

Total: 30 Periods

Total Periods: 30+30 =60 Periods

Text Books:	1. Michael Minelli, Michelle Chambers, and AmbigaDhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013. 2. Eric Sammer, "Hadoop Operations", O'Reilley, 2012. 3. Sadalage, Pramod J. "NoSQL distilled", 2013
Reference Books:	1. Tom White, Hadoop: The Definitive Guide, 4th Edition, O'Reilly Media, 2020 2. Chuck Lam, Hadoop in Action, 2nd Edition, Manning Publications, 2021 3. Holden Karau et al., Learning Spark: Lightning-Fast Big Data Analysis, 2nd Edition, O'Reilly Media, 2020 4. Jules S. Damji et al., Spark: The Definitive Guide, O'Reilly Media, 2020
MOOC/Web Platforms:	https://onlinecourses.nptel.ac.in/noc25_cs131/preview

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IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the evolution and components of Big Data platforms, including modern applications.	Understand (K2)
CO2	Compare and apply NoSQL databases and schema design strategies.	Understand (K2)
CO3	Develop and test data processing jobs using MapReduce and Spark.	Apply (K3)
CO4	Manage data storage using HDFS and modern file systems	Apply (K3)
CO5	Use tools like HBase, Hive, Pig, Flink, and NiFi for scalable data analytics and processing.	Analyze (K4)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	2	-	-	1	-	-	-	-	2	-	-	3
CO2	3	3	-	2	-	-	-	-	-	-	-	3	-	-	3
CO3	2	3	-	3	-	-	-	-	-	-	-	3	-	-	2
CO4	2	2	-	3	-	-	-	-	-	-	-	2	-	-	2
CO5	2	3	-	3	-	-	-	-	-	-	-	3	-	-	2

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23AD601 Advanced Python

Prerequisite	Program Name	Sem	Category	L	T	P	C
23GE102 - Problem Solving and Python Programming	B.Tech AI&DS	VI	PCC	2	0	2	3

II - Course Objectives

1.	To teach advanced Python programming features for writing efficient and modular code.
2.	To enable students to handle, preprocess, and visualize data using Python libraries.
3.	To introduce machine learning techniques and model building using Python frameworks.
4.	To develop skills in automation, API integration, web scraping, and database connectivity.
5.	To guide students in creating, testing, and deploying complete Python applications.

III - Course Content

Preamble: This course introduces advanced Python programming techniques essential for modern software, data, and AI-driven applications. It covers functional programming, object-oriented concepts, and efficient data handling with industry-standard libraries. Students learn machine learning model development, API integration, automation, and performance optimization. The course also enables learners to build, test, and deploy real-world applications using contemporary Python frameworks and cloud technologies.

Unit - I	ADVANCED PYTHON PROGRAMMING	6 Periods

Advanced Python features: Iterators, generators, decorators, context managers – Functional programming concepts: lambda, map(), filter(), reduce() – Object Oriented Programming in Python: inheritance, polymorphism, abstraction – Advanced exception handling and logging

Unit - II	DATA HANDLING AND VISUALIZATION	6 Periods

File handling and serialization using CSV, JSON and Pickle – Working with large datasets using NumPy and Pandas – Data cleaning, preprocessing and transformation – Data visualization using Matplotlib and Seaborn – Interactive visualization using Plotly or Dash – Introduction to data pipelines – Handling large datasets using Dask.

Unit - III	PYTHON FOR ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING	6 Periods

Overview of Scikit-learn, TensorFlow and PyTorch – Implementation of regression, classification and clustering techniques – Feature selection and scaling – Model evaluation and validation techniques – Introduction to neural networks – AutoML concepts – Basics of transfer learning – Model tracking and visualization using TensorBoard.

Unit - IV	INTEGRATION, AUTOMATION AND OPTIMIZATION	6 Periods

API integration using Python – Web scraping: BeautifulSoup and Selenium – Database connectivity using SQLite and SQLAlchemy – Multithreading and multiprocessing – Performance optimization and profiling – Developing REST APIs using FastAPI – JWT based authentication – Containerization using Docker – Basics of microservices

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Unit- V	APPLICATION DEVELOPMENT AND DEPLOYMENT	6 Periods
Application development using Flask / Streamlit – Package and environment management – Unit testing using PyTest – Version control using Git and GitHub – Basics of CI/CD – Introduction to cloud deployment (AWS / GCP / Azure) – Case Study: Development and deployment of an AI / Data application.		
		TOTAL:30 Periods

PRACTICAL EXERCISE:

1. Program using iterators, generators, and decorators in Python.
2. Implement object-oriented concepts with inheritance, polymorphism, and exception handling.
3. Perform data manipulation operations using NumPy and Pandas.
4. Visualize data using Matplotlib and Seaborn libraries.
5. Implement classification and regression models using Scikit-learn.
6. Apply clustering techniques using K-Means and evaluate results.
7. Access and process data from web APIs using the requests module.
8. Connect Python with a SQLite database and perform CRUD operations.
9. Develop a simple data application using Flask or Streamlit framework.

TOTAL:30 Periods

TOTAL:30+30 = 60 Periods

Text Books:	1. Luciano Ramalho, Fluent Python, 2nd Edition, O'Reilly Media, 2022. 2. Wes McKinney, Python for Data Analysis, 3rd Edition, O'Reilly Media, 2022.
Reference Books:	1. Brett Slatkin, Effective Python: 90 Specific Ways to Write Better Python, 2nd Edition, Addison-Wesley Professional, 2019. 2. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, 2nd Edition, O'Reilly Media, 2019. 3. Al Sweigart, Automate the Boring Stuff with Python, 2nd Edition, No Starch Press, 2019.
MOOC/ Web Platforms:	https://nptel.ac.in/courses/106106212

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IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Describe advanced Python features such as iterators, generators, decorators, and OOP concepts.	Understand (K2)
CO2	Perform data cleaning, manipulation, and visualization using NumPy, Pandas, and visualization libraries.	Apply (K3)
CO3	Build and evaluate basic machine learning models using Scikit-learn, TensorFlow, or PyTorch.	Apply (K3)
CO4	Implement automation tasks, API integration, web scraping, and database operations using Python tools.	Analyze (K4)
CO5	Create test, and deploy Python applications using frameworks like Flask, Streamlit, and FastAPI.	Analyze (K4)

V -Mapping Table - Mapping of COs with POs and PSOs

COs/ POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	2	1	2	-	-	-	-	1	-	1	3	2	2
CO2	2	3	2	2	3	-	-	-	-	1	-	1	3	3	2
CO3	2	3	3	3	3	-	-	-	-	1	-	1	3	3	3
CO4	2	2	3	3	3	-	-	-	-	2	-	1	2	3	3
CO5	2	3	3	3	3	-	-	2	3	3	2	2	3	3	3

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23AD602 Natural Language Processing

Prerequisite	Program Name	Sem	Category	L	T	P	C
23AD501 - Deep Learning	B.Tech AI&DS	VI	PCC	3	0	2	4

II - Course Objectives

1.	Understand the fundamentals of Natural Language Processing and linguistic structure.
2.	Preprocess and represent text data effectively for computational analysis.
3.	Apply statistical and machine learning models for NLP tasks.
4.	Implement word embeddings and deep learning architectures for NLP applications.
5.	Design and deploy real-world NLP solutions using modern transformer-based frameworks

III - Course Content

Preamble: This course introduces the foundations of Natural Language Processing, combining linguistics, statistics, and machine learning approaches to process and understand human language. It provides hands-on exposure to modern NLP tools and models used in AI-driven systems.

Unit - I	Introduction & Text Preprocessing	9 Periods

Overview of Natural Language Processing -Linguistic essentials: Morphology, syntax, semantics, pragmatics-Text preprocessing: tokenization, stemming, lemmatization, stop word removal, regex- Text normalization, noise and special character handling (emojis, hashtags, slang) -Part-of-Speech tagging: rule-based and statistical approaches (HMM, CRF).

Unit - II	Syntax and Parsing Techniques	9 Periods

Formal language theory: Regular expressions, automata, finite state machines-Context-Free Grammar and parsing algorithms (top-down, bottom-up, CYK)-Dependency and constituency parsing - Semantic role labeling basics- Introduction to NLP tools (NLTK, spaCy)

Unit - III	Semantics and Word Representations	9 Periods

Lexical semantics and word sense disambiguation-Distributional semantics: Bag-of-Words, TF- IDF-Word embeddings: Word2Vec, GloVe, FastText-Contextual embeddings: ELMo, BERT fundamentals- Sentence embeddings (SBERT / Universal Sentence Encoder – concept) -Named Entity Recognition (NER) and Ontologies (WordNet)

Unit - IV	Statistical Models and Machine Learning for NLP	9 Periods

N-gram language models and smoothing techniques-Hidden Markov Models (HMMs)-Text classification techniques: Naive Bayes, SVM, Logistic Regression-Topic modeling: Latent Dirichlet Allocation (LDA)-Evaluation metrics for NLP task- Introduction to explainable NLP: LIME / SHAP (concepts).

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Unit V	Deep Learning and Advanced Applications	9 Periods
Neural networks: RNN, LSTM, GRU, Encoder-Decoder models-Attention mechanisms and Transformer architecture-Pretrained models: BERT, GPT, fine-tunes strategies-Applications: Machine Translation, Chatbots, Question Answering, Summarization-Ethical issues.		
		TOTAL:45 Periods

PRACTICAL EXERCISE:

1. Text Preprocessing (tokenization, stemming, lemmatization) using NLTK/spaCy
2. Implementation of Part-of-Speech Tagger using HMM or CRF
3. Parsing using Context-Free Grammar and CKY Algorithm
4. Dependency Parsing and Phrase Structure Parsing
5. Creation of Word Embeddings using Word2Vec and GloVe
6. Exploring Contextualized Word Embeddings with BERT
7. Text Classification using Naive Bayes and SVM
8. Sentiment Analysis using Pretrained Transformer Models
9. Machine Translation using Sequence-to-Sequence Models
10. Building a Question Answering System using Transformers

TOTAL:30 Periods

Total: 45+30 = 75 Periods

Text Books:	1. Daniel Jurafsky and James H. Martin, Speech and Language Processing, 3rd Edition, Pearson, 2023. 2. Steven Bird, Ewan Klein, and Edward Loper, Natural Language Processing with Python, O'Reilly Media, 2nd Edition, 2021. 3. Palash Goyal, Sumit Pandey, and Karan Jain, Deep Learning for Natural Language Processing, Apress, 2018.
Reference Books:	1. Sowmya Vajjala et al., Practical Natural Language Processing: A Comprehensive Guide to Building Real-World NLP Systems, O'Reilly Media, 2020. 2. Hobson Lane, Cole Howard, and Hannes Hapke, Natural Language Processing in Action, Manning Publications, 2019.
MOOC/ Web Platforms:	https://nptel.ac.in/courses/106/101/106101007

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IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand core NLP concepts including text preprocessing, syntax, and semantics	Understand (K2)
CO2	Apply linguistic and probabilistic models for parsing and language modeling.	Apply (K3)
CO3	Develop and evaluate word representations and semantic analysis techniques	Apply (K3)
CO4	Implement machine learning algorithms for text classification, sentiment analysis, and topic modeling.	Apply (K3)
CO5	Design and implement deep learning models including transformers for advanced NLP applications.	Analyze (K4)

V -Mapping Table - Mapping of COs with POs and PSOs

COs / POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	2	1	2	-	-	-	-	1	-	1	3	2	2
CO2	2	3	3	3	3	-	-	-	-	2	-	1	3	3	2
CO3	2	3	3	3	3	-	-	-	-	1	-	1	3	3	3
CO4	2	3	3	3	3	-	-	2	-	2	1	1	3	3	3
CO5	2	3	3	3	3	-	-	2	3	3	2	2	3	3	3

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23AD611 Mini Project

Prerequisite	Programme Name	Sem	Category	L	T	P	C
NIL	B.Tech AI&DS	VI	EEC	0	0	4	2

II - Course Objectives

1.	To gain knowledge for identifying real-world problems.
2.	To develop skills to find the solutions for real-world problems.
3.	To develop skills for documentation and presentation of identified solution.

III - Instructions **TOTAL: 60 Periods**

1. Mini project should be completed within the scheduled semester timeline.
2. Students must work in **the** assigned team size (usually 2–4 members).
3. Project topic must be approved by the Project Coordinator and HoD.
4. The project must **be** simple, innovative, and based on basic principles learned in the course.
5. Students should attend all review meetings, provide progress updates, and implement mentor feedback.
6. Plagiarism is not permitted; students must submit original work.
7. Final submission must include:
    - Mini project report
    - Working model/demo
    - Presentation slides
8. Marks will be based on problem definition, methodology, execution, teamwork, documentation, and viva.

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V - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Apply **theoretical knowledge** gained from coursework to solve a **practical engineering problem**.	Apply (K3)
CO2	Design and implement a **system, model, prototype, or software** relevant to the chosen project.	Apply (K3)
CO3	Maintain **proper project documentation**, including reports and references.	Understand (K2)
CO4	Demonstrate **professional ethics**, originality, and adherence to academic standards.	Apply (K3)
CO5	Develop **teamwork, documentation, presentation, and basic project management skills**.	Apply (K3)

(Action verb of each CO to be matched with the next mapping table)

VI - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	3	3	3	2	2	3	3	3	2	2	3	2	2
CO-2	3	3	3	3	3	2	2	3	3	3	2	2	3	2	2
CO-3	-	-	-	-	-	-	-	3	3	3	2	2	-	-	-
CO-4	-	-	-	-	-	-	-	3	3	3	-	-	-	-	-
CO-5	-	-	-	-	-	-	-	3	3	3	3	3	3	3	1

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23GE709-Human Values and Ethics for AI

Prerequisite	Program Name	Sem	Category	L	T	P	C
Nil	B.Tech AI&DS	VII	HSMC	2	0	0	2

II - Course Objectives

1.	To introduce fundamental human values and professional ethics relevant to AI practitioners.
2.	To familiarize students with Responsible AI principles and ethical considerations across the AI lifecycle.
3.	To examine major ethical issues arising from AI applications, automation, data use, and generative technologies.
4.	To provide an understanding of global and Indian governance frameworks, laws, and policies for AI.
5.	To develop ethical reasoning skills through case studies and encourage students to formulate a personal code of AI ethics.

III - Course Content

Preamble: This course introduces the human values and ethical principles essential for responsible AI practice.It helps students understand ethical challenges in AI development, deployment, and societal impact.The course explains global and Indian AI governance frameworks to promote trustworthy AI systems.Through case studies, students learn to analyze ethical dilemmas and make value-based decisions in AI.

Unit - I	Human Values, Professional Ethics & Technology	6 Periods

Human values: empathy, honesty, integrity, respect, responsibility. Professional ethics for AI engineers. Ethical theories: utilitarianism, deontology, virtue ethics (overview).Technology and moral responsibility; dual-use nature of AI. Value conflicts in AI-driven societies.

Unit - II	Responsible AI Principles & Lifecycle	6 Periods

Introduction to Responsible AI. Principles: Fairness, Transparency, Explainability, Accountability, Safety, Privacy, Inclusiveness.Ethical considerations in the AI lifecycle, Bias sources and mitigation basics.

Unit - III	Ethical Issues in AI Practice	6 Periods

Data ethics: consent, ownership, data minimisation, privacy.Algorithmic bias, discrimination and fairness issues.Generative AI ethics: deepfakes, misinformation, manipulation, copyright concerns. Workplace impact: automation, job displacement, worker surveillance. Ethical issues in predictive policing, credit scoring, healthcare and education.

Unit - IV	Governance, Law and Policy for AI	6 Periods

Need for AI regulation and governance frameworks. Overview of the EU AI Act: risk categories, prohibited practices, high-risk system obligations. India's Digital Personal Data Protection (DPDP) Act, AI audits, documentation, transparency reports, internal ethics boards. Corporate AI policies & global Responsible AI initiatives.

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Unit V	Ethical AI	6 Periods
Ethical AI in Practice: Case Studies & Indian-ContextCase studies from:Facial recognition- Social media recommender systems-Automated recruitment-Healthcare AI-Generative AI misuse-Stakeholder analysis and harm–benefit evaluation.-Ethical dilemma resolution frameworks.Cultural and societal considerations for AI in the Indian context.Creating a personal code of ethics for AI professionals.		
		TOTAL:30 Periods

Text Books:	1. "Ethics of Artificial Intelligence and Robotics" – Stanford Encyclopedia of Philosophy (SEP). 2. Mark Coeckelbergh – AI Ethics, MIT Press, 2020. 3. Virginia Dignum – Responsible Artificial Intelligence: Designing AI for Human Values, Springer, 2019.
Reference Books:	1. Cathy O'Neil – Weapons of Math Destruction, Penguin Books, 2016. 2. Ramesh Srinivasan – Beyond the Valley: Understanding the New Digital Economy, MIT Press, 2020. 3. Patrick Lin, Keith Abney, Ryan Jenkins – Robot Ethics 2.0, Oxford University Press, 2017. 4. Brian Christian – The Alignment Problem: Machine Learning and Human Values, W. W. Norton, 2020.
MOOC/ Web Platforms:	www.coursera.org/learn/ai-for-everyone

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Describe core human values and professional ethics applicable to AI development.	Understand (K2)
CO2	Explain Responsible AI principles and ethical considerations across the AI lifecycle.	Understand (K2)
CO3	Identify ethical issues related to data use, generative AI, automation, and algorithmic bias.	Understand (K2)
CO4	Interpret AI governance frameworks, including global regulations, EU AI Act, and India's DPDP Act.	Understand (K2)
CO5	Analyze real-world AI case studies and apply ethical reasoning to propose responsible solutions.	Apply (K3)

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V -Mapping Table - Mapping of COs with POs and PSOs

COs/ POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	1	1	1	-	2	3	2	1	1	1	1	1	1	1
CO2	2	1	1	2	-	3	2	2	1	1	1	1	1	1	1
CO3	2	1	1	2	-	2	2	3	1	1	2	1	1	1	1
CO4	2	1	1	2	-	3	2	3	1	2	2	2	1	1	1
CO5	1	1	2	3	-	3	3	3	2	2	2	2	1	2	1

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23AD711 Summer Internship-II

Prerequisite	Programme Name	Sem	Category	L	T	P	C
NIL	B.Tech AI&DS	VII	EEC	0	0	0	2

II - Course Objectives

1.	Gain advanced professional exposure in AI&DS industries, research organizations, or academia.
2.	Analyze complex, real-world problems using AI and data-driven approaches.
3.	Design and implement end-to-end AI/DS solutions using modern tools and platforms.
4.	Understand automation, deployment, MLOps, and ethical considerations in AI systems.
5.	Enhance technical reporting, presentation, and leadership skills.

III – Guidelines **TOTAL: 4 Weeks**

1. Students shall undergo the internship only in approved companies/organizations relevant to their domain.
2. A minimum duration of 4 weeks is mandatory; attendance must be certified by the industry mentor.
3. Students shall submit an Internship Request/ Bonafide Letter approved by the principal through department before starting.
4. Students shall complete the internship before the starting of the classes for VII Semester and may attend for 1 week after reopening with proper permission from the principal if required.
5. Students shall strictly follow the company's code of conduct, working Periods, and confidentiality rules.
6. Any change in internship location/duration must receive prior approval from the department.
7. On completion, students must submit the following:
    - Completion certificate
    - Internship report
    - Presentation
8. Evaluation will be based **on industry feedback, report quality, viva-voce, and presentation**.

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IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand AI&DS industry processes, emerging technologies, and best practices.	Understand (K2)
CO2	Design suitable AI and data science solutions for complex business problems.	Apply (K3)
CO3	Build, test, deploy, and optimize AI/DS models on target platforms.	Apply (K3)
CO4	Apply professional, ethical, and collaborative practices in real-world projects.	Apply (K3)
CO5	Prepare comprehensive technical reports and deliver effective presentations.	Analyze (K4)

(Action verb of each CO to be matched with the next mapping table)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	2	2	-	-	2	-	-	-	-	-	-	2	2	2	-
CO-2	3	3	-	-	3	-	-	-	-	-	-	-	3	3	2
CO-3	3	3	3	2	3	-	-	-	-	-	-	-	3	3	3
CO-4	-	-	3	3	-	2	2	3	3	2	-	-	-	-	-
CO-5	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23AD712-Research paper writing & publication

Prerequisite	Program Name	Sem	Category	L	T	P	C
Nil	B.Tech AI&DS	VII	EEC	0	0	2	1

II - Course Objectives

1.	To help students identify research problems and formulate clear research objectives
2.	To enable students to conduct effective literatures reviews and manage references professionally.
3.	To develop skills in academic writing, structuring research papers, and adhering to publication formats.
4.	To guide students in implementing research models, generating experimental results, and Visualizing findings.
5.	To train students in plagiarism checking, ethical practices, and successful preparation of research manuscripts for publication.

III - Course Content

PRACTICAL EXERCISE: **TOTAL: 30 Periods**

1. Identification of Research Problem and Objective Formulation
2. Literature Search and Preparation of Review Summary
3. Reference Management Using Mendeley/Zotero
4. Academic Writing Enhancement Using AI-Assisted Tools
5. Research Paper Structuring and Template Formatting (IEEE/Elsevier)
6. Dataset Selection and Preprocessing for Research
7. Model Implementation and Experimental Result Generation
8. Visualization of Results Using Scientific Plots and Tables
9. Plagiarism Detection and Ethical Compliance Checking
10. Final Research Paper Compilation and Presentation Preparation

Text Books:	1. Ranjit Kumar – Research Methodology: A Step-by-Step Guide for Beginners, Sage Publications. 2. C. R. Kothari & Gaurav Garg – Research Methodology: Methods and Techniques, New Age International. 3. Robert A. Day & Barbara Gastel – How to Write and Publish a Scientific Paper, Cambridge University Press.

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Reference Books:	1. Wayne C. Booth, Gregory G. Colomb, Joseph M. Williams – The Craft of Research, University of Chicago Press. 2. Michael Alley – The Craft of Scientific Writing, Springer. 3. Elsevier Researcher Academy Learning Modules. 4. IEEE Author Center Resources.
MOOC/ Web Platforms:	https://www.coursera.org/learn/sciwrite

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Apply techniques for identifying research problems and conducting literature review.	Apply (K3)
CO2	Apply academic writing skills, referencing methods, and publication formatting rules.	Apply (K3)
CO3	Analyze datasets, preprocess data, and generate experimental results for research.	Analyze (K4)
CO4	Analyze research findings and prepare scientific visualizations and reports.	Analyze (K4)
CO5	Evaluate research papers for plagiarism, ethical compliance, and Publication readiness.	Evaluate (K5)

V -Mapping Table - Mapping of COs with POs and PSOs

COs/ POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	2	1	2	2	1	1	1	1	1	1	3	1	2	1
CO2	2	2	1	2	2	1	1	1	1	2	1	3	2	1	2
CO3	2	2	2	3	2	1	1	1	1	2	2	2	1	2	2
CO4	3	2	2	3	3	1	1	1	1	1	2	2	2	2	1
CO5	3	2	2	3	3	1	2	1	1	2	2	3	2	2	2

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23AD811 - Project Work

Prerequisite	Programme Name	Sem	Category	L	T	P	C
NIL	B.Tech AI&DS	VIII	EEC	0	0	20	10

II - Course Objectives

1.	To enable students to undertake research-oriented or application-oriented projects with measurable outcomes.
2.	To provide guidance in selecting relevant project topics aligned with the academic program and industry needs.
3.	To develop skills in systematic planning, execution, and review of projects as per institutional timelines.
4.	To promote ethical practices, proper documentation, and avoidance of plagiarism in project work.
5.	To enhance students' ability to design, implement, and present technical solutions effectively.

III – Guidelines

TOTAL: 300 Periods

1. Project work shall be research-oriented or application-oriented with measurable outcomes.
2. Students shall choose a project relevant to their program with Project coordinator and HoD approval.
3. Project teams shall strictly follow the institutional project timeline and attend all scheduled reviews.
4. Students shall maintain a project logbook with weekly progress signed by the Supervisor.
5. Any external project collaboration shall be supported by an MoU or permission letter from the Principal through department.
6. Students shall adhere to ethical practices, avoid plagiarism, and ensure proper citation of references.
7. Final submission includes:
    - Project report as per approved format
    - System design/model/prototype/source code
    - Publication in IEEE/Scopus indexed conferences and journals
    - Final presentation
8. Evaluation will be based on innovation, technical depth, implementation, documentation, and viva-voce.

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IV- Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Identify and define a real-world problem and develop an appropriate technical solution.	Apply (K3)
CO2	Identify, analyze, and define a real-world problem and formulate appropriate technical solutions.	Analyze (K4)
CO3	Design and develop a small-scale system, model, or application using relevant tools and technologies.	Analyze (K4)
CO4	Enhance skills in literature survey, problem modeling, implementation, and testing.	Apply (K3)
CO5	Present and defend the project effectively through reports, presentations, and viva-voce, meeting evaluation criteria.	Apply (K3)

(Action verb of each CO to be matched with the next mapping table)

VII - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	3	3	3	2	2	3	3	3	3	3	3	3	2
CO-2	3	3	3	3	3	2	2	3	3	3	3	3	3	3	2
CO-3	3	3	3	3	3	2	2	3	3	3	2	2	-	2	1
CO-4	3	3	3	2	2	2	2	3	3	3	-	-	-	-	-
CO-5	-	-	-	-	-	-	-	3	3	3	3	3	3	3	2

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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ELECTIVE MANAGEMENT COURSES

I - Course Name: 23GE701 Principles of Management

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E/B.Tech – Common to All	VII	HSMC	3	0	0	3

II - Course Objectives

1	To familiarize students with modern management concepts, functions, and organizational practices.
2	To understand managerial roles and responsibilities essential for technical environments.
3	To explore fundamental HR processes and workplace behaviour.
4	To apply contemporary management theories to engineering and business settings.
5	To relate individual and organizational goals for effective managerial decision-making.

III - Course Content

Preamble:
This course introduces engineering students to the fundamentals of managerial practices, organizational processes, and human behaviour at work. It highlights the importance of planning, organizing, directing, and controlling, and equips learners with essential management skills required for effective communication, leadership, and teamwork in technical and business environments.

Unit - I	BASICS OF MANAGEMENT & ORGANIZATIONAL FORMS	9 Periods

Meaning and importance of management – Management as a science, art, and professional practice – Roles, skills, and competencies of modern managers – Evolution of management thought: Scientific, Behavioural, Systems, Contingency and Contemporary approaches – Types of business organizations: Proprietorship, Partnership, Corporations, Start-ups – Organizational culture, environment, and emerging global trends in management.

Unit - II	MANAGERIAL PLANNING & DECISION STRATEGIES	9 Periods

Purpose and significance of planning – Planning hierarchy – Types of plans: Strategic, Tactical, Operational – Setting goals and policies – Planning assumptions – Strategic management basics – Planning and forecasting tools – Decision making: stages, techniques, and analytical approaches used in engineering and business settings.

Unit - III	ORGANIZING & HUMAN RESOURCE PROCESSES	9 Periods

Purpose of organizing – Formal and informal structures – Organization charts – Types of organization structures: Line, Functional, Matrix, Hybrid – Authority and responsibility relationships – Departmentation – Delegation and decentralization – Job design elements – Overview of HRM: Human resource planning, recruitment and selection, training and development, performance appraisal, employee career development.

Unit - IV	LEADING PEOPLE & WORKPLACE BEHAVIOUR	9 Periods

Fundamentals of individual and group behaviour – Motivation theories and techniques – Job satisfaction and employee involvement – Leadership styles and modern leadership approaches – Communication process and barriers – Improving communication effectiveness – Digital and technology-enabled communication at workplace.

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Unit - V	CONTROL SYSTEMS & PERFORMANCE MANAGEMENT	9 Periods
Nature and importance of control – Types of control systems: Pre-control, Concurrent, Post-control – Budgetary and non-budgetary methods – Role of IT and analytics in organizational control – Productivity measurement and improvement – Managerial reporting and performance monitoring – Corrective and preventive control mechanisms.		

TOTAL: 45 Periods

Text Books:	1. Harold Koontz and Heinz Weihrich "Essentials of management" Tata McGraw Hill, 1998. 2. Stephen P. Robbins and Mary Coulter, " Management", Prentice Hall (India)Pvt. Ltd., 10th Edition, 2009.
Reference Books:	1. Robert Kreitner and MamataMohapatra, " Management", Biztantra, 2008. 2. Stephen A. Robbins and David A. Decenzo and Mary Coulter, "Fundamentals of Management" Pearson Education, 7th Edition, 2011. 3. Tripathy PC and Reddy PN, "Principles of Management", Tata Mcgraw Hill, 1999.
MOOC/Web Platforms:	1. https://nptel.ac.in/courses/110/105/110105121/ 2. https://www.coursera.org/learn/principles-of-management 3. https://www.edx.org/learn/management/introduction-to-management

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Explain the fundamental concepts, roles, and approaches of modern management.	Understand (K2)
CO2	Apply planning and decision-making techniques in managerial situations.	Apply (K3)
CO3	Demonstrate understanding of organizational design and HR processes.	Apply (K3)
CO4	Analyze employee behaviour, leadership styles, and communication practices.	Analyze (K4)
CO5	Assess control systems and performance measures used in organizations.	Analyze (K4)

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V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO 2
CO1	3	-	--	-	-	1	-	-	-	-	-	-	1	-
CO2	-	1	1	-	-	-	-	-	-	-	-	-	1	-
CO3	1	-	-	2	-	-	1	-	2	-	1	1	1	-
CO4	-	1	1	1	2	-	-	1	2	-	-	-	1	-
CO5	1	-	-	-	1	1	-	-	-	3	1	1	1	-

Mapping: 1-Low, 2-Medium, 3-High

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I - Course Name: 23GE702 Total Quality Management

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E/B.Tech – Common to All	VII	HSMC	3	0	0	3

II - Course Objectives

1	To know the need for quality, its evolution, basic concepts, contribution of quality gurus, TQM framework, Barriers and Benefits of TQM.
2	To explain the TQM Principles for applications.
3	To define the basics of traditional tools, new tools, benchmarking and FMEA.
4	To know about Taguchi's quality loss function and performance measures.
5	To apply QMS and EMS in any organization.

III - Course Content

Preamble:
This course provides the fundamental concepts, principles, and tools of Total Quality Management needed for improving organizational performance. It equips students with practical knowledge of quality tools, Six Sigma, QFD, TPM, and international standards like ISO 9001 and ISO 14001. The course enables learners to apply quality systems effectively in industrial environments.

Unit - I	FOUNDATIONS OF QUALITY & TQM	9 Periods

Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of product and service quality - Definition of TQM - Basic concepts of TQM - Gurus of TQM (Brief introduction) - TQM Framework- Barriers to TQM - Benefits of TQM.

Unit - II	PRINCIPLES & PRACTICES OF TQM	9 Periods

Leadership - Deming Philosophy, Quality Council, Quality statements and Strategic planning- Customer Satisfaction - Customer Perception of Quality, Feedback, Customer complaints, Service Quality, Kano Model and Customer retention - Employee involvement - Motivation, Empowerment, Team and Teamwork, Recognition & Reward and Performance Appraisal - Continuous process improvement - Juran Trilogy, PDSA cycle, 5S and Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating and Relationship development.

Unit - III	QUALITY IMPROVEMENT TOOLS - I	9 Periods

The seven traditional tools of quality - New management tools - Six-sigma Process Capability- Bench marking - Reasons to benchmark, Benchmarking process, What to Bench Mark, Understanding Current Performance, Planning, Studying Others, Learning from the data, Using the findings, Pitfalls and Criticisms of Benchmarking - FMEA - Intent , Documentation, Stages: Design FMEA and Process FMEA.

Unit - IV	QUALITY IMPROVEMENT TOOLS - II	9 Periods

Quality circles - Quality Function Deployment (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures- Cost of Quality - BPR.

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Unit - V	QUALITY SYSTEMS & INTERNATIONAL STANDARDS	9 Periods
Introduction-Benefits of ISO Registration - ISO 9000 Series of Standards-Sector Specific Standards - AS 9100, TS16949 and TL 9000 - ISO 9001 Requirements Implementation - Documentation-Internal Audits - Registration - Environmental Management System: Introduction - ISO 14000 Series Standards - Concepts of ISO 1400 - Requirements of ISO 14001 - Benefits of EMS.		

TOTAL: 45 Periods

Text Books:	1. Dale H. Besterfield et al., "Total Quality Management", Pearson Education, 3rd Edition. 2. S. Balasubramanian, "Total Quality Management", PHI Learning. 3. K. Shridhara Bhat, "Total Quality Management", Himalaya Publishing House.
Reference Books:	1. Joel E. Ross, "Total Quality Management: Text, Cases and Readings", CRC Press. 2. Poornima M. Charantimath, "Total Quality Management", Pearson. 3. Amitava Mitra, "Fundamentals of Quality Control and Improvement", Wiley.
MOOC/Web Platforms:	1. https://www.coursera.org/learn/six-sigma-principles 2. https://nptel.ac.in/courses/112/105/112105305/ 3. https://nptel.ac.in/courses/110/106/110106149/

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Apply TQM concepts in a selected enterprise.	Apply (K3)
CO2	Apply TQM principles in a selected enterprise.	Apply (K3)
CO3	Understand Six Sigma and apply Traditional tools, New tools, Benchmarking and FMEA.	Understand (K2)
CO4	Understand Taguchi's Quality Loss Function, Performance Measures and apply QFD, TPM, COQ and BPR.	Understand (K2)
CO5	Apply QMS and EMS in any organization.	Apply (K3)

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V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO 2
CO1	3	2	2	2	1	1	-	1	2	1	1	2	1	-
CO2	3	3	3	2	1	1	-	1	2	2	1	2	1	-
CO3	2	2	2	2	1	1	-	1	2	1	1	2	1	-
CO4	2	2	2	2	1	1	-	1	2	1	1	2	1	-
CO5	3	2	2	2	1	1	-	1	2	2	1	3	1	-

Mapping: 1-Low, 2-Medium, 3-High

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I - Course Name: 23GE703 Engineering Economics and Financial Accounting

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E/B.Tech – Common to All	VII	HSMC	3	0	0	3

II - Course Objectives

1	To understand the concept of engineering economics.
2	To know the various micro economics concept in real life.
3	To understand the different procedures of pricing.
4	To gain knowledge in the field of macroeconomics.
5	To learn the various cost related concepts in micro economics.

III - Course Content

Preamble:
This course introduces the fundamental concepts of engineering economics and financial accounting required for effective decision-making in engineering projects. It helps students understand demand, cost, pricing, financial statements, and capital budgeting. The course enables learners to evaluate economic feasibility and apply financial principles in real-time industrial situations.

Unit - I	DEMAND & SUPPLY ANALYSIS	9 Periods

Managerial Economics - Relationship with other disciplines - Firms: Types, objectives and goals - Managerial decisions - Decision analysis. Demand - Types of demand - Determinants of demand - Demand function – Demand elasticity - Demand forecasting - Supply - Determinants of supply - Supply function -Supply elasticity.

Unit - II	PRODUCTION AND COST ANALYSIS	9 Periods

Production function - Returns to scale - Production optimization - Least cost input - Isoquants - Managerial uses of production function. Cost Concepts - Cost function - Determinants of cost - Short run and Long run cost curves - Cost Output Decision - Estimation of Cost.

Unit - III	PRICING	9 Periods

Determinants of Price - Pricing under different objectives and different market structures - Price discrimination - Pricing methods in practice.

Unit - IV	FINANCIAL ACCOUNTING (ELEMENTARY TREATMENT)	9 Periods

Balance sheet and related concepts - Profit & Loss Statement and related concepts - Financial Ratio Analysis - Cash flow analysis - Funds flow analysis - Comparative financial statements - Analysis & Interpretation of financial statements.

Unit - V	CAPITAL BUDGETING (ELEMENTARY TREATMENT)	9 Periods

Investments - Risks and return evaluation of investment decision - Average rate of return - Payback Period - Net Present Value - Internal rate of return.

TOTAL: 45 Periods

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Text Books:	1. Panneer Selvam, R, "Engineering Economics", Prentice Hall of India Ltd, New Delhi, 2001 2. Managerial Economics: Analysis, Problems and Cases - P. L. Mehta, Edition, 13. Publisher, Sultan Chand, 2007.
Reference Books:	1. Chan S.Park, "Contemporary Engineering Economics", Prentice Hall of India, 2011. 2. Donald.G. Newman, Jerome.P.Lavelle, "Engineering Economics and analysis" Engg. Press, Texas, 2010. 3. Degarmo, E.P., Sullivan, W.G and Canada, J.R, "Engineering Economy", Macmillan, New 224 York, 2011. 4. Zahid A khan: Engineering Economy, "Engineering Economy", Dorling Kindersley, 2012 5. Dr. S. N. Maheswari and Dr. S.K. Maheshwari: Financial Accounting, Vikas, 2009
MOOC/Web Platforms:	1. https://www.edx.org/learn/accounting/financial-accounting 2. https://www.coursera.org/learn/microeconomics-principles 3. https://nptel.ac.in/courses/110/105/110105054/

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Apply the basics of economics and cost analysis to engineering and take economically sound decisions.	Apply (K3)
CO2	Analyze the economic theories, cost concepts and pricing policies.	Analyze (K4)
CO3	Understand the market structures and integration concepts.	Understand (K2)
CO4	Understand the measures of national income, the functions of banks and concepts of globalization.	Understand (K2)
CO5	Apply the concepts of financial management for project appraisal.	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs / PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO 2
CO1	3	3	2	3	2	1	-	1	2	2	2	3	1	-
CO2	3	3	3	3	2	1	-	1	2	2	2	3	1	-
CO3	2	2	2	2	1	1	-	1	2	1	1	2	1	-
CO4	2	2	2	2	1	1	-	1	2	1	1	2	1	-
CO5	3	3	3	3	2	1	-	1	2	2	2	3	1	-

Mapping: 1-Low, 2-Medium, 3-High

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I - Course Name: 23GE704 Human Resource Management

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E/B.Tech – Common to All	VII	HSMC	3	0	0	3

II - Course Objectives

1	To know the fundamentals of Human Resource Management and its role in organizations.
2	To learn the processes involved in manpower planning, recruitment, and selection.
3	To gain knowledge on training, skill development, and employee capability building.
4	To be familiarize with compensation systems and employee motivation.
5	To know the performance management, employee relations, and workplace issues.

III - Course Content

Preamble:

This course introduces the essential concepts and practices of Human Resource Management, focusing on manpower planning, training, compensation, and performance management. The syllabus is designed to help engineering students understand how HR practices support organizational productivity and employee development. It also highlights modern HR trends relevant to technology-driven workplaces.

Unit - I	INTRODUCTION TO HUMAN RESOURCE MANAGEMENT	9 Periods

Role and importance of human resources – Scope and functions of HRM – HR policies – HR manager's responsibilities – Modern HR challenges in technology-driven organizations

Unit - II	HUMAN RESOURCE PLANNING	9 Periods

Need for HR planning – Manpower forecasting – Job analysis and job description – Sources of human resources – Recruitment methods (traditional & digital) – Selection process – Orientation & onboarding.

Unit - III	TRAINING AND EXECUTIVE DEVELOPMENT	9 Periods

Concept of training – Types of training (technical, soft skills, safety, induction) – Executive development – E-learning & digital training tools – Training evaluation (basics).

Unit - IV	EMPLOYEE COMPENSATION	9 Periods

Components of compensation – Incentives, rewards & recognition – Employee motivation basics – Career planning and career development – Mentoring and coaching in modern workplaces

Unit - V	PERFORMANCE EVALUATION AND CONTROL	9 Periods

Performance appraisal methods – Feedback mechanisms – Key performance indicators (KPIs) – Grievances and redressal approaches – Basics of employee relations – Workplace discipline.

TOTAL: 45 Periods

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Text Books:	1. Decenzo and Robbins, "Human Resource Management", 8th Edition, Wiley, 2007. 2. John Bernardin. H., "Human Resource Management – An Experimental Approach", 5th Edition, Tata McGraw Hill, 2013, New Delhi.
Reference Books:	1. Luis R,. Gomez-Mejia, DavidB. Balkin and Robert L. Cardy, "Managing Human Resources", 7th Edition, PHI, 2012. 2. Dessler, "Human Resource Management", Pearson Education Limited, 2007.
MOOC/Web Platforms:	1. https://nptel.ac.in/courses/110/105/110105054/ 2. https://www.coursera.org/specializations/human-resource-management 3. https://www.edx.org/learn/human-resource-management

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Explain the fundamental concepts, roles, and functions of Human Resource Management in organizations	Understand (K2)
CO2	Describe the processes of human resource planning, recruitment, selection, and onboarding.	Understand (K2)
CO3	Apply appropriate training and skill development methods suitable for technical and organizational needs.	Apply (K3)
CO4	Analyze compensation systems, reward mechanisms, and career development practices.	Analyze (K4)
CO5	Analyze performance management approaches and propose solutions for handling grievances and employee relations issues	Analyze (K4)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO 2
CO1	3	2	1	1	1	1	-	1	2	1	1	2	1	-
CO2	3	3	2	2	1	1	-	1	2	1	1	2	1	-
CO3	3	3	3	2	1	1	-	1	2	1	1	3	1	-
CO4	2	3	3	2	1	1	-	1	2	1	1	3	1	-
CO5	2	2	1	1	1	1	-	1	2	1	1	2	1	-

Mapping: 1-Low, 2-Medium, 3-High

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I - Course Name: 23GE705 Knowledge Management

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E/B.Tech – Common to All	VII	HSMC	3	0	0	3

II - Course Objectives

1	To learn the evolution of Knowledge management.
2	To be familiar with creating the culture of learning and knowledge sharing.
3	To be familiar knowledge management tools.
4	To be exposed to knowledge management applications.
5	To be familiar with future trends and case studies.

III - Course Content

Preamble:
This course introduces the foundations, tools, and applications of Knowledge Management, enabling learners to understand how organizations create, share, and utilize knowledge. It also equips students with skills to use KM technologies and develop KM strategies aligned with organizational goals.

Unit - I	INTRODUCTION	9 Periods

Introduction: An Introduction to Knowledge Management - The foundations of knowledge management- including cultural issues- technology applications organizational concepts and processes- management aspects- and decision support systems. The Evolution of Knowledge management: From Information Management to Knowledge Management - Key Challenges Facing the Evolution of Knowledge Management Ethics for Knowledge Management.

Unit - II	CREATING THE CULTURE OF LEARNING AND KNOWLEDGE SHARING	9 Periods

Organization and Knowledge Management - Building the Learning Organization. Knowledge Markets: Cooperation among Distributed Technical Specialists – Tacit Knowledge and Quality Assurance.

Unit - III	KNOWLEDGE MANAGEMENT-THE TOOLS	9 Periods

Telecommunications and Networks in Knowledge Management - Internet Search Engines and Knowledge Management - Information Technology in Support of Knowledge Management - Knowledge Management and Vocabulary Control - Information Mapping in Information Retrieval - Information Coding in the Internet Environment - Repackaging Information.

Unit - IV	KNOWLEDGE MANAGEMENT APPLICATION	9 Periods

Components of a Knowledge Strategy - Case Studies (From Library to Knowledge Center, Knowledge Management in the Health Sciences, Knowledge Management in Developing Countries).

Unit - V	FUTURE TRENDS AND CASE STUDIES	9 Periods

Advanced topics and case studies in knowledge management - Development of a knowledge management map/plan that is integrated with an organization's strategic and business plan - A case study on Corporate Memories for supporting various aspects in the process life -cycles of an organization.

TOTAL: 45 Periods

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Text Books:	1. Srikantaiah, T.K., Koenig, M., "Knowledge Management for the Information Professional" Information Today, Inc., 2000
Reference Books:	1. Nonaka, I., Takeuchi, H., "The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation", Oxford University Press, 1995.
MOOC/Web Platforms:	1. https://nptel.ac.in/courses/110/105/110105139/ 2. https://www.udemy.com/course/knowledge-management-fundamentals/ 3. https://www.futurelearn.com/courses/digital-knowledge-management

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the process of acquire knowledge from experts.	Understand (K2)
CO2	Understand the learning organization.	Understand (K2)
CO3	Use the knowledge management tools.	Apply (K3)
CO4	Develop knowledge management applications.	Apply (K3)
CO5	Apply knowledge management for future trends.	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	1	1	1	1	1	1	2	1	1	1	1	-
CO2	2	2	1	1	1	1	1	1	3	1	1	1	1	-
CO3	2	3	3	2	2	1	1	1	2	2	1	1	1	-
CO4	3	3	3	3	2	1	1	1	2	2	1	2	1	-
CO5	3	3	3	3	3	1	1	1	2	3	2	2	1	-

Mapping: 1-Low, 2-Medium, 3-High

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I - Course Name: 23GE706 Industrial Management

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E/B.Tech – Common to All	VII	HSMC	3	0	0	3

II - Course Objectives

1	To study the basic concepts of management and approaches to management.
2	To study the planning; organizing and staffing functions of management in professional organization.
3	To study the leading; controlling and decision making functions of management in professional organization.
4	To learn the organizational theory in professional organization.
5	To learn the principles of productivity and modern concepts in management in professional organization.

III - Course Content

Preamble:
This course introduces the principles and functions of management essential for industrial settings. It equips students with knowledge of planning, organizing, leading, and controlling, along with modern management concepts used in engineering and industrial environments

Unit - I	INTRODUCTION TO MANAGEMENT	9 Periods

Management: Introduction; Definition and Functions – Approaches to the study of Management – Mintzberg's Ten Managerial Roles – Principles of Taylor; Fayol; Weber; Parker – Forms of Organization: Sole Proprietorship; Partnership; Company (Private and Public); Cooperative – Public Sector Vs Private Sector Organization – Business Environment: Economic; Social; Political; Legal – Trade Union: Definition; Functions; Merits & Demerits.

Unit - II	FUNCTIONS OF MANAGEMENT - I	9 Periods

Planning: Characteristics; Nature; Importance; Steps; Limitation; Planning Premises; Strategic Planning; Vision & Mission statement in Planning– Organizing: Organizing Theory; Principles; Types; Departmentalization; Centralization and Decentralization; Authority & Responsibility – Staffing: Systems Approach; Recruiting and Selection Process; Human Resource Development (HRD) Concept and Design.

Unit - III	FUNCTIONS OF MANAGEMENT - II	9 Periods

Directing (Leading): Leadership Traits; Style; Morale; Managerial Grids (Blake-Mounton, Reddin) – Communication: Purpose; Model; Barriers – Controlling: Process; Types; Levels; Guidelines; Audit (External, Internal, Merits); Preventive Control – Decision Making: Elements; Characteristics; Nature; Process; Classifications.

Unit - IV	ORGANIZATION THEORY	9 Periods

Organizational Conflict: Positive Aspects; Individual; Role; Interpersonal; Intra Group; Inter Group; Conflict Management – Maslow's hierarchy of needs theory; Herzberg's motivation-hygiene theory; McClelland's three needs motivation theory; Vroom's valence-expectancy theory – Change Management: Concept of Change; Lewin's Process of Change Model; Sources of Resistance; Overcoming Resistance; Guidelines to managing Conflict.

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Unit - V	PRODUCTIVITY AND MODERN TOPICS	9 Periods
Productivity: Concept; Measurements; Affecting Factors; Methods to Improve – Modern Topics (concept, feature/characteristics, procedure, merits and demerits): Business Process Reengineering (BPR); Benchmarking; SWOT/SWOC Analysis; Total Productive Maintenance; Enterprise Resource Planning (ERP); Management of Information Systems (MIS).		

TOTAL: 45 Periods

Text Books:	1. M. Govindarajan and S. Natarajan, "Principles of Management", Prentice Hall of India, New Delhi, 2009. 2. Koontz. H. and Weihrich. H., "Essentials of Management: An International Perspective", 8th Edition, Tata McGrawhill, New Delhi, 2010.
Reference Books:	1. Joseph J, Massie, "Essentials of Management", 4th Edition, Pearson Education, 1987. 2. Saxena, P. K., "Principles of Management: A Modern Approach", Global India Publications, 2009. 3. S.Chandran, "Organizational Behaviours", Vikas Publishing House Pvt. Ltd., 1994. 4. Richard L. Daft, "Organization Theory and Design", South Western College Publishing, 11th Edition, 2012. 5. S. TrevisCerto, "Modern Management Concepts and Skills", Pearson Education, 2018.
MOOC/Web Platforms:	1. https://nptel.ac.in/courses/110/107/110107146/ 2. https://www.coursera.org/learn/foundations-of-management 3. https://www.edx.org/learn/management

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the basic concepts of management and approaches to management.	Understand (K2)
CO2	Apply the planning; organizing and staffing functions of management in professional organization.	Apply (K3)
CO3	Apply the leading; controlling and decision making functions of management in professional organization.	Apply (K3)
CO4	Apply the organizational theory in professional organization.	Apply (K3)
CO5	Apply the principles of productivity and modern concepts in management in professional organization.	Apply (K3)

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V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO 2
CO1	3	2	1	1	1	1	1	1	2	2	1	1	1	-
CO2	3	2	2	1	1	1	1	1	2	2	1	1	1	-
CO3	3	3	2	2	2	1	1	1	3	2	1	2	1	-
CO4	3	3	2	2	2	1	1	1	3	3	2	2	1	-
CO5	3	3	3	2	3	1	1	1	3	3	2	2	1	-

Mapping: 1-Low, 2-Medium, 3-High

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XII– MANDATORY COURSES

I - Course Name: 23MC901 ENGLISH FOR COMMUNICATION

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All B.E/B.Tech Programmes	-	MC	3	0	0	0

II - Course Objectives

1	To improve the four essential skills of mastering the English language: Listening, Speaking, Reading, and Writing (LSRW)
2	To enhance students' confidence and fluency in communicating effectively in academic and professional contexts.
3	To develop vocabulary, pronunciation, and grammatical accuracy.

III - Course Content

Preamble:
The course English for Communication is designed to equip students with essential language skills required for effective communication in academic, professional, and social contexts. Emphasizing practical usage, the course focuses on developing proficiency in speaking, listening, reading, and writing.

Unit – I	Effective Listening	9 Periods
Active Listening: Techniques and Importance-Reasons for Poor Listening-Traits of a Good Listener-Listening Modes and Types-Barriers to Listening-Listening Practice: General vs. Specific Listening		
Unit – II	**Effective Speaking**	**9 Periods**
Basics of English Speech Sounds-Word and Sentence Stress-Intonation Patterns-Introducing Self and Others		
Unit – III	**Effective Communication**	**9 Periods**
Building Confidence and Fluency-Vocal Cues: Tone, Pitch, Rate of Speech-Telephone Etiquette and Real-life Conversations-Dialogue Writing		
Unit – IV	**Effective Reading**	**9 Periods**
Reading for Gist and Specific Information-Techniques: Skimming, Scanning, Predicting-SQ3R Reading Method-Study Skills for Comprehension		
Unit – V	**Effective Vocabulary Building**	**9 Periods**
Vocabulary Building: Prefixes, Suffixes, Synonyms, Antonyms, One-word Substitutes-Writing Sentences and Paragraphs-Writing for Digital Platforms-Précis Writing: Rules and Examples		

Total: 45 Periods

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Text Books:	1. M.V. Rodrigues, **"English for Effective Communication"**, Oxford University Press 2. Simon Sweeney, "**English for Business Communication**", Cambridge University Press
Reference Books:	1. Krishna Mohan & Meera Banerji, **"Developing Communication Skills"**, Macmillan India 2. Sanjay Kumar & Pushpa Lata, **"Communication Skills"**, Oxford University Press
MOOC/Web Platforms:	https://www.coursera.org/?utm_source=chatgpt.com https://www.edx.org/?utm_source=chatgpt.com https://www.udemy.com/?utm_source=chatgpt.com

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Demonstrate effective listening skills in academic and general contexts.	Apply (K3)
CO2	Communicate fluently and clearly using correct pronunciation, stress, and intonation.	Apply (K3)
CO3	Participate in conversations and telephonic communications with appropriate etiquette.	Apply (K3)
CO4	Comprehend and interpret various types of texts using reading strategies.	Analyze (K4)
CO5	Produce clear, well-structured written content with appropriate vocabulary and grammar.	Create (K6)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
CO-2	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
CO-3	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
CO-4	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
CO-5	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23MC902 INTRODUCTION TO WOMEN AND GENDER STUDIES

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All B.E/B.Tech Programmes	-	MC	3	0	0	0

II - Course Objectives

1	To familiarize students with basic gender-related concepts like sex, gender, patriarchy, and hegemony.
2	To critically examine different feminist theories and their contribution to gender discourse.
3	To trace the historical and socio-political development of women's movements globally and in India.
4	To analyze how language and media shape and reflect gender identities and representations.
5	To encourage critical thinking and resistance strategies against gender discrimination.

III - Course Content

Preamble: This course explores key gender concepts, feminist theories, and movements, focusing on the intersections of power, identity, and representation. It examines gender roles, media, and the impact of language in shaping societal norms.		
UNIT-I	**CONCEPTS**	**9 Periods**
Sex vs. Gender, masculinity, femineity, socialization, patriarchy, public/private, essentialism, binarism, power, hegemony, hierarchy, stereotype, gender roles, gender relation, deconstruction, resistance, sexual division labor.		
UNIT-II	**FEMINIST THEORY**	**9 Periods**
Liberal, Marxist, Socialist, Radical, Psychoanalytic, postmodernist, Ecofeminist, Gender Identity.		
UNIT-III	**WOMEN'S MOVEMENTS: GLOBAL, NATIONAL AND LOCAL.**	**9 Periods**
Rise of Feminism in Europe and America. Women's Movement in India.		
UNIT-IV	**GENDER AND LANGUAGE.**	**9 Periods**
Linguistic Form and Gender, Gender and narratives		
UNIT-V	**GENDER AND REPRESENTATION**	**9 Periods**
Advertising and popular visual media. Gender and Representation in Alternative Media. Gender and social media.		

Total: 45 Periods

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Text Books:	1. Connell, R.W. (1995). Gender. Cambridge: Polity Press. 2. Agarwal, B. (1988). Structures of Patriarchy: State, Community and Household in Modern South Asia. New Delhi: Kali for Women. 3. Vandana Shiva (1989). Staying Alive: Women, Ecology and Development. New Delhi: Kali for Women.
Reference Books:	1. Krishnaraj, Maithreyi (Ed.). (1985). Evolving New Methodologies in Research on Women's Studies. SNDT Women's University, Bombay. 2. Harding, Sandra (1987). Feminism and Methodology. Indiana University Press. 3. Rosemarie Tong (2009). Feminist Thought: A More Comprehensive Introduction. Westview Press. 4. Judith Butler (1990). Gender Trouble: Feminism and the Subversion of Identity. Routledge. 5. Radha Kumar (1993). The History of Doing: An Illustrated Account of Movements for Women's Rights and Feminism in India, 1800–1990. Kali for Women.
MOOC/Web Platforms:	https://archive.nptel.ac.in/courses/109/107/109107191/?utm_source=chatgpt.com

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand foundational gender concepts and their application in real-world contexts.	Understand (K2)
CO2	Apply feminist theoretical approaches to critique social norms and institutions.	Apply (K3)
CO3	Evaluate the role of social movements in shaping gender equality.	Evaluate (K5)
CO4	Examine gendered language patterns and narrative constructions.	Analyze (K4)
CO5	Analyze the portrayal and representation of gender in traditional and new media.	Analyze (K4)

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V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
CO-2	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
CO-3	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
CO-4	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
CO-5	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23MC903 DISASTER RISK REDUCTION AND MANAGEMENT

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All B.E/B.Tech Programmes	-	MC	3	0	0	0

II - Course Objectives

1.	To understand fundamental disaster concepts and different types of disasters.
2.	To learn Disaster Risk Reduction (DRR) principles and the phases of the disaster cycle.
3.	To Grasp India's disaster management laws, policies, and institutional structures.
4.	To identify and use key tools and technologies for disaster preparedness and response.
5.	To analyze real-world disaster scenarios and develop practical response planning skills.

III - Course Content

Preamble:
This course addresses the critical need to manage increasing disaster risks in our interconnected world. It focuses on reducing risks, building resilience, and fostering safety rather than just reacting to disasters.

Unit – I	HAZRADS, VULNERABILITY AND DISASTER RISKS	9 Periods

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Types of Disasters: Natural, Human induced, Climate change induced –Earthquake, Landslide, Flood, Drought, Fire etc – Technological disasters- Structural collapse, Industrial accidents, oil spills -Causes, Impacts including social, Economic, political, environmental, health, psychosocial, etc.- Disaster vulnerability profile of India and Tamil Nadu - Global trends in disasters: urban disasters, pandemics, Complex emergencies, - - Inter relations between Disasters and Sustainable development Goals.

Unit – II	DISASTER RISK REDUCTION (DRR)	9 Periods

Sendai Framework for Disaster Risk Reduction, Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community Based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions / Urban Local Bodies (PRIs/ULBs), States, Centre, and other stakeholders- Early Warning System – Advisories from Appropriate Agencies- Relevance of indigenous Knowledge, appropriate technology and Local resources.

Unit – III	DISASTER MANAGEMENT	9 Periods

Components of Disaster Management – Preparedness of rescue and relief, mitigation, rehabilitation and reconstruction- Disaster Risk Management and post disaster management – Compensation and Insurance- Disaster Management Act (2005) and Policy - Other related policies, plans, programmers and legislation - Institutional Processes and Framework at State and Central Level- (NDMA –SDMA-DDMA-NRDF- Civic Volunteers).

Unit – IV	TOOLS AND TECHNOLOGY FOR DISASTER MANAGEMENT	9 Periods

Early warning systems -Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment. - Elements of Climate Resilient Development –Standard

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operation Procedure for disaster response – Financial planning for disaster Management.		
Unit – V	**DISASTER MANAGEMENT: CASE STUDIES**	**9 Periods**
Discussion on selected case studies to analyse the potential impacts and actions in the contest of disasters-Landslide Hazard Zonation: Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.- Field work-Mock drill.		

Total: 45 Periods

Text Books:	1. Taimpo (2016), Disaster Management and Preparedness, CRC Publications 2. Singh R (2017), Disaster Management Guidelines for earthquakes, Landslides, Avalanches and tsunami, Horizon Press Publications 3. Singhal J.P. "Disaster Management", Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN- 13: 978-9380386423 4. Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India Education Pvt. Ltd., 2012. ISBN-10: 1259007367, ISBN-13: 978-1259007361]
Reference Books:	1. Govt. of India: Disaster Management Act, Government of India, New Delhi, 2005. 2. Government of India, National Disaster Management Policy, 2009. 3. Shaw R (2016), Community based Disaster risk reduction, Oxford University Press.
MOOC/Web Platforms:	https://onlinecourses.swayam2.ac.in/ini25_hs32/preview https://onlinecourses.swayam2.ac.in/cec25_hs135/preview https://onlinecourses.swayam2.ac.in/ntr25_ed61/preview

IV - Course Outcome

	On completion of the course, the students will be able to	Bloom's Level Mapped
CO1	Impart knowledge on the concepts of Disaster, Vulnerability and Disaster Risk reduction (DRR).	Apply (K3)
CO2	Enhance understanding on Hazards, Vulnerability and Disaster Risk Assessment prevention and risk reduction.	Apply (K3)
CO3	Develop disaster response skills by adopting relevant tools and technology.	Apply (K3)
CO4	Enhance awareness of institutional processes for Disaster response in the country.	Understand (K2)
CO5	Develop rudimentary ability to respond to their surroundings with potential Disaster response in areas where they live, with due sensitivity.	Apply (K3)

(Action verb of each CO to be matched with the next mapping table)
(For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

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V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	3	3	-	-	2	2	-	-	2	-	2	-	1
CO-2	3	3	3	3	-	-	2	1	-	-	2	-	2	-	1
CO-3	3	3	3	3	-	-	2	2	-	-	-	-	2	-	1
CO-4	3	3	3	3	-	-	2	1	-	-	2	-	2	-	1
CO-5	3	3	3	3	-	-	2	2	-	-	2	-	3	-	1

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23MC904 HISTORY OF SCIENCE AND TECHNOLOGY IN INDIA

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All B.E/B.Tech Programmes	-	MC	3	0	0	0

II - Course Objectives

1	To learn sources of history of Science, Technology and Medicine in Early India
2	To understand the development of Science and Technology in Medieval India.
3	To study the different scientific surveys and debates in British India.
4	To analyse the developments of Science, Technology and Medicine in Independent India.
5	To analyse the developments of Agriculture Technology and Harvesting in Independent India

III - Course Content

Preamble: Students will be able to: Understand the premises informing the twin themes of science and Technology, development of science, and origin of Agriculture in perspective.		
Unit – I	**CONCEPTS AND PERSPECTIVES**	**9 Periods**
Meaning of History Objectivity, Determinism, Relativism, Causation, Generalization in History; Moral judgment in history Extent of subjectivity, contrast with physical sciences, interpretation and speculation, causation verses evidence, concept of historical inevitability, Historical Positivism. Science and Technology- Meaning, Scope and Importance, Interaction of science, technology & society, Sources of history on science and technology in India.		
Unit – II	**HISTORIOGRAPHY OF SCIENCE AND TECHNOLOGY IN INDIA**	**9 Periods**
Introduction to the works of D.D. Kosambi, Dharmpal, Debiprasad Chattopadhyay, Rehman, S. Irfan Habib, Deepak Kumar, Dhruv Raina, and others.		
Unit – III	**SCIENCE AND TECHNOLOGY IN ANCIENT INDIA**	**9 Periods**
Technology in pre-historic period Beginning of agriculture and its impact on technology Science and Technology during Vedic and Later Vedic times Science and technology from 1st century AD to C-1200.		
Unit – IV	**SCIENCE AND TECHNOLOGY IN MEDIEVAL INDIA**	**9 Periods**
Legacy of Technology in Medieval India, Interactions with Arabs Development in medical knowledge, interaction between Unani and Ayurveda and alchemy Astronomy and Mathematics: interaction with Arabic Sciences Science and Technology on the eve of British conquest		

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Unit – V	AGRARIAN TECHNOLOGY: HISTORY OF AGRICULTURE AND HYDROLOGY	9 Periods
Plant science in ancient India – Knowledge of plants and agricultural practices - Agricultural tools and technology Water harvesting technology – Harappan, Mauryan, Gupta and Post Gupta eras		

Total: 45 Periods

Text Books:	1. Arnold, David, 1999. Science, Technology and Medicine in Colonial India, The New Cambridge History of India Series, Cambridge, Oxford University Press. 2. Bose, D. N., 1989. A Concise History of Science in India, New Delhi, Indian National Science Academy.
Reference Books:	1. Dharmapal, 1971. Indian Science and Technology in the Eighteenth Century, Delhi. Gopal, S. and Kumar Ravindra, Colonial Development, Education and Social Awareness up to 2000, PHISPC, Delhi, Oxford University Press. 2. 4.Jaggi, O. P., 1977. Medicines in Medieval India, Delhi, Atma Ram & Sons, Delhi. 3. 5.Jaggi, O. P., Dawn of Indian Technology (Pre & Proto Historic Period – Vol. I) (Vedic &Upnishadic Period – Vol. II) Indian System of Medicine Vo. IV, Indian Astronomy & Mathematics Vol. VI, Science & technology in Medieval – India Vol. VII, S. Delhi, Atma Ram & Sons.
MOOC/Web Platforms:	1. https://dst.gov.in/ 2. https://www.india.gov.in/topics/science-technology

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Explain the meaning, scope, and importance of science and technology and their interaction with society through historical perspectives.	Understand (K2)
CO2	Evaluate the impact of these historiographical works on the understanding of indigenous knowledge systems and colonial influence on science and technology.	Apply (K3)
CO3	Trace the evolution of science and technology in India from the 1st century AD to around 1200 AD.	Apply (K3)
CO4	Examine developments in medical knowledge, particularly the interplay between Unani, Ayurveda, and alchemy.	Analyze (K4)
CO5	Analyze the evolution of water harvesting and irrigation technologies during the Harappan, Mauryan, Gupta, and Post-Gupta periods	Analyze (K4)

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V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-2	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-3	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-4	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-5	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23MC905 POLITICAL AND ECONOMIC THROUGHT FOR A HUMANE SOCIETY

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All B.E/B.Tech Programmes	-	MC	3	0	0	0

II - Course Objectives

1	The course will start by exploring human needs and desires, and how various political and economic systems attempt to address them
2	The course will culminate in a critical assessment of the systems discussed, examining their past execution and exploring future prospects.

III - Course Content

Preamble:
This course explores political and economic ideas that shape just and equitable societies, emphasizing human dignity, inclusivity, and ethical responsibility.

Unit – I	**FOUNDATIONS OF A HUMANE SOCIETY**	**10 Periods**
Considerations for humane society, holistic thought, human being's desires, harmony in self, harmony in relationships, society, and nature, societal systems.		
Unit – II	**POLITICAL AND ECONOMIC SYSTEMS IN THE MODERN WORLD**	**9 Periods**
Capitalism – Free markets, demand-supply, perfect competition, laissez-faire, monopolies, imperialism. Liberal democracy, Fascism and totalitarianism. World War I and II.		
Unit – III	**FOUNDATIONS AND MODELS OF COMMUNISM**	**9 Periods**
Communism – Mode of production, theory of labour, surplus value, class struggle, dialectical materialism, historical materialism, Russian and Chinese models.		
Unit – IV	**THE WELFARE STATE AND HUMAN-CENTERED DEVELOPMENT**	**9 Periods**
Welfare state. Relation with human desires. Empowered human beings, satisfaction, Gandhian thought. Swaraj, Decentralized economy & polity,Community. Control over one's lives.		
Unit – V	**INDIAN CIVILIZATION AND THE SHAPING FORCES OF SOCIETY**	**9 Periods**
Relationship with nature, Essential elements of Indian civilization, Technology as driver of society, Role of education in shaping of society. Future directions		

Total: 45 Periods

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Text Books:	1. A. R. Nagaraj, " The Flaming Feet and other Essays: The Dalit Movement in India, "Seagull Books London Ltd. 2. "J. C. Kumarappa and Gandhi's Struggle for Economic Justice", Venu Madhav Govindu and Deepak Malghan, Oxford University Press; Illustrated edition (August 2016). 3. "The Theory of Moral Sentiments, Adam Smith, Penguin Classics; Anniversary edition (May 2010). 4. "The Principles of Political Economy", John Stuart Mill, Create Space Independent Pub (September 2016).
Reference Books:	1. Challengers to capitalism: Marx, Lenin, and Mao", John G. Gurley, San Francisco Book Co (January 1976) 2. " Small is Beautiful: Economics as if People Mattered", E. F. Schumacher, Harper Perennial; Reprint edition (October 2010) 3. " The History and Culture of the Indian People: Volume 9: British Paramountcy and Indian Renaissance Part I", R.C. Majumdar, Bhartiya Vidya Bhavan (January 2002)
MOOC/Web Platforms:	https://www.sistk.org/downloads/MATERIALS/23HS0814-UHV.pdf?utm_source=chatgpt.com https://www.investopedia.com/articles/investing/102914/main-characteristics-capitalist-economies.asp https://uhv.org.in/UHVII%20Course%20Material%202024/L%2022%20Sum%20Up%20and%20Program%20v5.pdf?utm_source=chatgpt.com

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Relationship with nature, Essential elements of Indian civilization, Technology as driver of society, Role of education in shaping of society. Future directions	Understand (K2)
CO2	Demonstrate the ability to analyze and resolve ethical dilemmas using principles of universal human values and ethical reasoning.	Understand (K2)
CO3	Develop an appreciation for cultural diversity and demonstrate behaviours that reflect sensitivity and respect for different cultural perspectives and practices.	Apply (K3)
CO4	Identify and engage in actions that reflect human values, contributing positively to their communities and promoting social harmony	Apply (K3)
CO5	Regularly reflect on theirpersonal development in terms of values and ethics, and articulateways in which they can continue to grow and apply these in their lives.	Apply (K3)

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V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	1	3	-	3	3	-	3	-	3	3	3	-	3	3	-
CO-2	1	3	-	2	3	-	3	2	2	3	3	1	2	3	-
CO-3	1	3	-	3	3	-	2	2	2	2	3	-	2	2	-
CO-4	1	3	-	2	2	-	2	3	2	3	1	-	3	2	-
CO-5	1	3	-	2	3	-	3	3	3	3	2	1	3	2	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23MC906 WELL BEING WITH TRADITIONAL PRACTICES - YOGA, AYURVEDA AND SIDDHA

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All B.E/B.Tech Programmes	-	MC	3	0	0	0

II - Course Objectives

1	To Understand the essential components of health and their importance.
2	To Develop confidence to maintain a healthy lifestyle.
3	To Learn effective techniques to prevent lifestyle-related disorders.
4	To Recognize the role of balanced diet and physical activity in health maintenance.
5	To Explore traditional systems like Ayurveda and Siddha for holistic well-being and disease prevention.

III - Course Content

Preamble: This course explores holistic health and wellness, emphasizing the importance of prevention over treatment. It delves into various dimensions of health—physical, mental, emotional, social, spiritual, and environmental—while highlighting the role of diet, traditional medicine, and lifestyle in disease prevention. With insights from modern science and ancient Indian systems like Ayurveda and Siddha, learners gain practical tools for maintaining well-being. The course also reflects on the relationship between civilization, nature, and technology in shaping future health and societal outcomes.

Unit – I	HEALTH AND ITS IMPORTANCE	9 Periods

Present health status -Definition -Importance of maintaining health – More importance on prevention than treatment. Ten types of health one has to maintain – Physical health – Mental health – Social health – Financial health – Emotional health – Spiritual health – Intellectual health – Relationship health – Environmental health – Occupational/Professional health

Types of diseases and disorders-The life expectancy-present status – mortality rate – dreadful diseases non-communicable diseases (NCDs) the leading cause of death – 60% – heart disease – cancer – diabetes – chronic pulmonary diseases – risk factors – tobacco – alcohol – unhealthy diet – lack of physical activities.

Types of diseases and disorders – Lifestyle disorders – Obesity – Diabetes – cardiovascular diseases - Cancer – Strokes – COPD – Arthritis – Mental health issues

Causes of the above diseases/disorders – Importance of prevention of illness – Takes care of health – Improves quality of life – Reduces absenteeism – Increase satisfaction – Saves time

Simple lifestyle modifications to maintain health – Healthy Eating habits (Balanced diet according to age) Physical Activities (Stretching exercise, aerobics, resisting exercise) – Maintaining BMI Importance and actions to be taken

Unit – II	DIET	9 Periods

Role of diet in maintaining health – energy one needs to keep active throughout the day – nutrients one needs for growth and repair – helps one to stay strong and healthy – helps to prevent diet-related illness, such as some cancers – keeps active and – helps one to maintain a healthy weight – helps to reduce risk of

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developing lifestyle disorders like diabetes – arthritis – hypertension – PCOD – infertility – ADHD – sleeplessness -helps to reduce the risk of heart diseases – keeps the teeth and bones strong. **Balanced Diet and its 7 Components** – Carbohydrates – Proteins – Fats – Vitamins – Minerals Fibre and Water. **Food additives and their merits & demerits** – Effects of food additives – Types of food additives Food additives and processed foods – Food additives and their reactions **Definition of BMI and maintaining it with diet** - Importance – Consequences of not maintaining BMI – different steps to maintain optimal BMI Nutrigenomics: How Food Influences Gene Expression. Anti-inflammatory and Immunomodulatory Diets in Traditional Medicine **Common cooking mistakes** - Different cooking methods, merits and demerits of each method		
Unit – III	**ROLE OF AYURVEDA & SIDDHA SYSTEMS IN MAINTAINING HEALTH**	**9 Periods**
AYUSH systems and their role in maintaining health – preventive aspect of AYUSH – AYUSH as a soft therapy. **Secrets of traditional healthy living** – Traditional Diet and Nutrition – Regimen of Personal and Social Hygiene – Daily routine (Dinacharya) – Seasonal regimens (Ritucharya) – basic sanitation and healthy living environment – Sadvritta (good conduct) – for conducive social life. **Principles of Siddha & Ayurveda systems** – Macrocosm and Microcosm theory – Pancheekarana Theory / (Five Element Theory) 96 fundamental Principles – Uyir Thathukkal (Tri-Dosha Theory) – Udal Thathukkal Tridosha Theory and Its Modern Biomedical Correlates. Rasayana and Kayakalpa: Traditional Rejuvenation Therapies. Role of Siddha Varma and Marma Therapies in Neurological and Musculoskeletal Health.		
Unit – IV	**MENTAL WELLNESS**	**9 Periods**
Emotional health – Definition and types – Three key elements: the subjective experience – the physiological response – the behavioral response – Importance of maintaining emotional health Role of emotions in daily life -Short term and long-term effects of emotional disturbances – Leading a healthy life with emotions – Practices for emotional health – Recognize how thoughts influence emotions – Cultivate positive thoughts – Practice self-compassion – Expressing a full range of emotions. **Stress management** – Stress definition – Stress in daily life – How stress affects one's life – Identifying the cause of stress – Symptoms of stress – Managing stress (habits, tools, training, professional help) – Complications of stress mismanagement. **Sleep** – Sleep and its importance for mental wellness – Sleep and digestion. **Immunity** – Types and importance – Ways to develop immunity		
Unit – V	**CIVILIZATION, NATURE, AND THE ROLE OF TECHNOLOGY**	**9 Periods**
Relationship with nature, Essential elements of Indian civilization, Technology as driver of society, Role of education in shaping of society. Future directions		

Total: 45 Periods

Reference Books:	1. WHAT WE KNOW ABOUT EMOTIONAL INTELLIGENCE How It Affects Learning, Work, Relationships, and Our Mental Health, by Moshe Zeidner, Gerald Matthews, and Richard D. Roberts 2. A Bradford Book, The MIT Press, Cambridge, Massachusetts, London, England 3. The Mindful Self-Compassion Workbook, Kristin Neff, Ph.D Christopher Germer, Ph.D, Published by The Guilford Press A Division of Guilford Publications, Inc.370 Seventh Avenue, Suite 1200, New York, NY 10001

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MOOC/ Web Platforms:	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4799645/ https://www.niddk.nih.gov/health-information/diet-nutrition/changing-habits-betterhealth#:~:text=Make%20your%20new%20healthy%20habit,t%20have%20time%20to%20cook. https://www.cdc.gov/nutrition/resources-publications/benefits-ofhealthy-eating.html

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Learn the importance of different components of health	Understand (K2)
CO2	Gain confidence to lead healthy life.	Apply (K3)
CO3	Learn new techniques to prevent lifestyle health disorders	Apply (K3)
CO4	Understand the importance of diet and workouts in maintaining health	Understand (K2)
CO5	Explore traditional health systems for holistic well-being and disease prevention.	Apply (K3)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
CO-2	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
CO-3	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
CO-4	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
CO-5	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23MC907 STATE NATION BUILDING POLICIES IN INDIA

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All B.E/B.Tech Programmes	-	MC	3	0	0	0

II - Course Objectives

1	To understand how the state operates through its main branches: the executive, legislature, and judiciary.
2	To familiarize the student with the foundational ideas of politics and sovereignty, and how they're changing in our interconnected world.
3	To familiarize the students with the historical journey of India's national movement and the evolution of its Constitution.
4	To make the students understand why India adopted a parliamentary-federal system and the core principles behind its Constitution.
5	To acquaint the student with the dynamic nature of India's political landscape, including current challenges in national integration and nation-building.

III - Course Content

Preamble:
From this course, understanding the political landscape, the functioning of the state, and the ongoing process of nation-building is crucial for truly impactful contributions. This course will equip the students with a nuanced perspective on how India, a vibrant and complex democracy, operates.

Unit – I	**State, Sovereignty, and Political Dynamics**	**8 Periods**
Understanding the need and role of State and politics. Development of Nation-State, sovereignty, sovereignty in a globalized world.		
Unit – II	**Structure and Functioning of the State**	**8 Periods**
Organs of State – Executive, Legislature, Judiciary. Separation of powers, forms of government- unitary-federal, Presidential-Parliamentary, The idea of India.		
Unit – III	**The Revolt of 1857 and the National Awakening**	**7 Periods**
1857 and the national awakening.		
Unit – IV	**Indian National Movement and Constitution Making**	**7 Periods**
1885 Indian National Congress and development of national movement – its legacies. Constitution making and the Constitution of India.		
Unit – V	**Foundations of Federalism and Nation-Building**	**7 Periods**
Goals, objective and philosophy. Why a federal system? National integration and nation-building.		
Unit – VI	**Contemporary Challenges and Future of Indian Politics**	**8 Periods**
Challenges of nation-building – State against democracy (Kothari) New social movements. The changing nature of Indian Political System, the future scenario. What can we do?		

Total: 45 Periods

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Text Books:	1. Sunil Khilnani, The Idea of India. Penguin India Ltd., New Delhi. 2. Madhav Khosla, The Indian Constitution, Oxford University Press. New Delhi, 2012. 3. Brij Kishore Sharma, Introduction to the Indian Constitution, PHI, New Delhi, latest edition. 4. Sumantra Bose, Transforming India: Challenges to the World's Largest Democracy, Picador India, 2013. 5. Atul Kohli, Democracy and Discontent: India's Growing Crisis of Governability, Cambridge University Press, Cambridge, U. K., 1991. 6. M. P. Singh and Rekha Saxena, Indian Politics: Contemporary Issues and Concerns, PHI, New Delhi, 2008, latest edition. 7. Rajni Kothari, Rethinking Democracy, Orient Longman, New Delhi, 2005.
Reference Books:	1. D. D. Basu, *Introduction to the Constitution of India*. LexisNexis/PHI Learning. 2. Granville Austin, The Indian Constitution: Cornerstone of a Nation. Oxford University Press. 3. Ramachandra Guha, India After Gandhi: The History of the World's Largest Democracy. Picador India. 4. Christophe Jaffrelot, The Hindu Nationalist Movement and Indian Politics. Penguin India.
MOOC/Web Platforms:	https://onlinecourses.nptel.ac.in/noc25_lw05/preview https://onlinecourses.nptel.ac.in/noc25_lw19/preview

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Grasp the theoretical aspect of the state, its various organs, and how they function.	Apply (K3)
CO2	Understand the historical context and philosophical basis of India's current political system.	Apply (K3)
CO3	Identify the major challenges and ongoing efforts related to national integration and nation-building in India.	Apply (K3)
CO4	Develop a clear and accurate understanding of India's political system and processes.	Understand (K2)
CO5	Critically analyze to improve civic participation and contribute to better governance and public service delivery.	Apply (K3)

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V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	1	1	-	3	-	2	2	-	1	3	-	2	-
CO-2	3	3	1	1	-	3	-	2	2	-	1	3	-	2	-
CO-3	3	3	1	1	-	3	-	2	2	-	1	3	-	2	-
CO-4	3	3	1	1	-	3	-	2	2	-	1	3	-	2	-
CO-5	3	3	-	-	-	3	-	2	2	-	-	2	-	2	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23MC908 INDUSTRIAL SAFETY

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All B.E/B.Tech Programmes	-	MC	3	0	0	0

II - Course Objectives

1	To impart knowledge on different facets and aspects of engineering systems
2	To understand the Focusing on Tools, and the techniques.
3	To study the Methodologies needed for prevention of Occurence
4	To analyse the accidents under different industrial settings
5	To analyse the Environmental condition to avoid noise pollution

III - Course Content

Preamble:		
Unit – I	SAFETY TERMINOLOGIES	9 Periods
Hazard-Types of Hazard- Risk-Hierarchy of Hazards Control Measures-Lead indicators- lag Indicators-Flammability- Toxicity Time-weighted Average (TWA) – Threshold LimitValue (TLV) – Short Term Exposure Limit (STEL)- Immediately dangerous to life or health (IDLH)- acute and chronic effects- Routes of Chemical Entry-Personnel Protective Equipment- Health and Safety Policy-Material Safety Data Sheet MSDS		
Unit – II	STANDARDS AND REGULATIONS	9 Periods
Indian Factories Act-1948- Health- Safety- Hazardous materials and Welfare- ISO 45001:2018 occupational health and safety (OH&S) – Occupational Safety and Health Audit IS14489:1998- Hazard Identification and Risk Analysis- code of practice IS 15656:2006		
Unit – III	SAFETY ACTIVITIES	9 Periods
Toolbox Talk- Role of safety Committee- Responsibilities of Safety Officers and Safety Representatives-Safety Training and Safety Incentives- Mock Drills- On-site Emergency Action Plan- Off-site Emergency Action Plan- Safety poster and Display- Human Error Assessment		
Unit – IV	WORKPLACE HEALTH AND SAFETY	9 Periods
Noise hazard- Particulate matter- musculoskeletal disorder improper sitting poster and lifting Ergonomics RULE & REBA- Unsafe act & Unsafe Condition- Electrical Hazards- Crane Safety- Toxic gas Release		
Unit – V	ENVIRONMENTAL CONTROL	9 Periods
Industrial Health Hazards – Environmental Control – Industrial Noise – Noise measuring instruments, Control of Noise, Vibration – Personal Protection.		

Total: 45 Periods

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Reference Books:	1. R.K. Jain and Prof. Sunil S. Rao Industrial Safety, Health and Environment Management Systems KHANNA PUBLISHER 2. L. M. Deshmukh Industrial Safety Management: Hazard Identification and Risk Control McGraw-Hill Education 3. Frank Lees (2012) 'Lees' Loss Prevention in Process Industries.Butterworth-Heinemann publications, UK, 4th Edition. 4. John Ridley & John Channing (2008)Safety at Work: Routledge, 7th Edition. 5. Dan Petersen (2003) Techniques of Safety Management: A System Approach.. 6. Alan Waring.(1996).Safety management system: Chapman &Hall,EnglandSociety of Safety Engineers, USA
MOOC/Web Platforms:	https://archive.nptel.ac.in/courses/110/105/110105094/ https://www.shiksha.com/online-courses/industrial-safety-courses-certification-training-by-nptel-st575-tg1307

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the concepts of flammability, toxicity, and various exposure limits.	Apply (K3)
CO2	Explain the key provisions of the Indian Factories Act and apply the principles of ISO 45001:2018	Apply (K3)
CO3	Identify the responsibilities and duties of Safety Officers and Safety Representatives in ensuring compliance with safety protocols and regulations.	Apply (K3)
CO4	Identify and assess common workplace hazards such as noise, particulate matter, and toxic gas release, and evaluate their impact on worker health.	Analyze (K4)
CO5	Describe the sources and effects of industrial noise and use noise measuring instruments to assess workplace noise levels.	Analyze (K4)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-2	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-3	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-4	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-5	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23MC909 INDIAN CONSTITUTION

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All B.E/B.Tech Programmes	-	MC	3	0	0	0

II - Course Objectives

1	Understand the basics of Constitution of India – meaning, nature, fundamental right and duties.
2	Explain the parliamentary system of the government and the relationship between the governments
3	Detail the powers and functions of Central government
4	Detail the powers and functions of State government

III - Course Content

Preamble: Students will be able to: Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional
• Role and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism. To address the role of socialism in India after the commencement of the Bolshevik
• Revolutionin1917and its impact on the initial drafting of the Indian Constitution.

Unit – I	**HISTORY OF MAKING OF THE INDIAN CONSTITUTION**	**9 Periods**
History, Drafting Committee, (Composition & Working)		
Unit – II	**PHILOSOPHY OF THE INDIAN CONSTITUTION**	**9 Periods**
Preamble, Salient Features		
Unit – III	**CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES**	**9 Periods**
Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.		
Unit – IV	**ORGANS OF GOVERNANCE**	**9 Periods**
Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.		
Unit – V	**INDIAN SOCIETY**	**9 Periods**
Nature, Meaning and definition; Indian Social Structure; Caste, Religion, Language in India; Constitutional Remedies for citizens – Political Parties and Pressure Groups; Right of Women, Children and Scheduled Castes and Scheduled Tribes and other Weaker Sections.		

Total: 45 Periods

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Reference Books:	1.The Constitution of India,1950(Bare Act),Government Publication 2.Dr.S.N.Busi, Dr.B. R.Ambedkar framing of Indian Constitution,1st Edition, 2015. 3.M.P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis,2014. 4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015
MOOC/Web Platforms:	https://onlinecourses.nptel.ac.in/noc20_lw02/preview

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Describe the historical background and events that led to the framing of the Indian Constitution.	Apply (K3)
CO2	Identify and analyze the salient features of the Indian Constitution, including federalism, parliamentary democracy, secularism, and the rule of law.	Apply (K3)
CO3	Explain the significance and scope of Fundamental Rights enshrined in the Indian Constitution and their role in ensuring individual liberty and equality	Apply (K3)
CO4	Describe the qualifications and disqualifications of Members of Parliament and assess their significance in maintaining democratic integrity	Analyze (K4)
CO5	Analyze the structure of Indian society, including the role and interrelationship of caste, religion, and language.	Analyze (K4)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-2	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-3	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-4	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-5	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23MC910 ELEMENTS OF LITERATURE

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All B.E/B.Tech Programmes	-	MC	3	0	0	0

II - Course Objectives

1	To identify and define the fundamental elements of literature, including plot, character, setting, theme, point of view, tone, and style.
2	To analyze literary works across various genres such as fiction, poetry, and drama using appropriate literary terminology.
3	To interpret how literary devices and techniques contribute to the meaning and impact of a text.

III - Course Content

Preamble: The course Elements of Literature is designed to introduce students to the foundational components of literary works and to cultivate an appreciation for the art of storytelling. Through the study of various genres, styles, and cultural contexts, students will develop critical reading, analytical, and interpretive skills.

Unit – I	**INTRODUCTION TO LITERATURE**	**9 Periods**
Nature, purpose, and scope of literature - Functions of literature: Emotional, social, moral, aesthetic - Literature as a reflection of life and a tool for transformation – Enhancing reading, writing, critical thinking, and discussion through literature - Understanding catharsis and human empathy through texts.		
Unit – II	**ELEMENTS OF FICTION**	**9 Periods**
Fiction, fact, and literary truth-Narrative techniques and perspectives - Plot structure: exposition, conflict, climax, resolution -Characterization: dynamic vs static, round vs flat - Setting, theme, tone, and atmosphere.		
Unit – III	**ELEMENTS OF POETRY**	**9 Periods**
Emotions, imagination, and subjective experience – Figurative language: simile, metaphor, conceit, symbol, pun, irony - Devices of sound: alliteration, assonance, rhyme, rhythm - Poetic forms: sonnet, ballad, haiku, free verse - Personification, animation, rhetorical trends.		
Unit – IV	**ELEMENTS OF DRAMA**	**9 Periods**
Drama as a performative and representational art - Dramatic modes and structural components: act, scene, dialogue - Theatrical performance and stage directions - Drama as narration, mediation, and persuasion - Features of tragedy, comedy, satire.		
Unit – V	**INTRODUCTION TO LITERARY CRITICISM**	**9 Periods**
What is literary theory? - Brief overview of major schools: Formalism, Marxism, Psychoanalysis, Feminism - Applying critical perspectives to text interpretation - Writing literary analysis: structure, thesis, evidence, citation - Interdisciplinary connections: literature and society, history, psychology.		

Total: 45 Periods

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Reference Books:	1. Literature: An Introduction to Fiction, Poetry, Drama, and Writing by X.J. Kennedy & Dana Gioia 2. How to Read Literature Like a Professor by Thomas C. Foster 3. Beginning Theory: An Introduction to Literary and Cultural Theory by Peter Barry

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	**Recall** the fundamental elements of literature such as plot, character, setting, theme, and point of view.	Understand (K2)
CO2	**Apply** literary terms and concepts to analyze a variety of genres, including fiction, poetry, and drama.	Apply (K3)
CO3	**Analyze** how cultural, historical, and social contexts influence literary works and their interpretations.	Analyze (K4)
CO4	**Create** well-organized written and oral analyses that demonstrate critical thinking and insight into literary texts.	Create (K6)
CO5	**Compare and contrast** different literary works and traditions to identify unique and shared features.	Analyze (K4)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
CO-2	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
CO-3	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
CO-4	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
CO-5	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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XIII - PROFESSIONAL ELECTIVE COURSES: VERTICALS

I - Course Name: 23PAD09 KNOWLEDGE ENGINEERING

Prerequisite	Programme Name	Sem	Category	L	T	P	C
NIL	B.E/B.Tech. – Common to CSE, IT and AI&DS	V/VI/ VII	PEC	2	0	2	3

II - Course Objectives

1.	Understand the Foundations of Knowledge-Based Systems
2.	Learn Knowledge Representation Techniques
3.	Develop Skills in Knowledge Acquisition and Modeling
4.	To apply reasoning with ontologies and rules
5.	To understand learning and rule learning.

III - Course Content

Preamble:
This course is designed to equip learners with the theoretical foundations and practical methodologies required to build knowledge-based systems. It emphasizes logical reasoning, probabilistic inference, fuzzy logic, and structured knowledge representation, which together form the core of intelligent behavior in machines.

Unit – I	REASONING UNDER UNCERTAINTY C	6 Periods

Introduction – Abductive reasoning – Probabilistic reasoning: Enumerative Probabilities – Subjective Bayesian view – Belief Functions – Baconian Probability – Fuzzy Probability – Uncertainty methods-Evidence-based reasoning – Intelligent Agent – Mixed-Initiative Reasoning – Knowledge Engineering. Bayesian reasoning, belief functions, and fuzzy logic

Unit – II	METHODOLOGY AND MODELING	6 Periods

Conventional Design and Development – Development tools and Reusable Ontologies – Agent Design and Development using Learning Technology – Problem Solving through Analysis and Synthesis – Inquiry-driven Analysis and Synthesis – Evidence-based Assessment – Believability Assessment – Drill-Down Analysis, Assumption-based Reasoning, and What-If Scenarios. Introduces agent architecture, decision models, and design methodologies.

Unit – III	ONTOLOGIES – DESIGN AND DEVELOPMENT	6 Periods

Concepts and Instances – Generalization Hierarchies – Object Features – Defining Features – Representation – Transitivity – Inheritance – Concepts as Feature Values – Ontology Matching.
Design and Development Methodologies – Steps in Ontology Development – Domain Understanding and Concept Elicitation – Modelling-based Ontology Specification

Unit – IV	REASONIING WITH ONTOLOGIES AND RULES	6 Periods

Production System Architecture – Complex Ontology-based Concepts – Reduction and Synthesis rules and the Inference Engine – Evidence-based hypothesis analysis – Rule and Ontology Matching– Partially Learned Knowledge – Reasoning with Partially Learned Knowledge. Covers production rules, Drools/CLIPS-style systems in depth

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Unit – V	LEARNING AND RULE LEARNING	6 Periods
Machine Learning – Concepts – Generalization and Specialization Rules – Types – Formal definition of Generalization. Modelling, Learning and Problem Solving – Rule learning and Refinement –Overview – Rule Generation and Analysis – Hypothesis Learning. NLP-based Knowledge Acquisition		

TOTAL: 30 Periods

PRACTICAL EXERCISES:

1. Perform operations with Evidence Based Reasoning.
2. Perform Evidence based Analysis.
3. Perform operations on Probability Based Reasoning.
4. Perform Believability Analysis.
5. Implement Rule Learning and refinement.
6. Perform analysis based on learned patterns.
7. Construction of Ontology for a given domain.

TOTAL : 30 Periods

TOTAL : 30+30=60 Periods

Text Books:	1. Gheorghe Tecuci, Dorin Marcu, Mihai Boicu, David A. Schum, Knowledge Engineering Building Cognitive Assistants for Evidence-based Reasoning, Cambridge University Press, First Edition, 2016. (Unit 1 – Chapter 1 / Unit 2 – Chapter 3,4 / Unit 3 – Chapter 5, 6 / Unit 4 - 7 , Unit 5 – Chapter 8, 9)
Reference Books:	1. Ronald J. Brachman, Hector J. Levesque: Knowledge Representation and Reasoning, Morgan Kaufmann, 2004. 2. Ela Kumar, Knowledge Engineering, I K International Publisher House, 2018. 3. John F. Sowa: Knowledge Representation: Logical, Philosophical, and Computational Foundations, Brooks/Cole, Thomson Learning, 2000. 4. King , Knowledge Management and Organizational Learning , Springer, 2009. 5. Jay Liebowitz, Knowledge Management Learning from Knowledge Engineering, 1st Edition,2001
MOOC/Web Platforms:	https://nptel.ac.in/courses/106106179

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IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the core concepts and scope of knowledge engineering, including types and sources of knowledge.	Understand (K2)
CO2	Apply various knowledge representation techniques such as logic, frames, semantic networks, and ontologies	Apply (K3)
CO3	Analyze reasoning techniques under uncertainty, including fuzzy logic, Bayesian inference, and belief networks	Apply (K3)
CO4	Design intelligent agents and rule-based systems using appropriate knowledge engineering methodologies	Apply (K3)
CO5	Develop and reason with ontologies using semantic web technologies like RDF, OWL, and SPARQL	Apply (K3)

(Action verb of each CO to be matched with the next mapping table)
(For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	1	1	1	1	1	-	-	1	2	1	2	1	1	1
CO-2	3	2	3	2	2	-	-	-	2	2	1	1	2	1	2
CO-3	2	2	3	2	2	-	-	-	1	2	2	2	1	2	1
CO-4	2	2	3	1	1	-	-	-	2	2	2	2	2	2	2
CO-5	2	2	2	1	1	-	-	-	2	2	1	2	1	2	2

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23PAD06 RECOMMENDER SYSTEMS

Prerequisite	Programme Name	Sem	Category	L	T	P	C
NIL	B.E/B.Tech. – Common to CSE, IT and AI&DS	V/VI/VII	PEC	2	0	2	3

II - Course Objectives

1.	To understand the fundamentals, types, and significance of recommender systems in real-world applications.
2.	To explore collaborative and content-based filtering techniques using various similarity measures.
3.	To apply matrix factorization, hybrid models, and neural approaches like GNNs and NCF for recommendation.
4.	To address challenges such as cold start, sparsity, and bias while designing effective recommender
5.	To evaluate recommendation models using standard metrics and analyze use cases from platforms like Netflix and Amazon.

III - Course Content

Preamble:
This course introduces the fundamentals and techniques of Recommender Systems used in domains like e-commerce and entertainment. It covers collaborative, content-based, and hybrid models, along with recent advancements like deep learning and GNNs. Students will learn to build, evaluate, and improve recommendation models using real-world data and tools.

Unit – I	**Introduction to Recommender Systems**	**6 Periods**
Definition and importance-Use cases: E-commerce, entertainment, social media-Types: Collaborative filtering, content-based filtering, hybrid systems-Challenges: cold start, sparsity, scalability-Graph Neural Networks (GNNs) for recommendation		
Unit – II	**Similarity Measures and Collaborative Filtering**	**6 Periods**
User-user and item-item filtering-Cosine similarity, Jaccard similarity, Pearson correlation-Model-based vs. memory-based methods-Clustering and neighborhood models-Reinforcement Learning in Recommender Systems		
Unit – III	**Content-Based Filtering and Feature Engineering**	**6 Periods**
User profiling and item profiling-Term Frequency-Inverse Document Frequency (TF-IDF)-Feature weighting and dimensionality reduction-Advantages and limitations of content-based models-Privacy and Bias Mitigation		
Unit – IV	**Matrix Factorization and Hybrid Systems**	**6 Periods**
Latent factor models: SVD, NMF-Hybrid models: switching, feature combination, meta-level-Integration of knowledge-based and demographic recommenders-Neural Collaborative Filtering (NCF)		
Unit – V	**Evaluation and Advanced Topics**	**6 Periods**
Evaluation metrics: RMSE, MAE, Precision, Recall, NDCG, MAP-Cross-validation techniques-Recent advances: Deep learning, graph-based recommender systems-Case studies: Netflix, Amazon, Spotify.		

TOTAL: 30 Periods

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PRACTICAL EXERCISES:

1. Build a basic movie recommendation engine using user ratings (MovieLens dataset)
2. Explore types of recommender systems using sample datasets
3. Implement user-user collaborative filtering
4. Implement item-item collaborative filtering using Cosine and Pearson similarity
5. Build a content-based recommender using TF-IDF for books/movies
6. Develop item profiles and compute similarities
7. Implement hybrid recommender: weighted combination of CF and CBF
8. Apply SVD/NMF for dimensionality reduction
9. Evaluate recommender system using MAE, RMSE, Precision, Recall, NDCG
10. A/B testing simulation for different algorithms

TOTAL : 30 Periods
TOTAL : 30+30=60 Periods

Text Books:	1. Charu C. Aggarwal, Recommender Systems: The Textbook, Springer, 2016. 2. Dietmar Jannach , Markus Zanker , Alexander Felfernig and Gerhard Friedrich, Recommender Systems: An Introduction, Cambridge University Press (2011), 1st ed. 3. Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, Mining of massive datasets, 3rd edition, Cambridge University Press, 2020
Reference Books:	1. Francesco Ricci , Lior Rokach , Bracha Shapira , Recommender Sytems Handbook, 1st ed,Springer (2011)
MOOC/Web Platforms:	https://www.coursera.org/specializations/recommender-systems

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Identify various types of recommender systems and the challenges in designing them.	Understand (K2)
CO2	Apply similarity metrics to implement collaborative and content-based filtering	Apply (K3)
CO3	Analyze and evaluate matrix factorization and hybrid methods.	Apply (K3)
CO4	Design and implement a recommender model with real-world datasets.	Apply (K3)
CO5	Assess recommendation quality using suitable evaluation metrics.	Apply (K3)

(Action verb of each CO to be matched with the next mapping table)
(For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

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V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	2	-	-	-	-	-	-	-	1	-	2	2	-	3
CO-2	3	3	2	2	3	-	-	-	-	2	-	2	3	2	3
CO-3	3	2	3	2	3	-	-	-	-	2	-	2	3	3	3
CO-4	3	3	3	3	3	-	-	-	1	2	1	2	3	3	3
CO-5	3	3	2	3	3	2	-	2	2	3	2	3	3	3	3

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23PAD16 REINFORCEMENT LEARNING

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E/B.Tech. – Common to CSE, IT and AI&DS	V/VI/ VII	PEC	2	0	2	3

II - Course Objectives

1.	To introduce the key concepts and mathematical foundations of reinforcement learning.
2.	To explore Markov Decision Processes (MDPs) and dynamic programming-based solution techniques.
3.	To apply TD learning, function approximation, and policy gradient methods in RL.
4.	To understand and implement deep reinforcement learning methods including DQN and hierarchical models.
5.	To explore advanced topics like POMDPs and evaluate RL applications in real-world domains.

III - Course Content

Preamble:
This course introduces the foundational concepts and algorithms in Reinforcement Learning (RL), where agents learn optimal behavior through trial and error.It covers Markov Decision Processes, policy evaluation, TD learning, deep RL methods like DQN, and real-world applications including POMDPs.

Unit – I	**Foundations of Reinforcement Learning**	**6 Periods**
Introduction to Reinforcement Learning – Agent-Environment interaction, Rewards, Returns-Exploration-Exploitation trade-offs – Multi-armed Bandit Problem-Bandit Algorithms: Upper Confidence Bound (UCB), Probably Approximately Correct (PAC) bounds-Median Elimination Algorithm for Bandit-Introduction to Policy Gradient Methods		
Unit – II	**Markov Decision Processes and Solution Methods**	**6 Periods**
Markov Decision Processes (MDPs) – Definitions, Examples-Bellman Equations – State Value Functions, Action Value Functions-Bellman Optimality Principle-Dynamic Programming – Value Iteration, Policy Iteration-Temporal Difference (TD) Methods – TD(0), TD(λ), SARSA		
Unit – III	**Advanced Reinforcement Learning Techniques**	**6 Periods**
Eligibility Traces – TD(λ) and n-step methods-Function Approximation – Linear Function Approximation, Nonlinear Function Approximation-Bias-Variance Trade-offs in Approximation		
Unit – IV	**Deep Reinforcement Learning and Hierarchical Methods**	**6 Periods**
Fitted Q-learning – Concept and Implementation-Deep Q-Networks (DQN) – Architecture, Experience Replay, Target Networks-Hierarchical Reinforcement Learning – Options Framework, Temporal Abstraction		
Unit – V	**Advanced Topics and Applications**	**6 Periods**
Partially Observable Markov Decision Processes (POMDPs)- Approximate Solution Methods for POMDPs-Applications of POMDPs in Real-World Problems-Future Directions in Reinforcement Learning		

TOTAL: 30 Periods

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PRACTICAL EXERCISES:

1. Implement ε-greedy and UCB algorithms for Multi-Armed Bandit problem
2. Solve Markov Decision Processes using Policy Iteration and Value Iteration
3. Implement SARSA and Q-Learning algorithms on FrozenLake environment
4. Apply linear function approximation with Temporal Difference learning
5. Build and train a Deep Q-Network (DQN) for CartPole environment
6. Design a simple Hierarchical RL agent using Options framework
7. Simulate a Partially Observable Markov Decision Process (POMDP) environment and implement approximate solution

TOTAL : 30 Periods

TOTAL : 30+30=60 Periods

Text Books:	1. Richard S.Sutton and Andrew G.Barto, Reinforcement learning: An introduction, Second Edition, MIT Press, 2019. 2. Michael Hu, The Art of Reinforcement Learning – Fundamentals, Mathematics and Implementations with Python, Apress, 2024.
Reference Books:	1. Sudharsan Ravichandiran, Deep Reinforcement Learning with Python, Second Edition, Packet Publishing, Birmingham, 2020. 2. Csaba Szepesvari, Algorithms for Reinforcement Learning (Synthesis Lectures on Artificial Intelligence & Machine Learning), Morgan & Claypool Publishers, 2010. 3. Laura Graesser and Wah Loon Keng, Foundations of Deep Reinforcement learning: theory and Practice in Python, Pearson India, New Delhi, 2022.
MOOC/Web Platforms:	https://www.coursera.org/specializations/reinforcement-learning

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Explain fundamental RL concepts and bandit algorithms	Understand (K2)
CO2	Solve MDPs using Bellman equations and TD methods	Understand (K2)
CO3	Apply advanced RL techniques like eligibility traces and function approximation.	Apply (K3)
CO4	Develop deep RL models and hierarchical learning structures	Apply (K3)
CO5	Model and solve problems under uncertainty using POMDPs	Apply (K3)

(Action verb of each CO to be matched with the next mapping table)
(For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

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V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	2	-	1	-	-	-	-	-	-	-	2	2	-	-
CO-2	3	3	2	3	2	-	-	-	-	1	-	2	3	2	-
CO-3	2	2	3	2	2	1	-	-	2	2	1	2	3	2	-
CO-4	3	3	2	3	2	-	-	-	-	1	-	3	3	3	-
CO-5	3	3	2	3	3	1	-	-	-	2	-	3	3	3	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23PAD08 SOFT COMPUTING

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E/B.Tech. – Common to CSE, IT and AI&DS	V/VI/ VII	PEC	2	0	2	3

II - Course Objectives

1.	Classify the various soft computing frame works
2.	Be familiar with the design of neural networks, fuzzy logic and fuzzy systems
3.	Learn mathematical background for optimized genetic programming
4.	Design and Implement Soft Computing-Based Solutions
5.	Be exposed to neuro-fuzzy hybrid systems and its applications

III - Course Content

Preamble:
This course introduces the foundational principles and techniques of Soft Computing, including Fuzzy Logic, Artificial Neural Networks, Genetic Algorithms, and Probabilistic Reasoning. These methods do not rely on exact models but instead mimic human reasoning to arrive at satisfactory solutions with limited or imprecise data.

Unit – I	**Introduction to Soft Computing**	**6 Periods**
Introduction to Soft Computing: Artificial Intelligence, Neural Networks, Fuzzy Systems, Genetic Algorithms, Swarm Intelligence. McCulloch & Pitts model, Hebbian and Delta learning rules, Perceptron, Adaline, Madaline. Soft vs Hard computing, soft computing characteristics, Applications in robotics, NLP, medical diagnosis.		
Unit – II	**Artificial Neural Networks**	**6 Periods**
Backpropagation, Kohonen maps, Learning Vector Quantization, Hamming NN, Hopfield NN, BAM, ART, SVM. Spike neural networks, Deep learning transition from soft computing.		
Unit – III	**Fuzzy Logic Systems**	**6 Periods**
Classical & fuzzy sets, fuzzy relations, membership functions, defuzzification, arithmetic, rule base, reasoning, Fuzzy controllers, TSK model, Fuzzy clustering (FCM)		
Unit – IV	**Genetic Algorithms**	**6 Periods**
Concepts, encoding, fitness, reproduction, crossover, mutation, convergence. Multi-objective GA, Pareto optimality, evolutionary strategy (ES)		
Unit – V	**Hybrid Systems**	**6 Periods**
Combining ANN, Fuzzy, GA; Fuzzy BP, fuzzy neuron, fuzzy ART. Neuro-fuzzy inference systems (ANFIS), Evolutionary neural networks, applications in adaptive control		

TOTAL: 30 Periods

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PRACTICAL EXERCISES:	TOTAL: 30 Periods

1. Design and Implementation of a Fuzzy Inference System
2. Classification Using a Discrete Perceptron Model
3. Implementation of XOR Function Using Backpropagation Algorithm
4. Implementation of Self-Organizing Maps for a Specific Application
5. Maximization of a Function Using Genetic Algorithm
6. Implementation of a Two-Input Sine Function
7. Implementation of a Three-Input Nonlinear Function

TOTAL: 60 Periods

Text Books:	1. K. K. Mishra, N. Das, P. K. Sa,Soft Computing: Fundamentals and Applications, Springer, 2024
Reference Books:	1. S. Rajasekaran, G. A. Vijayalakshmi Pai, Neural Networks, Fuzzy Systems and Evolutionary Algorithms, PHI, 2023 2. F. O. Karry, C. V. Thomas, Soft Computing and Intelligent Systems Design, Pearson, 2023 3. Timothy J. Ross, Fuzzy Logic with Engineering Applications, Wiley, 2020 4. Sandhya Samarasinghe, Introduction to Artificial Neural Networks and Deep Learning, CRC Press, 2021 5. J. Sivanandam, S. N. Deepa, Genetic Algorithms: Concepts and Applications, Springer, 2020B. K. Tripathy, J. Anuradha, Soft Computing Techniques and Applications, OUP, 2019
MOOC/Web Platforms:	https://nptel.ac.in/courses/106106179

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the fundamentals and scope of soft computing.	Understand (K2)
CO2	Apply neural networks for pattern recognition and classification.	Apply (K3)
CO3	Design fuzzy logic systems and apply fuzzy inference.	Apply (K3)
CO4	Solve optimization problems using genetic algorithms.	Apply (K3)
CO5	Develop hybrid systems using neural, fuzzy, and evolutionary models.	Apply (K3)

(Action verb of each CO to be matched with the next mapping table)
(For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

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V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	2	-	-	1	-	-	-	-	-	-	2	3	3	2
CO-2	2	3	2	2	2	-	-	-	-	-	-	2	2	2	2
CO-3	3	3	3	2	2	-	-	-	-	-	-	2	3	2	3
CO-4	2	2	3	2	3	-	-	-	-	-	-	2	2	2	3
CO-5	3	3	3	2	3	-	-	-	-	-	-	2	3	2	3

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23PAD07 TEXT AND SPEECH ANALYSIS

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E/B.Tech. – Common to CSE, IT and AI&DS	V/VI/VII	PEC	2	0	2	3

II - Course Objectives

1.	Understand the basics of how computers process text and speech.
2.	Learn common tools and models used in NLP and speech applications.
3.	Apply machine learning and deep learning to solve text and speech problems.
4.	Build simple systems for tasks like speech recognition and text-to-speech.
5.	Evaluate how well NLP and speech systems perform.

III - Course Content

Preamble:
This course introduces the fundamental concepts of Natural Language and Speech Processing. It covers core techniques for analyzing and modeling text and speech data, including preprocessing, classification, recognition, and synthesis. Learners will gain hands-on experience with tools like NLTK, spaCy, and Praat to build real-world NLP and speech applications.

Unit – I	Foundations of Text and Speech	6 Periods
Foundations of Natural Language Processing (NLP) - Levels of NLP: Morphological, Syntactic, Semantic. Basics of Speech Production and Phonetics - Structural comparison of text vs. speech - Regular Expressions in NLP -Tools introduction: NLTK, spaCy, Praat		
Unit – II	**Text Processing and Representation**	**6 Periods**
Text preprocessing: Tokenization, Stop-word Removal, Stemming, Lemmatization - Feature Representation: Bag of Words, N-Grams, TF-IDF - Word Embeddings:Word2Vec, GloVe, FastText -Text Classification: Naive Bayes, SVM - Overview of Deep Learning Models: RNN, Transformers - Introduction to Topic Modeling and Text Summarization		
Unit – III	**Integrated Text and Speech Systems**	**6 Periods**
Question Answering Systems: IR-based, Knowledge-based, Language model-based QA -Dialogue Systems and chatbots - Named Entity Recognition using CRF, LSTM -WordNet and Word Sense Disambiguation		
Unit – IV	**Speech Analysis and Recognition**	**6 Periods**
Basics of Speech Signals and Phonetic Features - Feature Extraction: MFCC, LPC, PLP, GFCC - Acoustic Models: HMM, DNN-HMM, DTW - Speech Recognition Pipeline: Viterbi Algorithm, CTC - ASR Evaluation: Word Error Rate		
Unit – V	**Text-to-Speech (TTS) Synthesis**	**6 Periods**
TTS Pipeline:Text Normalization - Phoneme Conversion - Audio generation ,TTS Approaches: Concatenative, Parametric, Deep Learning-based (Tacotron, WaveNet), Vocoding and Spectrogram Generation, Evaluation Metrics for TTS: MOS Score		

TOTAL: 30 Periods

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PRACTICAL EXERCISES:

1. Text Cleaning and Preprocessing
2. Text Representation using Bag of Words and TF-IDF
3. Word Embeddings using Word2Vec
4. Named Entity Recognition (NER)
5. Basic Speech Signal Visualization and MFCC Extraction
6. Simple Automatic Speech Recognition (ASR) using Pretrained
7. Text-to-Speech Conversion using pyttsx3

TOTAL : 30 Periods

TOTAL : 30+30=60 Periods

Text Books:	1. Daniel Jurafsky and James H. Martin, Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition, 3rd Draft Edition, 2021. 2. Steven Bird, Ewan Klein, and Edward Loper, Natural Language Processing with Python: Analyzing Text with the Natural Language Toolkit, O'Reilly Media, 2009. 3. Lawrence R. Rabiner and Ronald W. Schafer, Theory and Applications of Digital Speech Processing, Pearson, 2010.
Reference Books:	1. John Atkinson-Abutridy, Text Analytics: An Introduction to the Science and Applications of Unstructured Information Analysis, CRC Press, 2022. 2. Jim Schwoebel, Introduction to Voice Computing in Python, NeuroLex, 2018. 3. Lawrence Rabiner, Biing-Hwang Juang, and B. Yegnanarayana, Fundamentals of Speech Recognition, Pearson, 2009. 4. Bhargav Srinivasa-Desikan, Natural Language Processing and Computational Linguistics: A Practical Guide to Text Analysis with Python, Gensim, spaCy, and Keras, Packt Publishing, 2018. 5. Dipanjan Sarkar, Text Analytics with Python: A Practical Real-World Approach to Gaining Actionable Insights from Your Data, APress, 2018. 6. Tanveer Siddiqui and U. S. Tiwary, Natural Language Processing and Information Retrieval, Oxford University Press, 2008.
MOOC/Web Platforms:	https://huggingface.co/learn/audio-course

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IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Analyze the structure and meaning of text using rule-based and statistical methods.	Apply (K3)
CO2	Use machine learning models to classify text and recognize named entities.	Apply (K3)
CO3	Build question answering and chatbot systems using language models.	Apply (K3)
CO4	Process speech signals and build basic speech recognition systems.	Apply (K3)
CO5	Create and test a text-to-speech system using modern techniques.	Apply (K3)

(Action verb of each CO to be matched with the next mapping table)
(For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	2	3	1	3	-	-	-	1	2	1	2	1	1	1
CO-2	3	1	2	1	3	-	-	-	2	2	1	3	3	2	1
CO-3	2	2	1	3	1	-	-	-	3	3	1	2	3	3	1
CO-4	2	1	1	1	2	-	-	-	2	1	2	2	3	1	1
CO-5	1	3	2	2	1	-	-	-	3	2	1	1	2	3	1

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23PAD01 BUSINESS ANALYTICS

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E/B.Tech. – Common to CSE, IT and AI&DS	V/VI/VII	PEC	2	0	2	3

II - Course Objectives

1.	Introduce the fundamentals and characteristics of Business Analytics and its role in decision-making.
2.	To differentiate between Business Intelligence, Business Analytics, and understand the data science process.
3.	To equip students with knowledge of data management, preprocessing, integration, and modern data platforms.
4.	To develop skills in applying Descriptive, Predictive, and Prescriptive analytics using statistical and machine learning techniques.
5.	To enable learners to use analytics tools like Excel, Python, Power BI, and Tableau across various business functions

III - Course Content

Preamble:
Business Analytics empowers organizations to make data-driven decisions by analyzing business data.This course covers Descriptive, Predictive, and Prescriptive analytics with real-world applications. Students will learn data management, data science processes, and visualization using tools like Power BI and Tableau.

Unit – I	**INTRODUCTION TO BUSINESS ANALYTICS**	**6 Periods**
Introduction to Business Analytics – Characteristics – Business Intelligence vs Business Analytics – Data science process – Descriptive Analytics.Emerging trends in analytics, Applications in finance, marketing, and HR.		
Unit – II	**BUSINESS INTELLIGENCE**	**6 Periods**
Data Management – Data quality, Data integration – Data pre-processing – ETL – Data warehouses. Cloud-based data platforms, Data lakes, NoSQL databases.		
Unit – III	**BUSINESS FORECASTING**	**6 Periods**
Predictive Analytics – Regression analysis, Logistic regression, Time series analysis, Forecasting models. Decision trees, Random forest, Gradient boosting.		
Unit – IV	**HR & SUPPLY CHAIN ANALYTICS**	**6 Periods**
Prescriptive Analytics – Optimization, Linear programming, Simulation, Decision analysis. Heuristic optimization, Solver tools in Excel and Python.		
Unit – V	**MARKETING & SALES ANALYTICS**	**6 Periods**
Business Analytics applications – Marketing, Financial, HR, and Supply Chain Analytics. AI in Business Analytics, Dashboards, Power BI/Tableau tools		

TOTAL: 30 Periods

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PRACTICAL EXERCISES:

Use MS-Excel and Power-BI to perform the following experiments using a Business data set, and make presentations.

Students may be encouraged to bring their own real-time socially relevant data set.

I Cycle – MS Excel

1. Explore the features of Ms-Excel.
2. (i) Get the input from user and perform numerical operations (MAX, MIN, AVG, SUM, SQRT, ROUND) ii) Perform data import/export operations for different file formats.
3. Perform statistical operations - Mean, Median, Mode and Standard deviation, Variance, Skewness, Kurtosis
4. Perform Z-test, T-test & ANOVA
5. Perform data pre-processing operations i) Handling Missing data ii) Normalization
6. Perform dimensionality reduction operation using PCA, KPCA & SVD
7. Perform bivariate and multivariate analysis on the dataset.
8. Apply and explore various plotting functions on the data set.

II Cycle – Power BI Desktop

9. Explore the features of Power BI Desktop
10. Prepare & Load data
11. Develop the data model
12. Perform DAX calculations
13. Design a report
14. Create a dashboard and perform data analysis
15. Presentation of a case study

TOTAL : 30 Periods

TOTAL : 30+30=60 Periods

Text Books:	1. R. Evans James, Business Analytics, 2nd Edition, Pearson, 2017 2. R N Prasad, Seema Acharya, Fundamentals of Business Analytics, 2nd Edition, Wiley, 2016 3. Philip Kotler and Kevin Keller, Marketing Management, 15th edition, PHI, 2016 4. VSP RAO, Human Resource Management, 3rd Edition, Excel Books, 2010. 5. Mahadevan B, "Operations Management -Theory and Practice",3rd Edition, Pearson Education,2018.
Reference Books:	1. U. Dinesh Kumar, Foster Provost, Tom Fawcett, Data Science for Business, O'Reilly, 2021 2. S. Christian Albright, Wayne Winston, Business Analytics: Data Analysis and Decision Making, Cengage, 2022 3. Chris Anderson, Analytics in Practice: A Guide for Business Managers, Pearson, 2019 4. Wes McKinney, Python for Data Analysis, O'Reilly, 2023 5. Anil Maheshwari, Data Analytics Made Accessible, Amazon Digital, 2022
MOOC/Web Platforms:	https://onlinecourses.swayam2.ac.in/ntr25_ed73/preview

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IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the fundamentals of business analytics and its scope.	Understand (K2)
CO2	Perform data preprocessing and manage data for analytics tasks.	Apply (K3)
CO3	Apply predictive modelling techniques for business forecasting	Apply (K3)
CO4	Use optimization and prescriptive tools for business decisions	Apply (K3)
CO5	Build dashboards and use BI tools for data visualization and interpretation	Apply (K3)

(Action verb of each CO to be matched with the next mapping table)
(For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	2	2	1	2	-	1	1	-	1	2	-	2	2	2	1
CO-2	2	2	2	2	2	-	-	-	1	2	1	2	2	2	2
CO-3	2	2	2	2	2	-	-	-	1	2	1	2	2	3	2
CO-4	2	2	2	2	2	-	-	-	1	2	1	2	3	3	2
CO-5	2	2	2	2	3	-	-	-	1	3	2	2	3	3	3

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23PAD04 IMAGE AND VIDEO ANALYTICS

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E/B.Tech. – Common to CSE, IT and AI&DS	V/VI/ VII	PEC	2	0	2	3

II - Course Objectives

1.	To understand the fundamentals of image and video representation and processing.
2.	To apply modern deep learning models for object detection, segmentation, and classification.
3.	To explore generative and transformer-based models for image and video synthesis.
4.	To design real-time video analytics pipelines using standard tools and frameworks.
5.	To investigate self-supervised and few-shot learning approaches in visual understanding

III - Course Content

Preamble:
This course provides students with foundational and advanced concepts of image and video analytics. It covers data representation, feature extraction, object detection, deep learning models, and real-time analytics. Learners gain hands-on experience with industry tools, deep generative models, and emerging techniques such as transformers and self-supervised learning.

Unit – I	**FOUNDATIONS OF IMAGE AND VIDEO ANALYTICS**	**6 Periods**
Visual sensing and camera models – Image and video representation – Tools: OpenCV, PIL, skimage – Color models – Filtering and edge detection – Frame extraction and compression techniques.		
Unit – II	**VISUAL FEATURES AND SELF-SUPERVISED LEARNING**	**6 Periods**
Feature descriptors: ORB, SIFT, HOG – Optical flow methods – Self-supervised learning (SimCLR, DINO) – Applications in low-data environments.		
Unit – III	**OBJECT DETECTION USING MACHINE LEARNING**	**6 Periods**
CNN and Vision Transformer models – DETR, Segment Anything Model (SAM), CLIP – Object detection frameworks: YOLO, R-CNN.		
Unit – IV	**GENERATIVE VISION AND VIDEO MODELS**	**6 Periods**
GANs (StyleGAN, CycleGAN) – Diffusion models – Video synthesis – Prompt-based generation – Applications in editing and enhancement.		
Unit – V	**APPLICATIONS, DEPLOYMENT & TRENDS**	**6 Periods**
Action recognition (SlowFast, MoViNet) – Edge device analytics – Anomaly detection – Explainable AI – Trends: NeRF, Multimodal AI.		

TOTAL: 30 Periods

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PRACTICAL EXERCISES:

1. Write a program that computes the T-pyramid of an image.
2. Write a program that derives the quad tree representation of an image using the homogeneity criterion of equal intensity
3. Develop programs for the following geometric transforms: (a) Rotation (b) Change of scale (c) Skewing (d) Affine transform calculated from three pairs of corresponding points (e) Bilinear transform calculated from four pairs of corresponding points.
4. Develop a program to implement Object Detection and Recognition
5. Develop a program for motion analysis using moving edges, and apply it to your image sequences.
6. Develop a program for Facial Detection and Recognition
7. Write a program for event detection in video surveillance system

TOTAL : 30 Periods

TOTAL : 30+30=60 Periods

Text Books:	1. Milan Sonka, Vaclav Hlavac, Roger Boyle, "Image Processing, Analysis, and Machine Vision", 4nd edition, Thomson Learning, 2013. 2. Vaibhav Verdhan,(2021, Computer Vision Using Deep Learning Neural Network Architectures with Python and Keras,Apress 2021(UNIT-III,IV and V)
Reference Books:	1. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer Verlag London 2. Limited,2011. 2. Caifeng Shan, FatihPorikli, Tao Xiang, Shaogang Gong, "Video Analytics for Business Intelligence", Springer, 2012. 3. . D. A. Forsyth, J. Ponce, "Computer Vision: A Modern Approach", Pearson Education, 2003 4. E. R. Davies, (2012), "Computer & Machine Vision", Fourth Edition, Academic Press.
MOOC/Web Platforms:	https://onlinecourses.nptel.ac.in/

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IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand image and video data representations and processing pipelines	Understand (K2)
CO2	Apply modern deep learning architectures for visual recognition and segmentation.	Apply (K3)
CO3	Implement generative and transformer-based models for image and video synthesis.	Apply (K3)
CO4	Design and evaluate real-time analytics pipelines using industry tools.	Apply (K3)
CO5	Explore self-supervised and few-shot learning paradigms for visual understanding.	Apply (K3)

(Action verb of each CO to be matched with the next mapping table)
(For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	2	2	1	2	2	-	-	-	1	2	1	2	2	2	1
CO-2	2	2	2	2	2	-	-	-	1	2	1	2	2	2	2
CO-3	2	2	2	2	2	-	-	-	1	2	1	2	2	3	2
CO-4	2	2	2	2	2	-	-	-	1	2	1	2	3	3	2
CO-5	2	2	2	2	3	-	-	-	1	3	2	2	3	3	3

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I -Course Name: 23PAD902 COMPUTER VISION

Prerequisite	Programme Name	Sem	Category	L	T	P	C
23AD402 – Machine Learning	B.Tech AI&DS	V/VI/VII	PEC	2	0	2	3

II - Course Objectives

1.	To introduce the fundamental concepts of computer vision, including image formation and basic image processing techniques.
2.	To equip students with techniques for feature extraction and image segmentation to enable meaningful interpretation of visual data.
3.	To provide practical exposure to machine learning and neural network algorithms used in computer vision tasks.
4.	To develop analytical skills to handle 3D vision tasks such as stereo vision, motion estimation, and scene reconstruction.
5.	To enable students to design and evaluate deep learning models for advanced vision applications like object detection and real-time systems.

III - Course Content

Preamble: The Computer Vision course introduces core concepts of image formation, processing, and analysis. Students learn feature extraction, segmentation, and object recognition using classical and deep learning methods. The course covers 2D/3D vision tasks, motion analysis, and real-world applications like surveillance and autonomous driving. Emerging trends like vision transformers and self-supervised learning are also explored.

UNIT–I	Introduction and Image Processing	6 Periods
Introduction to Computer Vision: Definition, Scope, Applications, Recent Trends-Basic Image Processing: Geometric primitives and transformations - Photometric image formation - The digital camera - Point operators - Linear filtering - More neighborhood operators - Fourier transforms - Pyramids and wavelets - Global optimization-Case Study: Preprocessing Satellite Images for Agricultural Analysis		
UNIT–II	**Feature Extraction and Image Segmentation**	**6 Periods**
Edge Detection: Canny Edge Detector-Corner Detection: Harris and Shi-Tomasi- Feature Matching Techniques and Applications (Object Tracking, AR)-Image Segmentation Region Growing, Edge Based approaches to segmentation, Graph-Cut, Mean-Shift, MRFs, Texture Segmentation Case Study: Automatic Crack Detection in Pavement Images		
UNIT–III	**Deep Learning for Computer Vision**	**6 Periods**
CNN Basics and Architecture-Image Classification with CNN-Transfer Learning (VGG, ResNet)-Image Segmentation (Mask R-CNN, U-Net Overview)-Real-Time Applications: Gesture Recognition, OCR, Face Recognition -Case Study: Face Mask Detection using CNNs		

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UNIT–IV	3D Reconstruction	6 Periods
3D Reconstruction: Shape from X - Active range finding - Surface representations - Point-based representations Volumetric representations - Model-based reconstruction - Recovering texture maps - *Case Study:* 3D Reconstruction of Indoor Scenes using SfM		
UNIT–V	**Advanced Vision Techniques and Applications**	**6 Periods**
Object Detection and Recognition: R-CNN, Fast R-CNN, YOLO, SSD, Face Detection & Recognition-Semantic and Instance Segmentation: SegNet-Video Processing and Action Recognition: Optical Flow in Video, Activity Recognition, Object Tracking in Videos-Recent Trends: Zero-shot and Few-shot Learning, Self-supervised Learning, Vision Transformers. Case Study: Autonomous Vehicle Perception using YOLO and Mask R-CNN		

TOTAL: 30 Periods

PRACTICAL EXERCISES:	**30 Periods**
1.OpenCV Installation and Basic Image Operations (load, crop, resize, thresholding)	
2.Image Annotation (drawing lines, text, shapes)	
3.Image Enhancement (color spaces, histogram equalization, smoothing, edge detection)	
4.Feature Detection and Matching (ORB, SIFT, SURF, feature alignment)	
5.Image Segmentation (Graphcut / Grabcut methods)	
6.Camera Calibration (circular grid method)	
7.Pose Estimation	
8.3D Reconstruction from multiple views/stereo images	
9.Creating Depth Map from Stereo Images	
10.Object Detection and Tracking (Kalman Filter, Camshift)	

TOTAL : 30+30=60 Periods

Text Books:	1. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer- Texts in Computer Science, Second Edition, 2022. 2. Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, Second Edition, 2015.
Reference Books:	1. Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004. Christopher M. Bishop; Pattern Recognition and Machine Learning, Springer, 2006 3. E. 3. R. Davies, Computer and Machine Vision, Fourth Edition, Academic Press, 2012.
MOOC/Web Platforms:	https://onlinecourses.nptel.ac.in/noc25_cs143/preview

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IV- Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Explain the fundamentals of computer vision, image formation, and basic image processing operations	Understand (K2)
CO2	Apply feature extraction and segmentation techniques to analyze and interpret image data	Apply (K3)
CO3	Implement machine learning and neural network algorithms for visual recognition tasks	Apply (K3)
CO4	Analyze 3D vision tasks such as stereo imaging, motion estimation, and structure from motion	Apply (K3)
CO5	Develop and evaluate deep learning models for object detection, segmentation, and real-time vision applications	Apply (K3)

(Action verb of each CO to be matched with the next mapping table)

V- Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	2	2	1	2	2	-	-	1	2	1	2	2	2	1	2
CO-2	2	2	2	2	2	-	-	1	2	1	2	2	2	2	2
CO-3	2	2	2	2	2	-	-	1	2	1	2	2	2	2	2
CO-4	2	2	2	2	2	-	-	1	2	1	2	2	2	2	2
CO-5	2	2	2	2	2	-	-	1	2	1	2	2	2	2	2

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23PIT01 WEB TECHNOLOGIES

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E/B.Tech. – Common to CSE, IT and AI&DS	V/VI/VII	PEC	2	0	2	3

II - Course Objectives

1.	To understand the basic technologies used in web development.
2.	To learn client-side and server-side scripting using JavaScript, PHP, and Java.
3.	To build and deploy Java-based web applications using Servlets, JSP, and session management.
4.	To develop dynamic web applications using modern frameworks and databases
5.	To connect web applications to databases and use modern web frameworks for development.

III - Course Content

Preamble:

This course offers a strong foundation in web development, covering both front-end and back-end technologies. Students will learn to build responsive websites using HTML, CSS, JavaScript, and Bootstrap. It includes server-side programming with Java, PHP, and frameworks like AngularJS and React. The course also covers database integration and real-world case studies for practical learning.

Unit – I	**HTML 5, CSS 3, WEB 2.0**	**6 Periods**
HTML – Lists- Tables- Images- Forms- Media- Responsive Design- Bootstrap. CSS – Inline - Internal- External Style Sheets- Selectors- Box Model- Positioning-Flex/Grid Layouts-Transitions Animations		
Unit – II	**CLIENT SIDE SCRIPTING**	**6 Periods**
JavaScript – Syntax- Variables- Control Structures- Functions- Arrays- Events- Built-in Objects- Dynamic HTML- DOM Manipulation- Form Validation- Exception Handling- JSON.		
Unit – III	**INTRODUCTION TO PHP**	**6 Periods**
Web Servers – XAMPP- LAMPP- - Java Web Technologies – Servlets- Java Servlet Architecture – Servlet Life Cycle- Node.js-NPM- Callbacks-Events- Express framework-Cookies-Sessions- MeteorJS framework		
Unit – IV	**INTRODUCTION TO PHP AND XML**	**6 Periods**
PHP – Syntax- Variables- String Processing- Regular Expressions- Form Processing- Session Handling- Cookies- Dynamic Content- Business Logic.		
Unit – V	**WEB APPLICATIONS**	**6 Periods**
Database Connectivity – MySQL with Java (JDBC)- PHP (MySQLi)-Web Frameworks – MVC framework- AngularJS- React- Node.js- Express- Django.-Case Studies – Student Information System- Health Management System.		

TOTAL : 30 Periods

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PRACTICAL EXERCISES:

1. Create an HTML page with an image map and clickable hotspots that display related information on click.
2. Design a web page using all types of CSS: inline, internal, and external.
3. Implement client-side form validation using JavaScript/DHTML.
4. Install and configure Apache Tomcat web server.
5. Write Java Servlets to:
   - Handle form submissions from HTML pages
   - Implement session tracking
6. Develop JSP applications with database connectivity for:
   - Online examination system
   - Displaying student marks from a database
7. Create and validate XML documents using XML Schema.
8. Use XSLT/XSL to transform XML data into HTML or other formats.
9. Set up Node.js with Express and build a simple REST API returning JSON data.
10. Build a dynamic front-end web page using React or AngularJS.

TOTAL : 30 Periods

TOTAL : 30+30=60 Periods

Text Books:	1.Deitel and Deitel and Nieto, Internet and World Wide Web - How to Program, Prentice Hall, 5th Edition, 2011. 2.Jeffrey C and Jackson, Web Technologies A Computer Science Perspective, Pearson Education, 2011 3.Brad Dayley, Node.js, MongoDB, and AngularJS Web Development, Addison Wesley,2014 4.Morris Mano, Digital logic and Computer design,4th Edition, Pearson,2008.
Reference Books:	1.Stephen Wynkoop and John Burke "Running a Perfect Website", QUE, 2nd Edition, 1999. 2.Chris Bates, Web Programming – Building Intranet Applications, 3rd Edition, Wiley Publications, 2009. 3.Gopalan N.P. and Akilandeswari J., "Web Technology", Prentice Hall of India, 2011. 4.Uttam K.Roy, "Web Technologies", Oxford University Press, 2011. 5.Angular: Up and Running: Learning Angular, Step by Step, Shyam Seshadri, 1st edition, O'Reilly 6.JonDuckett,HTML &CSS Design and Build Websites, Wiley,2011 7.JonDuckett, JavaScript and JQuery: Interactive Front-End Web Development, Wiley,2014
MOOC/Web Platforms:	https://www.techtarget.com https://developer.mozilla.org/ https://html.spec.whatwg.org/ https://css-tricks.com/

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IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	To create responsive web pages using HTML, CSS, Bootstrap, and XML.	Apply (K3)
CO2	To build dynamic web pages using JavaScript with form validation and JSON.	Analyze (K4)
CO3	To develop server-side applications using Java Servlets, Node.js, and Express.	Evaluate (K5)
CO4	To use PHP to handle forms, sessions, cookies, and create dynamic content.	Apply (K3)
CO5	To connect web applications to databases and use frameworks like AngularJS, React, and Django.	Create (K6)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ Pos	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	2	3	2	3	-	-	-	-	2	-	3	2	1	3
CO-2	3	3	3	2	3	-	-	-	-	2	-	3	2	1	3
CO-3	3	3	3	2	3	-	-	-	-	2	-	3	2	1	3
CO-4	3	2	3	-	3	-	-	-	-	1	-	3	2	1	3
CO-5	3	3	3	2	3	-	-	-	-	-	-	3	2	1	3

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23PIT02 APP DEVELOPMENT

Prerequisite	Programme Name	Sem	Category	L	T	P	C
NIL	B.E/B.Tech. – Common to CSE, IT and AI&DS	V/VI/ VII	PEC	2	0	2	3

II - Course Objectives

1.	To provide a foundational understanding of web and mobile application development concepts, including industry trends and emerging technologies.
2.	To enable students to design and develop user-centric applications using modern frontend frameworks and UI/UX principles.
3.	To introduce backend development techniques, secure coding practices, and API integration for robust and dynamic applications.
4.	To incorporate cloud computing, AI, and machine learning tools into application development for scalability and performance.
5.	To develop students' skills in app testing, debugging, and end-to-end project execution through practical, industry-aligned exercises.

III - Course Content

Preamble:

This course provides an in-depth understanding of web and mobile application development, covering both frontend and backend technologies alongside industry-relevant tools and frameworks. Students will learn to design responsive user interfaces, develop secure and scalable applications, and integrate cloud-based services and AI functionalities.

Unit – I	**INTRODUCTION TO APP DEVELOPMENT**	**6 Periods**
Basics of Web and Mobile application development, Native App, Hybrid App, Cross-platform App Native vs hybrid vs web apps App development lifecycle-Industry trends and emerging technologies		
Unit – II	**FRONTEND DEVELOPMENT & UI/UX DESIGN**	**6 Periods**
HTML, CSS, JavaScript basics-React Native & Flutter framework for app development-UI/UX principles: usability, accessibility, responsive design-Wireframing and prototyping		
Unit – III	**BACKEND DEVELOPMENT & SECURITY**	**6 Periods**
Server-side programming (Node.js, Python) Database systems: MySQL, Firebase API development and integration-Secure coding practices, authentication techniques (OAuth, JWT), encryption		
Unit – IV	**CLOUD COMPUTING & AI IN APP DEVELOPMENT**	**6 Periods**
Cloud-based deployment and scalability- AI and Machine Learning integration in apps-Data analytics and recommendations systems-Performance optimization and debugging		

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Unit – V	APP TESTING, DEBUGGING & PROJECT DEVELOPMENT	6 Periods
Testing methodologies (Unit, Integration, Functional)-Debugging techniques and tools Industry best practices for deployment- Capstone Project – End-to-end application development		

TOTAL : 30 Periods

PRACTICAL EXERCISES:

1.Create a BMI Calculator using React Native
2. Build an Expense Manager App
3.Develop a Unit Conversion App
4.Design a To-Do App
5.Design a User Login Screen using Apache Cordova
6.Build a GPS-based Location Finder using Apache Cordova
7.Create an Android Library App using Java and SQLite
Extend Library App to include Book Lending and Reservation
8.Consume a REST API and Display Fetched Data
9.Capstone Project: Design and Deploy a Cross-Platform App

TOTAL : 30 Periods

TOTAL : 30+30=60 Periods

Text Books:	1."Mobile App Development with React Native" by Ethan Holmes & Tom Bray, O'Reilly. 2. "Flutter for Beginners" by Alessandro Biessek, Packt Publishing. 3."Node.js, MongoDB, and Angular Web Development" by Brad Dayley, Pearson.
Reference Books:	1. "Learning React Native" by Bonnie Eisenman, O'Reilly. 2."Pro Git" by Scott Chacon and Ben Straub (available free at git-scm.com). 3. "Cloud Computing: Concepts, Technology & Architecture" by Thomas Erl.
MOOC/Web Platforms:	https://www.coursera.org/ https://www.udemy.com/ https://www.edx.org/

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IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO-1	Apply the fundamentals of web and mobile technologies including HTML, CSS, JavaScript, and UI/UX principles to design responsive user interfaces.	Apply (K3)
CO-2	Develop cross-platform applications using frameworks like React Native and Flutter, incorporating wireframing, prototyping, and hybrid/native approaches.	Develop (K6)
CO-3	Integrate server-side programming and databases (Node.js, Python, MySQL, Firebase) to implement dynamic and data-driven applications. (K3)	Apply (K3)
CO-4	Implement secure coding practices, API integration, authentication techniques (OAuth, JWT), and deploy scalable apps using cloud services.	Implement (K4)
CO-5	Analyze and optimize app performance using testing methodologies and debugging tools, and develop an end-to-end Capstone Project applying industry practices.	Analyze (K6)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ Pos	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	3	3	2	2	1	-	2	2	1	1	3	3	1
CO-2	3	3	3	3	2	2	2	-	2	3	2	1	3	3	1
CO-3	3	3	3	3	3	2	2	-	2	3	2	1	3	3	1
CO-4	3	3	3	3	3	2	2	-	2	3	2	2	3	3	1
CO-5	3	3	3	3	3	2	2	-	3	3	2	2	3	3	1

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23PIT03 CLOUD SERVICES MANAGEMENT

Prerequisite	Programme Name	Sem	Category	L	T	P	C
23AD404-Networking Essentials	B.E/B.Tech. – Common to CSE, IT and AI&DS	V/VI/VII	PEC	2	0	2	3

II - Course Objectives

1.	Introduce Cloud Service Management terminology, definition & concepts
2.	Compare and contrast cloud service management with traditional IT service management
3.	Identify strategies to reduce risk and eliminate issues associated with adoption of cloud services
4.	Select appropriate structures for designing, deploying and running cloud-based services in a business environment
5.	Illustrate the benefits and drive the adoption of cloud-based services to solve real world problems

III - Course Content

Preamble: This course provides a comprehensive overview of cloud service management principles, strategies, and operations. It covers cloud service models, architecture, governance, and financial aspects like FinOps and TCO. Learners will gain insights into designing, deploying, and managing secure and scalable cloud services across hybrid and multi-cloud environments.

Unit – I	CLOUD SERVICE MANAGEMENT FUNDAMENTALS	6 Periods

Cloud Ecosystem & Stakeholders, Evolution ITSM to Cloud SM, Cloud-native vs Traditional, Cloud Service Management, Service Perspectives, Cloud Service Models (IaaS, PaaS, SaaS), Multi-cloud & Hybrid Models, Cloud Automation.

Unit – II	CLOUD SERVICES STRATEGY	6 Periods

Cloud Strategy Lifecycle, Cloud Strategy Management Framework,Adoption Frameworks (AWS CAF, Azure CAF, Google CCAI), Key Drivers, Risk Mitigation, Cloud Architecture:Microservices,Containers, Kubernetes;Change Management, Governance as Code

Unit – III	Cloud Service Design & Operations	6 Periods

Basics of Cloud Service Design, Cloud Service Reference Model, Cloud service lifecycle, SLAs & SLOs, Design Patterns, service operations, Legacy Modernization, benchmarking, Cloud Service Deployment and Migration, Cloud Marketplace, Cloud Service Operations Management

Unit – IV	CLOUD SERVICE ECONOMICS	6 Periods

Pricing models for Cloud Services, Freemium, Pay Per Reservation, Pay per User, Subscription based Charging, economics of cloud, Capex vs Opex Shift, FinOps practices, sustainability aspects

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Unit – V	Cloud Governance, Security & Compliance	6 Periods
IT Governance Definition, Cloud Governance Definition, Cloud Governance Framework, Governance Models & Maturity, Security (Zero Trust, IAM), Compliance (GDPR, HIPAA), Shared Responsibility, Risk Management, Value Measurement, Ethics & Sustainability, Measuring the value of Cloud Services, Balanced Scorecard, Total Cost of Ownership		

TOTAL: 30 Periods

PRACTICAL EXERCISES:

1. Create and manage a Cloud Organization using AWS/GCP/Azure/OpenStack.
2. Configure IAM roles, policies, and permission boundaries for secure access.
3. Set up monitoring dashboards (Grafana) and alerts using cloud-native tools.
4. Create a Cost-model for a web application using various services and do Cost-benefit analysis
5. Compare multi-cloud pricing for a web-based application using cost calculators.
6. Create Billing alerts for your Cloud Organization
7. Compare Cloud cost for a simple web application across AWS, Azure and GCP and suggest the best one

TOTAL : 30 Periods

TOTAL: 30+30=60 Periods

Text Books:	1. Mehul Mahrishi Kamal Kant Hiran, Ruchi Doshi, Dr. Fagbola Temitayo, "Cloud Computing", BPB Publications, First Edition,2019. 2. Shailendra Singh, "Cloud Computing", Oxford University Press, First edition, 2018.
Reference Books:	1. Economics of Cloud Computing by Praveen Ayyappa, LAP Lambert Academic Publishing 2. Mastering Cloud Computing Foundations and Applications Programming Rajkumar Buyya, Christian Vechhiola, S. Thamarai Selv
MOOC/Web Platforms:	https://onlinecourses.nptel.ac.in/noc21_cs14/ https://aws.amazon.com/architecture/well-architected/

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IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Explain the cloud ecosystem, stakeholders, service models, and cloud automation concepts.	Understand (K2)
CO2	Apply cloud strategy lifecycle, adoption frameworks, and cloud-native architectures like microservices and Kubernetes.	Apply (K3)
CO3	Design and manage cloud services including lifecycle, SLAs, legacy modernization, and cloud migration.	Create(K6)
CO4	Analyze cloud pricing models, economic impacts and sustainability considerations.	Analyze (K4)
CO5	Evaluate cloud governance frameworks, security models, compliance standards, risk management, and ethical aspects.	Evaluate (K6)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ Pos	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	2	2	1	1	2	2	1	2	2	2	1	3	2	2
CO-2	2	3	3	2	2	2	2	1	2	2	3	2	3	3	3
CO-3	3	3	3	2	3	2	2	2	3	3	3	3	3	3	3
CO-4	2	2	2	3	2	3	3	3	2	3	2	2	2	2	2
CO-5	2	2	2	2	2	3	3	3	2	3	2	3	2	3	3

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23PIT04 UI AND UX DESIGN

Prerequisite	Programme Name	Sem	Category	L	T	P	C
NIL	B.E/B.Tech. – Common to CSE, IT and AI&DS	V/VI/VII	PEC	2	0	2	3

II - Course Objectives

1.	To introduce the principles, differences, and current trends in UI and UX design.
2.	To develop understanding of visual design, interaction principles, and UI patterns.
3.	To explore UX processes, research methods, and user-centered design approaches.
4.	To build skills in creating and testing wireframes, prototypes, and mockups.
5.	To apply ideation techniques, information architecture, and advanced UX practices.

III - Course Content

Preamble: This course offers a comprehensive journey into modern UI/UX design, starting with foundational principles, the interaction between UI and UX, and current industry trends. Students can learn core design concepts—visual hierarchy, typography, interaction patterns—and user-centered methodologies grounded in research and empathy. Hands-on practice in sketching, wireframing, prototyping, and usability testing will solidify your skills in real-world scenarios.

UNIT–I	FOUNDATIONS OF UI/UX DESIGN & CURRENT TRENDS	6 Periods

UI Vs UX Design - Understanding the difference and the synergy - Importance of User-Centered Design Principles - Core Stages of Design Thinking - Divergent and Convergent Thinking - Emerging industry trends (AI in UX, dark mode, minimalism, etc.) – Six Hat Design Principles.

UNIT–II	UI DESIGN PRINCIPLES	6 Periods

Visual and UI Principles - UI Elements and Patterns - Interaction Behaviors and Principles – Style Guides - Typography and color theory, Visual identity and branding.

UNIT–III	UX DESIGN PRINCIPLES	6 Periods

Introduction to User Experience - Understanding User Experience - Analysing user data to identify key insights and pain points - Defining the UX Design Process and its Methodology - Research in User Experience Design - Tools and Method used for Research - User Needs and its Goals - Know about Business

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UNIT–IV	WIREFRAMING, PROTOTYPING AND TESTING	6 Periods
Sketching Principles - Sketching Red Routes - Responsive Design – Wireframing - Creating Wireflows - Building a Prototype - Building High- Fidelity Mockups - Designing Efficiently with Tools - Interaction Patterns - Conducting Usability Tests - Other Evaluative User Research Methods - Synthesizing Test Findings - Prototype Iteration.		
UNIT–V	RESEARCH, DESIGNING, IDEATING, & INFORMATION ARCHITECTURE	6 Periods
Identifying and Writing Problem Statements- Identifying Appropriate Research Methods - Creating Personas - Solution Ideation - Creating User Stories - Creating Scenarios-Flow Diagrams - Flow Mapping - Information Architecture Advanced Topics - AI in UX - Persuasive UX - Cultural and Legal Issues in UX - Measuring ROI from UX		

PRACTICAL EXERCISES: **30 Periods**

1. Study of various UI/UX open source tools.
2. Tool Setup & UI Screen Creation (e.g., login page)
3. Create User Persona & Empathy Map
4. Design Low-Fidelity Wireframes (mobile app/web app)
5. Build an Interactive Prototype for any societal application (Mood board, Fonts, Colors based on UI principles).
6. Conduct end-to-end user research - User research, creating personas, Ideation process (User stories, Scenarios), Flow diagrams, Flow Mapping.
7. Create a project for portfolio development.

Note: The lab instructor is expected to design Problems based on the topics listed. The Examination shall not be restricted to the sample experiments designed.

TOTAL: 30+30=60 Periods

Text Books:	1. Joel Marsh, "UX for Beginners", O'Reilly , 2022 2. Jon Yablonski, "Laws of UX using Psychology to Design Better Product & Services" O'Reilly 2021
Reference Books:	1. Jenifer Tidwell, Charles Brewer, Aynne Valencia, "Designing Interface" 3 rd Edition , O'Reilly 2020 2. Steve Schoger, Adam Wathan "Refactoring UI", 2018. 2. Steve Krug, "Don't Make Me Think, Revisited: A Commonsense Approach to Web & Mobile", Third Edition, 2015
MOOC/Web Platforms:	https://www.nngroup.com/articles/ https://www.interaction-design.org/literature

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IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Explain UI and UX foundations, differences, and trends.	Understand (K2)
CO2	Apply visual design and interaction principles in UI development.	Apply (K3)
CO3	Utilize UX processes and research to address user and business needs.	Analyze (K4)
CO4	Design and evaluate wireframes, prototypes, and mockups.	Apply (K 3)
CO5	Implement ideation techniques, information architecture, and advanced UX concepts.	Analyze (K4)

(Action verb of each CO to be matched with the next mapping table)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO - 1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	1	2	3	-	-	-	-	1	1	3	1	3	2	1
CO-2	3	2	1	2	2	-	-	-	2	2	2	1	3	2	3
CO-3	2	2	3	2	1	-	-	-	3	3	1	2	1	1	3
CO-4	1	3	1	3	1	-	-	-	1	2	1	1	1	3	1
CO-5	3	3	1	1	2	-	-	-	2	2	2	2	2	2	2

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23PIT05 SOFTWARE TESTING AND AUTOMATION

Prerequisite	Programme Name	Sem	Category	L	T	P	C
23AD304 – Systen Software and Operating Systems	B.E/B.Tech. – Common to CSE, IT and AI&DS	V/VI/VII	PEC	2	0	2	3

II - Course Objectives

1.	To understand the basics of software testing
2.	To learn how to do the testing and planning effectively
3.	To build test cases and execute them
4.	To focus on wide aspects of testing and understanding multiple facets of testing
5.	To get an insight about test automation and the tools used for test automation

III - Course Content

Preamble:

This course provides a strong foundation in software testing principles and practices, covering both manual and automated testing. The course emphasizes practical skills for ensuring software quality through real-world tools and industry practices.

Unit – I	FOUNDATIONS OF SOFTWARE TESTING	6 Periods

Purpose and objectives of testing, Software Development Life Cycle, Black box and White box testing, Software Testing Life Cycle, V Model of Software testing, failures, errors, faults(defects), Software testing principle, Stages of testing: Unit, Integration, System, Acceptance testing.

Unit – II	TEST PLANNING AND MANAGEMENT	6 Periods

Test planning: Goals, Strategy, Scope, High level expectations, inter group responsibilities, Resource Requirements, Test Strategy, Test phase, Test Schedule, Test cases, Tester Assignments, Metrics and Statistics.

Unit – III	TEST DESIGN AND EXECUTION	6 Periods

Test Objective Identification, Test Design Factors, Requirement identification, Testable Requirements, Modeling a Test Design Process, Modeling Test Results, Boundary Value Testing, Equivalence Class Testing, Path Testing, Data Flow Testing, Test Design Preparedness Metrics, Test Case Design Effectiveness, Model-Driven Test Design, Test Procedures, Test Case Organization and Tracking, Bug Reporting, Bug Life Cycle. Combinatorial Testing, (PICT and ACTS model)

Unit – IV	ADVANCED TESTING CONCEPTS	6 Periods

Performance Testing: Load Testing, Stress Testing, Volume Testing, Fail-Over Testing, Recovery Testing, Configuration Testing, Compatibility Testing, Usability Testing, Testing the Documentation, Security testing, Testing in the Agile Environment, Testing Web and Mobile Applications.

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Unit – V	TEST AUTOMATION AND TOOLS	6 Periods
Automated Software Testing, Automate Testing of Web Applications, Selenium: Introducing Web Driver and Web Elements, Locating Web Elements, Actions on Web Elements, Different Web Drivers, Understanding Web Driver Events. Introduction to Cucumber.		

TOTAL: 30 Periods

PRACTICAL EXERCISES:

1. Develop the test plan for testing an e-commerce web/mobile application(www.amazon.in).
2. Design the test cases for testing the e-commerce application
3. Test the e-commerce application and report the defects in it.
4. Develop the test plan and design the test cases for an inventory control system.
5. Execute the test cases against a client server or desktop application and identify the defects.
6. Test the performance of the e-commerce application.
7. Automate the testing of e-commerce applications using Selenium.
8. Integrate TestNG with the above test automation.
9. Mini project

a) Build a data-driven framework using Selenium and TestNG

b) Build Page object Model using Selenium and TestNG

C) Build BDD framework with Selenium, TestNG and Cucumber **TOTAL: 30 Periods**

TOTAL: 30+30=60 Periods

Text Books:	1. .Yogesh Singh, "Software Testing", Cambridge University Press, 2012. 2.Unmesh Gundecha, Satya Avasarala, "Selenium WebDriver 3 Practical Guide" – Second Edition 2018.
Reference Books:	1 Glenford J. Myers, Corey Sandler, Tom Badgett, The Art of Software Testing, 3rd Edition,2012, JohnWiley & Sons, Inc. 2.Ron Patton, Software testing, 2nd Edition, 2006, Sams Publishing. Paul C. Jorgensen, Software Testing: A Craftsman's Approach, Fourth Edition, 2014, Taylor & Francis Group 3.Carl Cocchiaro, Selenium Framework Design in Data-Driven Testing, 2018, Packet Publishing. 4.Elfriede Dustin, Thom Garrett, Bernie Gaurf, Implementing Automated Software Testing, 2009, PearsonEducation, Inc. 5.Satya Avasarala, Selenium WebDriver Practical Guide, 2014, Packet Publishing. 6.Varun Menon, TestNG Beginner's Guide, 2013, Packet Publishing.
MOOC/Web Platforms:	Coursera, edX, NPTEL / SWAYAM (India), Udemy

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IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the basic concepts of software testing and the need for software testing	Understand (K2)
CO2	Develop Test planning and different activities involved in test Planning	Apply (K3)
CO3	Design effective test cases that can uncover critical defects in the application	Apply (K3)
CO4	Carry out advanced types of testing	Apply (K3)
CO5	Automate the software testing using Selenium and TestNG	Apply (K3)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	2	1	2	-	-	-	1	1	3	2	3	2	3
CO-2	2	3	1	1	1	-	-	-	2	2	1	2	1	2	3
CO-3	2	2	1	3	1	-	-	-	1	3	1	2	1	3	2
CO-4	2	1	3	2	1	-	-	-	1	1	1	2	3	1	2
CO-5	2	2	1	3	1	-	-	-	1	3	2	1	2	1	3

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23PIT06 WEB APPLICATION SECURITY

Prerequisite	Programme Name	Sem	Category	L	T	P	C
NIL	B.E/B.Tech. – Common to CSE, IT and AI&DS	V/VI/ VII	PEC	2	0	2	3

II - Course Objectives

1.	To understand web app security fundamentals and architecture.
2.	To Apply secure development lifecycle and standards.
3.	To Secure APIs and subdomains against threats.
4.	To perform vulnerability assessment and penetration testing.
5.	To identify and prevent common web attacks using tools.

III - Course Content

Preamble:

This course introduces the fundamentals of web application security and secure software development. It covers common vulnerabilities, security standards, and best practices for building secure applications. Students will learn vulnerability assessment, penetration testing, and prevention of common attacks. The course also provides hands-on experience with security tools and techniques used by professionals.

Unit – I	WEB APPLICATION ARCHITECTURE AND SECURITY FUNDAMENTALS	6 Periods

History and Evolution of Software Security -Web Application Architecture: Modern vs Legacy-Structure of Modern Web Applications: REST APIs, JSON, Browser DOM, SPA Frameworks-Authentication and Authorization Systems-Secure Socket Layer (SSL) and Transport Layer Security (TLS)-0Session Management and Input Validation-Web Servers, Server-Side Databases, Client-Side Data Stores

Unit – II	SECURE DEVELOPMENT LIFECYCLE & STANDARDS	6 Periods

Web Application Security Principles-Security Testing and Vulnerability Management-Security Incident Response Planning-Microsoft Security Development Lifecycle (SDL)-OWASP CLASP (Comprehensive Lightweight Application Security Process)-Software Assurance Maturity Model (SAMM)-Defensive Software Architecture-Secure-Coding Anti-Patterns-Security Automation: Static and Dynamic Analysis

Unit – III	SUBDOMAIN, API SECURITY & INFORMATION EXPOSURE	6 Periods

Multiple Applications per Domain-Subdomain Enumeration (Brute Forcing & Dictionary Attacks)-Zone Transfer Attacks-Browser's Built-In Network Analysis Tools-Search Engine Caches, Accidental Archives, and Social Snapshots-API Security: Endpoint Discovery & Shapes, Authentication Mechanisms-Token-Based Authentication, API Keys, OAuth2-Securing Microservice APIs and Service-to-Service Communication-Rate Limiting, Encryption, Audit Logging

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Unit – IV	VULNERABILITY ASSESSMENT AND EXPLOITATION	6 Periods
Vulnerability Assessment Lifecycle-Vulnerability Assessment Tools: Host-based, Network-based, Cloud, and DB Scanners-Penetration Testing: External, Internal, Web App, Mobile, and Wireless Testing-Detecting Client-Side and Server-Side Frameworks-Secure vs Insecure Architecture Indicators-Common Vulnerabilities and Exposures (CVE) Database-Bug Bounty Programs and Vulnerability Regression Testing		
Unit – V	**COMMON ATTACKS, HACKING TECHNIQUES & PREVENTION TOOLS**	**6 Periods**
Cross-Site Scripting (XSS): Stored, Reflected, DOM-based, Mutation-based-Cross-Site Request Forgery (CSRF) and POST Manipulation-SQL Injection, Code Injection, Command Injection-XML External Entity (XXE) Attacks-Denial of Service (DoS): ReDoS, Logical DoS, Distributed DoS-Social Engineering Attacks-Insecure Cryptographic Storage and Security Misconfigurations-Prevention Tools: Open VAS, Comodo, Nexpose, Nikto, Burp Suite		

TOTAL: 30 Periods

PRACTICAL EXERCISES:

1. Install Wireshark and explore various protocols
   a. Analyze the difference between HTTP and HTTPS
   b. Analyze security mechanisms in different protocols
2. Identify vulnerabilities using OWASP ZAP tool
3. Create a simple REST API using Python for the following operations
4. a.GET b.PUSH c.POST d. DELETE
5. Install Burp Suite and perform the following attacks
   a. SQL Injection
   b. Cross-Site Scripting (XSS)
6. Simulate a website attack using Social Engineering techniques

TOTAL: 30 Periods

TOTAL: 30+30=60 Periods

Text Books:	1. Andrew Hoffman, Web Application Security- Exploitation and Countermeasures for Modern Web Applications, March 2020, 1st Edition, O'Reilly Media, California. 2. Bryan Sullivan, Vincent Liu, Web Application Security: A Beginners Guide, 2012, The McGraw Hill Companies. 3. Neil Madden, API Security in Action, 2020, Manning Publications Co., NY, USA.
Reference Books:	1. Michael Cross, Developer's Guide to Web Application Security, 2007, Syngress Publishing, Inc. 2. Ravi Das and Greg Johnson, Testing and Securing Web Applications, 2021, Taylor & Francis Group, LLC. 3. Prabath Siriwardena, Advanced API Security, 2020, Apress Media LLC, USA. 4. Malcom McDonald, Web Security for Developers, 2020, No Starch Press, Inc. Handbook of Research on Blockchain Technology- published by Elsevier Inc. ISBN: 9780128198162-2020.

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MOOC/Web Platforms:	https://owasp.org/ https://developers.google.com/web/fundamentals https://codepen.io/

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understanding the basic concepts of web application security and the need for it.	Understand (K2)
CO2	Be acquainted with the process for secure development and deployment of web applications.	Apply (K3)
CO3	Acquire the skill to design and develop secure web applications that use secure APIs.	Create (K6)
CO4	Be able to get the importance of carrying out vulnerability assessment and penetration testing.	Analyze (K4)
CO5	Acquire the skill to think like a hacker and to use hacker toolsets.	Evaluate (K6)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	2	2	2	3	-	-	-	-	-	1	-	3	2	1
CO-2	3	3	3	2	3	-	-	-	-	-	2	-	3	2	1
CO-3	3	3	3	2	3	-	-	-	-	-	2	-	3	2	1
CO-4	3	3	3	3	3	-	-	-	-	-	2	-	3	2	1
CO-5	3	3	3	3	3	-	-	-	-	-	1	-	3	2	1

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23PIT07 DEVOPS

Prerequisite	Programme Name	Sem	Category	L	T	P	C
23AD304 – Systen Software and Operating Systems	B.E/B.Tech. – Common to CSE, IT and AI&DS	V/VI/ VII	PEC	2	0	2	3

II - Course Objectives

1.	To introduce DevOps terminology, definition & concepts
2.	To understand the different Version control tools like Git, Mercurial
3.	To understand the concepts of Continuous Integration/ Continuous Testing/ Continuous Deployment)
4.	To understand Configuration management using Ansible
5.	Illustrate the benefits and drive the adoption of cloud-based Devops tools to solve real world problems

III - Course Content

Preamble:
This course introduces the core concepts of DevOps practices to streamline software development and operations. It covers version control, continuous integration, continuous deployment, and configuration management. Students will gain hands-on experience with tools like Git, Jenkins, Maven, Ansible, and Azure DevOps. The course emphasizes automation, collaboration, and best practices for faster and more reliable software delivery.

Unit – I	INTRODUCTION TO DEVOPS	6 Periods

Devops Essentials - Introduction to AWS, GCP, Azure-Version control systems: Git and Github. DevOps Lifecycle and Automation Tools Overview Infrastructure as Code (IaC) Fundamentals

Unit – II	COMPILE AND BUILD USING MAVEN & GRADLE	6 Periods

Introduction, Installation of Maven, POM files, Maven Build lifecycle, Build phases(compile build, test, package) Maven Profiles, Maven repositories (local, central, global),Maven plugins, Maven create and build Artificats, Dependency management, Installation of Gradle, Understand build using Gradle,Build Optimization Techniques and Best Practices Integrating Static Code Analysis Tools (e.g., SonarQube) in Build Process

Unit – III	CONTINUOUS INTEGRATION USING JENKINS	6 Periods

Install & Configure Jenkins, Jenkins Architecture Overview, Creating a Jenkins Job, Configuring a Jenkins job, Introduction to Plugins, Adding Plugins to Jenkins, Commonly used plugins (Git Plugin, Parameter Plugin, HTML Publisher, Copy Artifact and Extended choice parameters). Configuring Jenkins to work with java, Git and Maven, Creating a Jenkins Build and Jenkins workspace, Kubernetes – Cluster Architecture. Jenkins Pipelines using Groovy (Scripted and Declarative Pipelines) Integration with Docker and Containerized Builds

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Unit – IV	CONFIGURATION MANAGEMENT USING ANSIBLE	6 Periods
Ansible Introduction, Installation, Ansible master/slave configuration, YAML basics, Ansible modules, ansible Inventory files, Ansible playbooks, Ansible Roles, adhoc commands in ansible, Integration of ansible with Jenkins and CI/CD Pipelines ansible Vault for Securing Sensitive Information		
Unit – V	BUILDING DEVOPS PIPELINES USING AZURE	6 Periods
Create Github Account, Create Repository, Create Azure Organization, Create a new pipeline, Build a sample code, Modify azure pipelines. yaml file, Azure DevOps with Docker and Kubernetes Integration Monitoring and Feedback Loop Integration using Azure Monitor and Application Insights		

TOTAL: 30 Periods

PRACTICAL EXERCISES:

1. Create Maven Build pipeline in Azure
2. Run regression tests using Maven Build pipeline in Azure
3. Install Jenkins in Cloud
4. Create CI pipeline using Jenkins
5. Create a CD pipeline in Jenkins and deploy in Cloud
6. Create an Ansible playbook for a simple web application infrastructure
7. Build a simple application using Gradle
8. Install Ansible and configure ansible roles and to write playbooks

TOTAL: 30 Periods

TOTAL: 30+30=60 Periods

Text Books:	1.Roberto Vormittag, "A Practical Guide to Git and GitHub for Windows Users: From Beginner to Expert in Easy Step-By-Step Exercises", Second Edition, Kindle Edition, 2016. 2. Jason Cannon, "Linux for Beginners: An Introduction to the Linux Operating System and Command Line", Kindle Edition, 2014
Reference Books:	1.Hands-On Azure Devops: Cicd Implementation for Mobile, Hybrid, And Web Applications Using Azure Devops and Microsoft Azure: CICD Implementation for DevOps and Microsoft Azure (English Edition) Paperback – 1 January 2020 by Mitesh Soni 2.Jeff Geerling, "Ansible for DevOps: Server and configuration management for humans", First Edition, 2015. 3.David Johnson, "Ansible for DevOps: Everything You Need to Know to Use Ansible for DevOps", Second Edition, 2016. 4.Mariot Tsitoara, "Ansible 6. Beginning Git and GitHub: A Comprehensive Guide to Version Control, Project Management, and Teamwork for the New Developer", Second Edition, 2019.
MOOC/Web Platforms:	https://www.jenkins.io/user-handbook.pdf https://maven.apache.org/guides/getting-started/

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IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand different actions performed through Version control tools like Git.	Understand (K2)
CO2	Perform Continuous Integration and Continuous Testing and Continuous Deployment using Jenkins by building and automating test cases using Maven & Gradle.	Apply (K3)
CO3	To Perform Automated Continuous Deployment	Apply (K3)
CO4	To do configuration management using Ansible	Apply (K3)
CO5	Understand to leverage Cloud-based DevOps tools using Azure DevOps	Understand (K2)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	2	2	1	2	2	-	-	-	-	1	1	1	2	2	2
CO-2	2	1	-	1	1	-	-	-	-	2	1	1	2	3	1
CO-3	2	2	1	2	2	1	1	1	-	1	2	1	2	2	3
CO-4	3	2	2	1	2	-	-	-	-	1	1	2	3	3	2
CO-5	2	2	1	2	2	-	-	-	-	1	1	1	2	2	2

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23PIT08 PRINCIPLES OF PROGRAMING LANGUAGES

Prerequisite	Programme Name	Sem	Category	L	T	P	C
NIL	B.E/B.Tech. – Common to CSE, IT and AI&DS	V/VI/ VII	PEC	2	0	2	3

II - Course Objectives

1.	To understand the syntax and semantics of various programming languages.
2.	To analyze the principles of data types, variable binding, and scope management.
3.	To evaluate control structures and exception handling mechanisms in programming languages.
4.	To explore subprogram structures, parameter passing techniques, and their implementations.
5.	To gain insight into diverse programming paradigms, including object-oriented, functional, concurrent, and logic programming.

III - Course Content

Preamble:

This course introduces the fundamental concepts of programming languages, focusing on the principles of syntax, semantics, data types, control structures, subprograms, and modern programming paradigms. It enables students to understand the design and implementation of various language constructs and enhances their ability to analyze and evaluate different language features.

Unit – I	**SYNTAX AND SEMANTICS**	**6 Periods**
Syntax and Semantics: Evolution of programming languages, context-free grammars, attribute grammars, lexical analysis, parsing techniques, abstract syntax trees		
Unit – II	**DATA, DATA TYPES, AND BASIC STATEMENTS**	**6 Periods**
Data Types and Variables: Names, variables, binding, type checking, scope rules, lifetime, garbage collection, primitive data types, arrays, records, environments, declarations		
Unit – III	**EXPRESSIONS AND STRUCTURES**	**6 Periods**
Expressions and Control Structures: Arithmetic and Boolean expressions, control structures, selection and iteration constructs, exception handling, commands (imperative style), recursion constructs		
Unit – IV	**SUBPROGRAMS AND IMPLEMENTATIONS**	**6 Periods**
Subprograms and Implementations: Subprograms, parameter passing, stack and heap management, nested subprograms, closures, first-class functions		
Unit – V	**OBJECT-ORIENTATION IN PROGRAMMNG LANGUAGES**	**6 Periods**
Programming Paradigms: Object-oriented programming, functional programming, logic programming, concurrent programming, parallel constructs		

TOTAL: 30 Periods

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PRACTICAL EXERCISES:

1. Parsing and Abstract Syntax Trees
2. Lexical Analysis Mini-Scanner
3. Data Types and Binding Demonstration
4. Control Structures and Exception Handling
5. Recursion vs Iteration Efficiency
6. Subprograms, Closures, and Parameter Passing
7. Programming Paradigms Exploration.

TOTAL: 30 Periods

TOTAL: 30+30=60 Periods

Text Books:	1. Tucker, A. B., & Noonan, R. E. (2021). Programming languages: Principles and paradigms. McGraw-Hill Education. 2. Sebesta, R. W. (2021). Concepts of programming languages (12th ed.). Pearson.
Reference Books:	1. Pierce, B. C. (2020). Types and programming languages. MIT Press. 2. Scott, M. L. (2022). Programming language pragmatics (5th ed.). Morgan Kaufmann. 3. Friedman, D. P., Wand, M., & Haynes, C. T. (2020). Essentials of programming languages (3rd ed.). MIT Press.. 4. Bansal, A. K. (2021). Introduction to programming languages. CRC Press. 5. Appel, A. W., & Palsberg, J. (2022). *Modern compiler implementation in Java* (2nd ed.). Cambridge University Press.
MOOC/Web Platforms:	https://www.geeksforgeeks.org/introduction-to-programming-languages/ https://www.tutorialspoint.com/principles_of_programming_languages/index.htm https://www.cse.iitk.ac.in/users/pproy/pl/

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand syntax and semantics of programming languages.	Understand (K2)
CO2	Analyze data types and variable binding.	Analyze (K4)
CO3	Evaluate control structures and exception handling.	Evaluate (K6)
CO4	Understand subprograms and their implementations.	Understand (K2)
CO5	Explore different programming paradigms including concurrency and functional abstraction.	Analyze (K4)

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V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	2	3	2	-	1	1	1	-	-	2	2	3	2	1
CO-2	3	3	3	2	-	-	-	1	-	-	2	-	3	2	1
CO-3	3	3	3	3	2	1	1	2	-	-	2	2	3	2	1
CO-4	3	2	3	2	2	-	-	1	-	-	1	1	3	2	1
CO-5	3	3	3	3	3	1	1	1	-	-	-	-	3	2	1

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23CS902 DISTRIBUTED COMPUTING

Prerequisite	Programme Name	Sem	Category	L	T	P	C
23AD304 – Systen Software and Operating Systems	B.E/B.Tech. – Common to CSE,IT and AI&DS	V/VI/VII	PCC	2	0	2	3

II - Course Objectives

1.	To introduce the computation and communication models of distributed systems
2.	To illustrate the issues of synchronization and collection of information in distributed systems
3.	To describe distributed mutual exclusion and distributed deadlock detection techniques
4.	To elucidate agreement protocols and fault tolerance mechanisms in distributed systems
5.	To explain the cloud computing models and the underlying concepts

III - Course Content

Preamble: This course explores the fundamentals of distributed systems, including communication models, logical time, mutual exclusion, and consensus algorithms. It emphasizes synchronization, failure recovery, and deadlock detection in distributed environments. The course concludes with a study of cloud computing concepts, architectures, services, and virtualization technologies.

Unit – I	INTRODUCTION	6 Periods

Introduction: Definition-Relation to Computer System Components – Motivation – Message -Passing Systems versus Shared Memory Systems – Primitives for Distributed Communication – Synchronous versus Asynchronous Executions – Design Issues and Challenges; A Model of Distributed Computations: A Distributed Program – A Model of Distributed Executions – Models of Communication Networks – Kerberos- Securing electronics transaction- IEEE 802.11 WiFi.

Unit – II	LOGICAL TIME AND GLOBAL STATE	6 Periods

Logical Time: Physical Clock Synchronization: NTP – A Framework for a System of Logical Clocks- Events and process states Clock Synchronization - Logical clocks – Scalar Time – Vector Time; Message Ordering and Group Communication: Message Ordering Paradigms – Asynchronous Execution with Synchronous Communication – Synchronous Program Order on Asynchronous System – Group Communication – Causal Order – Total Order; Global State and Snapshot Recording Algorithms: Introduction – System Model and Definitions – Snapshot Algorithms for FIFO Channels

Unit – III	DISTRIBUTED MUTEX AND DEADLOCK	6 Periods

Distributed Mutual exclusion Algorithms: Introduction – Preliminaries – Lamport's algorithm – Ricart Agrawala's Algorithm — Token-Based Algorithms – Suzuki-Kasami's Broadcast Algorithm; Deadlock Detection in Distributed Systems: Introduction – System Model – Preliminaries – Models of Deadlocks – Chandy-Misra-Haas Algorithm for the AND model and OR Model

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Unit – IV	CONSENSUS AND RECOVERY	6 Periods
Consensus and Agreement Algorithms: Problem Definition – Overview of Results – Agreement in a Failure-Free System(Synchronous and Asynchronous) – Agreement in Synchronous Systems with Failures; Checkpointing and Rollback Recovery: Introduction – Background and Definitions – Issues in Failure Recovery – Checkpoint-based Recovery – Overview of replication- Distributed shared memory and Web services		
Unit – V	**CLOUD COMPUTING**	**6 Periods**
Definition of Cloud Computing – Characteristics of Cloud – Cloud Deployment Models – Cloud Service Models – Driving Factors and Challenges of Cloud – Virtualization on – Load Balancing –Scalability and Elasticity – Replica on – Monitoring – Cloud Services and Platforms: Compute Services – Storage Services – Applica on Services		

TOTAL: 30 Periods

PRACTICAL EXERCISES:

1. Distributed File Sharing System
2. Leader Election Using Bully Algorithm
3. Distributed Mutual Exclusion Using Ricart–Agrawala Algorithm
4. MapReduce-Based Word Count Application
5. Distributed Key–Value Store Using Consistent Hashing
6. Clock Synchronization Using Berkeley or Lamport Algorithm

TOTAL: 30 Periods

TOTAL: 30+30=60 Periods

Text Books:	1. George Coulouris- Jean Dollimore- Time Kindberg- "Distributed Systems Concepts and Design"- Fifth Edition- Pearson Education- 2012. 2.Kshemkalyani Ajay D- Mukesh Singhal- "Distributed Computing: Principles- Algorithms and Systems"- Cambridge Press- 2011 3.Andrew S. Tanenbaum, Maartenvan Steen, "Distributed Systems Principles and Paradigms", 2nd ed., Pearson Education, 2010.
Reference Books:	1. George Coulouris, Jean Dollimore, Time Kindberg, "Distributed Systems Concepts and Design", Fifth Edition, Pearson Education, 2012. 2. Pradeep L Sinha, "Distributed Operating Systems: Concepts and Design", Prentice Hall of India, 2007. 3. Tanenbaum A S, Van Steen M, "Distributed Systems: Principles and Paradigms", Pearson Education, 2007. 4. Liu M L, "Distributed Computing: Principles and Applications", Pearson Education, 2004. 5. Nancy A Lynch, "Distributed Algorithms", Morgan Kaufman Publishers, 2003. 6. Arshdeep Bagga, Vijay Madisetti, " Cloud Computing: A Hands-On Approach", Universities Press, 2014

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MOOC/Web Platforms:	https://cloud.google.com/docs/overview

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Explain the principles of logical and physical time synchronization in distributed system	Understand (K2)
CO2	Explain and apply advanced time synchronization technique	Apply (K3)
CO3	Apply advanced deadlock detection and prevention models	Apply (K3)
CO4	Explain and contrast various consensus algorithms under failure scenarios.	Understand (K2)
CO5	Explain key components of modern cloud-native infrastructures	Understand (K2)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	2	2	1	1	-	-	-	1	1	-	-	2	1	-
CO-2	3	3	3	2	2	-	-	-	1	2	-	-	3	2	1
CO-3	3	3	3	2	2	-	-	-	2	2	-	-	3	2	2
CO-4	3	2	2	1	1	-	-	-	1	1	-	-	2	1	-
CO-5	2	2	2	1	2	-	-	-	1	1	-	-	2	2	2

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23PCS01 VIRTUALIZATION

Prerequisite	Programme Name	Sem	Category	L	T	P	C
23AD304 – Systen Software and Operating Systems	B.E/B.Tech. – Common to CSE,IT and AI&DS	V/VI/ VII	PEC	2	0	2	3

II - Course Objectives

1.	Understand the basics and importance of virtualization.
2.	Learn different types of virtualization and their applications.
3.	Gain practical knowledge of virtual machine and hypervisor management.
4.	Explore storage, network, desktop, and server virtualization.
5.	Understand virtualization security, automation, and current trends.

III - Course Content

Preamble: This course introduces the foundational concepts and practical applications of virtualization in modern IT environments. It covers types of virtualization across hardware, servers, storage, and networks, emphasizing resource optimization and scalability. Learners will gain hands-on understanding of virtual machine management, hypervisors, and emerging trends in virtualization and cloud computing.

Unit – I	Introduction	6 Periods

Cloud Computing - Virtualization and cloud computing - Benefits and Need for Virtualization - Types : Hardware, Server, Desktop, Network, Storage - Limitations and Challenges - Overview of Virtualized IT Infrastructure

Unit – II	Virtual Machine Basics and Desktop virualization	6 Periods

Virtual Machine Basics and Lifecycle - Introduction to Hypervisors: Type 1 and Type 2- Role of Hypervisor and Virtual Machine Monitor (VMM) - VM Provisioning, Migration, and Scaling Basics - Desktop Virtualization - Types of Desktop Virtualization

Unit – III	Hardware and Server virtualization	6 Periods

Hardware Virtualization: Full, Para, and OS-level Virtualization - CPU, Memory, and Storage Virtualization Concepts - Server virtualization fundamentals and platforms (VMware ESXi, Hyper-V) - Creating and managing virtual desktops and servers- Server consolidation, resource allocation, and security

Unit – IV	Storage and Network Virtualization	6 Periods

Introduction to Network Virtualization: VLANs, Virtual Switches, and Virtual Networks - Storage Virtualization Basics: SAN, NAS, RAID - Managing Virtual Machines and Storage - Virtualization Management Tools

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Unit – V	Security, Automation, and Trends	6 Periods
Security in Virtualization: Risks and Best Practices - Basics of Automation and Backup in Virtual Environments - Recent Trends and Future Directions in Virtualization - Case Study		

TOTAL: 30 Periods

PRACTICAL EXERCISES:

1. Create a Virtual Machine Using VirtualBox or VMware
2. Allocate and Modify Virtual Machine Memory and Storage
3. Create and Manage Snapshots of a Virtual Machine
4. Set Up VLAN Networking Using Cisco Packet Tracer
5. Create Spanned and Mirrored Volumes on a Guest OS
6. Configure Desktop Virtualization Using VNC
7. Create a Nested Virtual Machine (VM Inside a VM)

TOTAL : 30 Periods

TOTAL : 30+30=60 Periods

Text Books:	1. Chris Wolf and Erick M. Halter, Virtualization, Apress 2. Latifa Boursas (Editor), Mark Carlson (Editor), Wolfgang Hommel (Editor), Michelle Sibilla (Editor), Kes Wold (Editor), Systems and Virtualization Management: Standards and New Technologies 3. Anthony T. Velte, Toby J. Velte, Robert Elsenpeter, Cloud Computing: A Practical Approach, Tata McGraw-Hill, 2010 4. Rajkumar Buyya, James Broberg, Andrzej Goscinski, Cloud Computing (Principles and Paradigms), Wiley, 2011 5. Nelson Ruest, Danielle Ruest, Virtualization: A Beginner's Guide, McGraw-Hill, 2009
Reference Books:	1. Massimo Cafaro (Editor), Giovanni Aloisio (Editor), Grids, Clouds and Virtualization, Springer 2. Edward L. Haletky, VMware ESX Server in the Enterprise, Prentice Hall 3. Gaurav Somani, Scheduling and Isolation in Virtualization, VDM Verlag Dr. Müller, Germany 4. Edward Haletky, VMware ESX and ESXi in the Enterprise – Planning Deployment of Virtualization Servers, Prentice Hall 5. David Marshall, Wade A. Reynolds, Advanced Server Virtualization: VMware and Microsoft Platform in the Virtual Data Center, Auerbach 6. William Von Hagen, Professional Xen Virtualization, Wiley, 2008 7. Matthew Portney, Virtualization Essentials, Wiley, 2012 8. Dave Shackleford, Virtualization Security: Protecting Virtualized Environments, Wiley, 2012
MOOC/Web Platforms:	https://labs.hol.vmware.com https://learn.microsoft.com/en-us/virtualization/hyper-v-on-windows/

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IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Explain key virtualization concepts and types.	Understand (K2)
CO2	Install and manage virtual machines and hypervisors.	Apply (K3)
CO3	Apply server, desktop, storage, and network virtualization techniques	Apply (K3)
CO4	Use management tools to administer virtualized environments.	Apply (K3)
CO5	Identify security challenges and implement automation in virtualization.	Understand (K2)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	2	2	2	2	-	-	-	2	2	3	3	3	2	3
CO-2	3	3	3	2	3	-	-	-	2	2	3	3	3	2	3
CO-3	3	3	3	3	3	-	-	-	2	2	3	3	3	2	3
CO-4	3	2	2	2	3	-	-	-	2	2	3	3	3	2	3
CO-5	3	3	3	2	3	2	2	-	2	2	3	3	3	2	3

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23PCS02 DATA WAREHOUSING

Prerequisite	Programme Name	Sem	Category	L	T	P	C
NIL	B.E/B.Tech. – Common to CSE, IT and AI&DS	V/VI/VII	PEC	2	0	2	3

II - Course Objectives

1.	To know the details of data warehouse Architecture
2.	To understand the OLAP Technology
3.	To understand the partitioning strategy
4.	To differentiate various schema
5.	To understand the roles of process manager & system manager

III - Course Content

Preamble: This course provides an in-depth understanding of data warehousing concepts, architecture, and technologies. It explores ETL processes, OLAP operations, metadata management, and dimensional modeling techniques essential for analytical systems. Students will gain practical insights into warehouse design, schema structures, and modern tools through case studies in domains like retail and banking.

Unit – I	INTRODUCTION TO DATA WAREHOUSE	6 Periods

Data warehouse Introduction - Data warehouse components- operational database Vs data warehouse – Data warehouse Architecture – Three-tier Data Warehouse Architecture - Autonomous Data Warehouse- Autonomous Data Warehouse Vs Snowflake - Modern Data Warehouse

Unit – II	ETL AND OLAP TECHNOLOGY	6 Periods

What is ETL – ETL Vs ELT – Types of Data warehouses - Data warehouse Design and Modeling - Delivery Process - Online Analytical Processing (OLAP) - Characteristics of OLAP - Online Transaction Processing (OLTP) Vs OLAP - OLAP operations- Types of OLAP- ROLAP Vs MOLAP Vs HOLAP.

Unit – III	META DATA, DATA MART AND PARTITION STRATEGY	6 Periods

Meta Data – Categories of Metadata – Role of Metadata – Metadata Repository – Challenges for Meta Management - Data Mart – Need of Data Mart- Cost Effective Data Mart- Designing Data Marts- Cost of Data Marts- Partitioning Strategy – Vertical partition – Normalization – Row Splitting – Horizontal Partition

Unit – IV	DIMENSIONAL MODELING AND SCHEMA	6 Periods

Dimensional Modeling - Multi-Dimensional Data Modeling – Data Cube- Star Schema- Snowflake schema- Star Vs Snowflake schema- Fact constellation Schema- Schema Definition - Process Architecture- Types of Data Base Parallelism – Datawarehouse Tools Case Study: Retail Store Sales Analysis

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Unit – V	SYSTEM & PROCESS MANAGERS	6 Periods
Data Warehousing System Managers: System Configuration Manager- System Scheduling Manager - System Event Manager - System Data Warehousing Process Managers: Load Manager – Warehouse Manager- Query Manager – Tuning – Testing, Data Governance and Security Case Study: Banking Data Warehouse Management		

TOTAL: 30 Periods

PRACTICAL EXERCISES:

1. Data exploration and integration with WEKA
2. Apply weka tool for data validation
3. Plan the architecture for real time application
4. Write the query for schema definition
5. Design data ware house for real time applications
6. Analyse the dimensional Modeling
7. Case Study: Sales Analysis for a Global Retail Chain
8. Case Study: Banking Transaction System
9. Implementation of warehouse testing.

TOTAL : 30 Periods

TOTAL : 30+30=60 Periods

Text Books:	1. Alex Berson and Stephen J. Smith "Data Warehousing, Data Mining & OLAP", Tata McGraw – Hill Edition, Thirteenth Reprint 2008. 2. Ralph Kimball, "The Data Warehouse Toolkit: The Complete Guide to Dimensional Modeling", Third edition, 2013.
Reference Books:	1. Paul Raj Ponniah, "Data warehousing fundamentals for IT Professionals", 2012. 2. K.P. Soman, ShyamDiwakar and V. Ajay "Insight into Data mining Theory and Practice", Easter Economy Edition, Prentice Hall of India, 2006.
MOOC/Web Platforms:	https://cloud.google.com/bigquery/docs/introduction https://aws.amazon.com/redshift/getting-started/

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IV - Course Outcome

	On completion of the course, the students will be able to	Bloom's Level Mapped
CO1	Design data warehouse architecture for various Problems	Understand (K2)
CO2	Apply the OLAP Technology	Apply (K3)
CO3	Analyse the partitioning strategy	Analyse (K4)
CO4	Critically analyze the differentiation of various schema for given problem	Analyse (K4)
CO5	Frame roles of process manager & system manager	Apply (K3)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	3	2	3	-	-	-	-	2	2	3	-	2	3
CO-2	3	-	2	-	3	-	-	-	-	-	-	3	2	-	3
CO-3	3	3	-	3	3	-	-	-	-	-	2	3	-	-	3
CO-4	3	3	3	2	3	-	-	-	-	2	2	3	-	-	3
CO-5	-	-	3	-	3	2	2	2	2	3	2	-	3	3	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23PCS03 STORAGE TECHNOLOGIES

Prerequisite	Programme Name	Sem	Category	L	T	P	C
23AD302 -Database Management Design Management	B.E/B.Tech. – Common to CSE, IT and AI&DS	V/VI/VII	PEC	3	0	0	3

II - Course Objectives

1.	Characterize the functionalities of logical and physical components of storage
2.	Describe various storage networking technologies
3.	Identify different storage virtualization technologies
4.	Discuss the different backup and recovery strategies
5.	Understand common storage management activities and solutions

III - Course Content

Preamble: This course covers the core concepts of modern information storage systems and data center infrastructure. It includes RAID, intelligent storage, SAN/NAS technologies, and data backup and replication. Emphasis is placed on securing storage environments and managing enterprise-scale storage solutions.

Unit – I	Introduction and Storage Systems	9 Periods

Introduction to Information Storage- Evolution of Storage Architecture-Data Center Infrastructure-Core Elements, Key Characteristics and Managing a Data Center-Virtualization and Cloud Computing-Information Lifecycle Management-Third Platform Technologies: Characteristics of third platform infrastructure and Imperatives for third platform transformation-Data Center Environment: Application, Compute, Connectivity – Storage-Disk Drive Components-Performance-Direct-Attached Storage

Unit – II	RAID AND INTELLIGENT STORAGE SYSTEMS	9 Periods

RAID implementation methods-Array Components-Techniques-levels-RAID Impact on Disk Performance-Intelligent storage system: Components-Caching- Storage Provision-virtual Storage Provisioning- Types of intelligent storage systems

Unit – III	STORAGE NETWORKING TECHNOLOGIES	9 Periods

Block-Based Storage System-File-Based Storage System -Object-Based and Unified Storage-Fibre Channel-SAN and Its Evolution-Components of SAN-FC Connectivity-Fibre Channel Architecture-Zoning-FC SAN Topologies-Virtualization in SAN-Network-Attached Storage: Components-NAS I/O Operations-Implementations-NAS File-Sharing Protocols-IP SAN: Components-iSCSI Topologies-iSCSI Protocol Stack and Discovery

Unit – IV	BACKUP, ARCHIVE AND REPLICATION	9 Periods

Purpose-Recovery Considerations-Backup Methods-Backup Architecture-Topologies-Backup in Virtualized Environments-Data Archiving -Solution Architecture-Replication: Uses of Local Replicas-Replica Consistency - Creating Multiple Replicas -Remote Replication Technologies-Three-Site Replication-Disaster Recovery with SRDF

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Unit – V	SECURING STORAGE INFRASTRUCTURE	9 Periods
Information security goals, Storage security domains, Threats to a storage infrastructure, Security controls to protect a storage infrastructure, Governance, risk, and compliance, Storage infrastructure management functions, Storage infrastructure management processes.		

TOTAL: 45 Periods

Text Books:	1. EMC Corporation, Information Storage and Management, Wiley, India 2. Jon Tate, Pall Beck, Hector Hugo Ibarra, Shanmuganathan Kumaravel and Libor Miklas, Introduction to Storage Area Networks, Ninth Edition, IBM - Redbooks, December 2017 3. Ulf Troppens, Rainer Erkens, Wolfgang Mueller-Friedt, Rainer Wolafka, Nils Haustein ,Storage Networks Explained, Second Edition, Wiley, 2009
Reference Books:	1. John Chirillo & Scott Blaul, Storage Security: Protecting SANs, NAS and DAS, Wiley 2. Susanta Dutta, Computer Storage Fundamentals, 2nd Edition, BPB Publications 3. Vaishali D. Khairnar & Nilima M. Dongre, Storage Network Management and Retrieval, Wiley India
MOOC/Web Platforms:	https://www.ibm.com/it-infrastructure/storage/learning-center https://www.cisco.com/c/en/us/solutions/data-center-virtualization/storage.html

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Describe the functionalities and architecture of logical and physical storage systems, including disk drive components and data center infrastructure.	Understand (K2)
CO2	Explain RAID levels, techniques, and the architecture of intelligent storage systems such as EMC Symmetrix and VNX.	Understand (K2)
CO3	Illustrate different types of storage networking technologies including SAN, NAS, and IP SAN, and analyze their protocols and topologies.	Apply (K3)
CO4	Evaluate various backup, archival, and replication strategies including solution architectures, recovery methods, and disaster recovery technologies.	Apply (K3)
CO5	Apply security frameworks and management practices to secure and manage storage infrastructures in virtualized and cloud environments.	Apply (K3)

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V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	2	2	2	2	1	1	-	-	1	1	2	2	3	2
CO-2	3	2	2	2	2	-	-	-	-	1	1	2	2	3	2
CO-3	3	3	3	2	3	1	1	-	-	2	2	3	3	3	3
CO-4	3	3	3	3	3	2	2	-	-	2	2	3	3	3	3
CO-5	3	3	3	2	3	2	2	3	1	2	2	3	3	3	3

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23PCS04 SOFTWARE DEFINED NETWORK

Prerequisite	Programme Name	Sem	Category	L	T	P	C
23AD404-Networking Essentials	B.E/B.Tech. – Common to CSE,IT and AI&DS	V/VI/ VII	PEC	2	0	2	3

II - Course Objectives

1.	To understand the need for SDN and its data plane operations
2.	To understand the functions of control plane
3.	To comprehend the migration of networking functions to SDN environment
4.	To explore various techniques of network function virtualization
5.	To comprehend the concepts behind network virtualization

III - Course Content

Preamble: This course introduces the fundamentals of Software Defined Networking (SDN) and Network Function Virtualization (NFV), highlighting their architectures, components, and protocols. It covers SDN planes, controllers, interfaces, and real-world applications in modern networks. The course also explores NFV infrastructure, integration with SDN, and practical use cases in virtualized environments.

Unit – I	**INTRODUCTION**	**6 Periods**
Traditional Networking vs. SDN - Benefits and Challenges of SDN - SDN Standards and Bodies Evolving Network Requirements – The SDN Approach – SDN architecture - SDN Data Plane , Control plane and Application Plane		
Unit – II	**SDN DATA PLANE AND CONTROL PLANE**	**6 Periods**
Data Plane functions and protocols – Open FLow Protocol - Flow Table - Control Plane Functions - Southbound Interface, Northbound Interface – SDN Controllers - Ryu, OpenDaylight, ONOS - Distributed Controllers Case study-Controller Placement Problem-Inter-controller Communication Protocols		
Unit – III	**SDN APPLICATIONS**	**6 Periods**
SDN Application Plane Architecture – Network Services Abstraction Layer- Monitoring-Security-Data Center Networking-Wide Area Networks (WAN)- Service Provider Networks-Internet Service Providers(ISPs).		
Unit – IV	**NETWORK FUNCTION VIRTUALIZATION**	**6 Periods**
Network Virtualization – Overlay Networking Protocols- Virtual LANs – OpenFlow VLAN Support - NFV Concepts – Benefits and Requirements – Reference Architecture		
Unit – V	**NFV FUNCTIONALITY**	**6 Periods**
NFV Infrastructure – Overlay Networking Protocols- Integration of SDN and NFV Virtualized Network Functions – NFV Management and Orchestration – NFV Use cases		

TOTAL: 30 Periods

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PRACTICAL EXERCISES:

1) Setup your own virtual SDN lab
   i) Virtualbox/Mininet Environment for SDN - http://mininet.org
   ii) https://www.kathara.org
   iii) GNS3
2) Create a simple mininet topology with SDN controller and use Wireshark to capture and visualize the OpenFlow messages such as OpenFlow FLOW MOD, PACKET IN, PACKET OUT etc.
3) Create a SDN application that uses the Northbound API to program flow table rules on the switch for various use cases like L2 learning switch, Traffic Engineering, Firewall etc.
4) Create a simple end-to-end network service with two VNFs using vim-emu
   https://github.com/containernet/vim-emu
5) Install OSM and onboard and orchestrate network service.

TOTAL : 30 Periods

TOTAL : 30+30=60 Periods

Text Books:	1.William Stallings, "Foundations of Modern Networking: SDN, NFV, QoE, IoT and Cloud", Pearson Education, 1st Edition, 2015
Reference Books:	1. Ken Gray, Thomas D. Nadeau, "Network Function Virtualization", Morgan Kauffman, 2016. 2. Thomas D Nadeau, Ken Gray, "SDN: Software Defined Networks", O'Reilly Media, 2013. 3. Fei Hu, "Network Innovation through OpenFlow and SDN: Principles and Design", 1st Edition, CRC Press, 2014. 4. Paul Goransson, Chuck Black Timothy Culver, "Software Defined Networks: A Comprehensive Approach", 2nd Edition, Morgan Kaufmann Press, 2016. 5. Oswald Coker, Siamak Azodolmolky, "Software-Defined Networking with OpenFlow", 2nd Edition, O'Reilly Media, 2017.
MOOC/Web Platforms:	https://www.udemy.com/course/sdn-and-openflow-introduction/ https://arxiv.org/abs/1603.07367

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IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	To explore the motivations for adopting SDN and study the operational aspects of its data plane.	Understand (K2)
CO2	To analyze the roles and responsibilities of the control plane in SDN architecture	Analyze (K4)
CO3	To comprehend the migration of networking functions to SDN environment	Understand (K2)
CO4	To explore various techniques of network function virtualization	Understand (K2)
CO5	To comprehend the concepts behind network virtualization	Understand (K2)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	2	-	-	2	1	1	-	-	2	-	2	-	2	-
CO-2	3	3	2	-	3	2	2	-	-	2	-	2	2	3	-
CO-3	3	3	-	-	2	2	2	-	-	1	-	1	3	2	-
CO-4	2	2	2	-	1	1	1	-	-	1	-	1	3	2	-
CO-5	2	2	2	-	2	2	2	-	-	1	-	1	3	2	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23PCS05 STREAM PROCESSING

Prerequisite	Programme Name	Sem	Category	L	T	P	C
NIL	B.E/B.Tech. – Common to CSE, IT and AI&DS	V/VI/ VII	PEC	2	0	2	3

II - Course Objectives

1.	Introduce Data Processing terminology, definition & concepts
2.	Define different types of Data Processing
3.	Explain the concepts of Real-time Data processing
4.	Select appropriate structures for designing and running real-time data services in a business environment
5.	Illustrate the benefits and drive the adoption of real-time data services to solve real world problems

III - Course Content

Preamble: This course explores the architecture and technologies behind modern data systems, focusing on batch and real-time processing. It introduces data models, query languages, and tools like Apache Kafka and Spark Streaming. Emphasis is placed on building scalable, event-driven analytics systems for dynamic data environments.

Unit – I	FOUNDATIONS OF DATA SYSTEMS	6 Periods

Introduction to Data Processing and Data Analytics-Stages of Data Processing-Batch Processing vs Stream Processing: Concepts and Use Cases-Transactional Data Processing and Data Mining Overview-Data Migration and Data Management Strategies-Storage, Processing, Integration, and Analytics in Data Systems-Benefits and Challenges of Data as a Service (DaaS)

Unit – II	REAL-TIME DATA PROCESSING	6 Periods

Introduction to Big Data and its Infrastructure-Real-Time vs Near Real-Time Analytics-Batch vs Stream Processing in Big Data Context-Lambda Architecture: Design and Use Cases-Kappa Architecture: Design and Use Cases-Stream Processing Concepts: Data Streams, Message Brokers, Stream Processors-Batch & Real-Time ETL Tools Overview-Storage for Streaming Data

Unit – III	DATA MODELS AND QUERY LANGUAGES	6 Periods

Relational Data Model and SQL-NoSQL Models: Document, Key-Value, Graph, and Network Models-Object-Relational Impedance Mismatch-Many-to-One and Many-to-Many Relationships-Schema Flexibility in NoSQL Systems-Declarative Query Languages: SQL, Cypher-SPARQL-Graph Queries in SQL and Semantic Web Concepts-CODASYL Model

Unit – IV	EVENT PROCESSING WITH APACHE KAFKA	6 Periods

Event-Driven Architecture Overview-Apache Kafka as an Event Streaming Platform-Kafka Core Concepts: Events, Producers, Consumers, Topics, Partitions, Brokers-Kafka APIs: Admin, Producer, Consumer, Streams, Connect-Kafka Use Cases and Ecosystem

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Unit – V	REAL-TIME PROCESSING USING SPARK STREAMING	6 Periods
Introduction to Structured Streaming-Concepts of Event-Time and Handling Late Data-Fault Tolerance and Exactly-Once Processing Semantics-Creating and Managing Streaming Datasets-Schema Inference and Partitioning-Operations on Streaming Data: Selection, Aggregation, Projection-Watermarking and Window Operations (Types of Windows)- Join Operations and Deduplication		

TOTAL: 30 Periods

PRACTICAL EXERCISES:

1. Install and configure MongoDB
2. Design and implement application using MongoDB
3. Query the designed system using MongoDB
4. Set up Apache Kafka and create a basic event stream
5. Real-time data pipeline using Kafka
6. Real-time stream processing using Spark Streaming
7. Micro-batch processing application using Spark
8. Real-time fraud and anomaly detection
9. Real-time personalization or marketing using streaming data

TOTAL : 30 Periods

TOTAL : 30+30=60 Periods

Text Books:	1.Karau, H., Konwinski, A., Wendell, P., & Zaharia, M. (2015). Learning Spark: Lightning-Fast Big Data Analysis. O'Reilly Media. 2.Streaming Systems: The What, Where, When and How of Large-Scale Data Processing by Tyler Akidau, Slava Chemyak, Reuven Lax, O'Reilly publication 3. Practical Real-time Data Processing and Analytics : Distributed Computing and Event Processing using Apache Spark, Flink, Storm and Kafka, Packt Publishing.
Reference Books:	1. https://spark.apache.org/docs/latest/streaming-programming-guide.html 2. Kafka.apache.org
MOOC/Web Platforms:	https://developer.confluent.io/learn-kafka/ https://spark.apache.org/docs/latest/structured-streaming-programming-guide.html

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IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand foundational data processing models and streaming concepts.	Understand (K2)
CO2	Explain big data architectures and real-time analytics frameworks.	Understand (K2)
CO3	Compare different data models and query languages suited for stream processing.	Understand (K2)
CO4	Design and implement event-driven streaming applications using Apache Kafka.	Apply (K3)
CO5	Develop fault-tolerant, scalable real-time data pipelines using Spark Streaming.	Apply (K3)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	2	2	2	2	-	-	-	-	-	2	2	2	3	3
CO-2	3	3	3	2	2	-	-	-	-	-	2	2	2	3	3
CO-3	3	3	3	2	2	-	-	-	-	-	2	2	2	3	3
CO-4	3	2	2	3	3	-	-	-	-	-	2	3	3	3	3
CO-5	3	3	3	3	3	-	-	-	-	-	2	3	3	3	3

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23PCS06 SECURITY AND PRIVACY IN CLOUD

Prerequisite	Programme Name	Sem	Category	L	T	P	C
NIL	B.E / B. Tech – Common to CSE, IT, AI&DS, and CSE(AI&ML)	V/VI/VII	PEC	2	0	2	3

II - Course Objectives

1	To introduce Cloud Computing terminology, definition & concepts.
2	To understand the security design and architectural considerations for Cloud.
3	To understand the Identity, Access control in Cloud.
4	To follow best practices for Cloud security using various design patterns.
5	To be able to monitor and audit cloud applications for security.

III - Course Content

Preamble: This course provides a comprehensive overview of cloud security concepts, design principles, and technologies essential for safeguarding cloud environments. Students will explore access control, infrastructure protection, security design patterns, and privacy management in modern cloud systems.

Unit – I	**FUNDAMENTALS OF CLOUD SECURITY CONCEPTS**	**7 Periods**

Overview of cloud security- Security Services - Confidentiality, Integrity, Authentication, Non repudiation- Cloud deployment models , Cloud service models , Cloud- Cloud security best practices

Unit – II	**SECURITY DESIGN & INFRASTRUCTURE SECURITY**	**6 Periods**

Security design principles for Cloud Computing - comprehensive data protection - End-to-end access control - Common attack vectors and threats- Infrastructure Security: The Application Level Data Security and Storage: Aspects of Data Security, Data Security Mitigation

Unit – III	**ACCESS CONTROL AND CLOUD SECURITY TECHNOLOGIES**	**6 Periods**

Access control requirements for Cloud infrastructure - User Identification - Authentication and Authorization - Roles-based Access Control- Network security in the cloud , Virtualization security technologies , Cloud-based security solutions- network access control options.

Unit – IV	**CLOUD SECURITY DESIGN PATTERNS**	**6 Periods**

Introduction to Design Patterns, Cloud bursting, Geo-tagging, Secure Cloud Interfaces, Cloud Resource Access Control, Secure On-Premise Internet Access, Secure External Cloud

Unit – V	**MONITORING, AUDITING, AND PRIVACY**	**5 Periods**

Proactive activity monitoring - Incident Response, Monitoring for unauthorized access, malicious traffic, abuse of system privileges - Events and alerts – Auditing- What Is Privacy, What Is the Data Life Cycle, What Are the Key Privacy Concerns in the Cloud, Who Is Responsible for Protecting Privacy, Changes to Privacy Risk Management

TOTAL: 30 Periods

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PRACTICAL EXERCISES:

1. Simulate a cloud scenario using Cloud Sim and run a scheduling algorithm not present in Cloud Sim.
2. Simulate resource management using CloudSim.
3. Simulate log forensics using cloud sim.
4. Simulate a secure file sharing using a cloud sim.
5. Implement data anonymization techniques over the simple dataset (masking, k-anonymization, etc).
6. Implement any encryption algorithm to protect the images.
7. Implement any image obfuscation mechanism.
8. Implement a role-based access control mechanism in a specific scenario.
9. Implement an attribute-based access control mechanism based on a particular scenario.
10. Develop a log monitoring system with incident management in the cloud.

TOTAL: 30 Periods

TOTAL : 30+30=60 Periods

Text Books:	1. Raj Kumar Buyya , James Broberg, andrzejGoscinski, —Cloud Computing , Wiley 2013 2. Dave shackleford, —Virtualization Security, SYBEX a wiley Brand 2013. 3. Mather, Kumaraswamy and Latif, —Cloud Security and Privacy, OREILLY 2011
Reference Books:	1. Mark C. Chu-Carroll —Code in the Cloud‖,CRC Press, 2011. 2. Mastering Cloud Computing Foundations and Applications Programming RajkumarBuyya, Christian Vechhiola, S. ThamaraiSelvi
MOOC/Web Platforms:	https://www.coursera.org/learn/cloud-computing-security?utm_source=chatgpt.com https://www.youtube.com/watch?v=fKUnblWDK14

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the basic components of cloud & Security in the cloud.	Understand (K2)
CO2	Understand the security design and architectural considerations for the Cloud.	Understand (K2)
CO3	Follow best practices for Cloud security using various design patterns	Apply (K3)
CO4	Monitor and audit cloud applications for security	Analyze (K4)
CO5	Understand the Identity, Access control in Cloud	Understand (K2)

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V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	3	1	2	-	-	-	-	1	1	3	3	1	2
CO-2	1	3	2	3	1	-	-	-	-	2	3	2	3	1	2
CO-3	3	2	2	3	2	-	-	-	-	1	1	2	2	3	1
CO-4	2	1	2	3	3	-	-	-	-	2	3	3	1	1	2
CO-5	1	3	3	1	1	-	-	-	-	3	3	2	2	3	2

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23PCS07 ETHICAL HACKING

Prerequisite	Programme Name	Sem	Category	L	T	P	C
NIL	B.E/B.Tech. – Common to CSE,IT, and AI&DS	V/VI/ VII	PEC	2	0	2	3

II - Course Objectives

1.	Understand the fundamentals of ethical hacking, penetration testing, and security auditing.
2.	Learn various hacking techniques and corresponding countermeasures.
3.	Explore tools and methodologies for vulnerability assessment and exploitation.
4.	Study legal and ethical aspects of cybersecurity and ethical hacking practices.
5.	Gain hands-on experience in simulating attacks and securing systems.

III - Course Content

Preamble: Ethical Hacking introduces principles and practices of identifying, testing, and securing vulnerabilities in computer systems and networks. The subject covers penetration testing methodologies, threat analysis, exploit mitigation, and legal/ethical considerations. Students learn hands-on techniques and tools to assess security posture and implement defensive measures.

Unit – I	INTRODUCTION	6 Periods

Ethical Hacking Overview - Role of Security and Penetration Testers - Penetration-Testing Methodologies- Laws of the Land Overview of TCP/IP - The Application Layer - The Transport Layer - The Internet Layer - IP Addressing - Network and Computer Attacks - Malware - Protecting Against Malware Attacks - Intruder Attacks - Addressing Physical Security- Information Security Program: The Process of Information Security- Component Parts of Information Security Program- Risk Analysis and Ethical Hacking

Unit – II	NETWORK INTELLIGENCE GATHERING AND SCANNING TECHNIQUES	6 Periods

Footprinting Concepts - Footprinting through Search Engines- Web Services- Social Networking Sites- Website- Email - Competitive Intelligence - Footprinting through Social Engineering - Footprinting Tools - Introduction to Scanning Objectives Scanning Methodology Tools - Scanning Techniques - Scanning Beyond IDS and Firewall

Unit – III	PREPARING FOR A HACK	6 Periods

Introduction Cracking Passwords Password- Cracking Websites Password- Guessing Password -Cracking Tools- Password Cracking -Countermeasures Escalating -Privileges Executing -Applications Keyloggers and Spyware- Technical Preparation- Managing the Engagement Reconnaissance: Social Engineering- Physical Security- Internet Reconnaissance

UNIT – IV	ENUMERATION CONCEPTS	6 Periods

Enumeration Concepts - NetBIOS Enumeration – SNMP, LDAP, NTP, SMTP and DNS Enumeration - Vulnerability Assessment Concepts - Desktop and Server OS Vulnerabilities - Windows OS Vulnerabilities - Tools for Identifying Vulnerabilities in Windows- Linux OS Vulnerabilities- Vulnerabilities of Embedded Oss- Preparing for the Next Phase Exploitation: Intutive Testing- Evasion- Threads and Groups

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Unit – V	NETWORK PROTECTION SYSTEMS	6 Periods
Access Control Lists -Cisco Adaptive Security Appliance -Firewall Configuration and Risk Analysis Tools for Firewalls and Routers- Intrusion Detection and Prevention Systems -Network Based and Host Based IDSs -IPSs Web Filtering -Security Incident – Incident Management- Security Policy -Response Teams - Honeypots		

TOTAL: 30 Periods

PRACTICAL EXERCISES:

1. Install Kali or Backtrack Linux / Metasploitable/ Windows XP
2. Practice the basics of reconnaissance.
3. Using FOCA / Search Diggity tools, extract metadata and expanding the target list.
4. Aggregates information from public databases using online free tools like Paterva's Maltego.
5. Information gathering using tools like Robtex.
6. Scan the target using tools like Nessus.
7. View and capture network traffic using Wireshark.
8. Automate dig for vulnerabilities and match exploits using Armitage

TOTAL: 30 Periods

TOTAL: 30 + 30 = 60 Periods

Text Books:	1. EC-Council. (2021). Certified Ethical Hacker (CEH) v11: Official Courseware. EC-Council. 2. Kim, D., & Solomon, M. G. (2016). Fundamentals of Information Systems Security (3rd ed.). Jones & Bartlett. 3. Grimes, R. A. (2019). Hacking the Hacker: Learn From the Experts Who Take Down Hackers. Wiley.
Reference Books:	1. Harper, A., Harris, S., Ness, J., Lenkey, C., & Williams, K. (2011). Gray Hat Hacking: The Ethical Hacker's Handbook (3rd ed.). McGraw-Hill. 2. Skoudis, E., & Liston, T. (2006). Counter Hack Reloaded. Prentice Hall. 3. Erickson, J. (2018). Hacking: The Art of Exploitation (2nd ed.). No Starch Press.
MOOC/Web Platforms:	https://onlinecourses.nptel.ac.in/noc22_cs13/preview https://nptel.ac.in/courses/106105217

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IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Describe the principles and scope of ethical hacking.	Understand (K2)
CO2	Apply scanning, enumeration, and exploitation techniques.	Apply (K3)
CO3	Analyze system and web vulnerabilities with hands-on tools.	Analyze (K4)
CO4	Evaluate cybersecurity defences and propose countermeasures.	Evaluate (K5)
CO5	Perform ethical hacking tasks in simulated environments.	Create (K6)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	2	-	-	-	2	3	2	-	-	-	2	2	2	3
CO-2	3	3	3	-	3	-	-	-	-	-	-	3	2	2	2
CO-3	3	3	3	3	3	2	-	-	-	-	-	3	3	3	1
CO-4	3	3	2	3	3	-	-	-	-	-	-	3	2	2	1
CO-5	3	3	3	3	3	-	-	-	-	-	-	3	3	1	3

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23PCS08 DIGITAL AND MOBILE FORENSICS

Prerequisite	Programme Name	Sem	Category	L	T	P	C
NIL	B.E/B.Tech. – Common to CSE,IT and AI&DS	V/VI/ VII	PEC	2	0	2	3

II - Course Objectives

1.	To understand the fundamentals of digital forensic science and legal considerations.
2.	To learn techniques for investigating digital crimes and handling cyber evidence.
3.	To familiarize with frameworks and best practices for digital forensic readiness.
4.	To analyze forensic techniques and tools specific to iOS platforms.
5.	To explore Android forensics, including file systems, rooting, and data recovery.

III - Course Content

Preamble: This course introduces students to the principles and tools of digital and mobile forensics. It covers methodologies for digital crime investigation, forensic readiness, and in-depth techniques for analyzing iOS and Android platforms.

Unit – I	INTRODUCTION TO DIGITAL FORENSICS	6 Periods

Fundamentals of forensic science and digital forensics-Types of digital evidence-Digital forensics process: identification, collection, examination, analysis, presentation-Chain of custody, evidence integrity, evidence dynamics.

Unit – II	DIGITAL CRIME AND INVESTIGATION	6 Periods

Digital crimes: hacking, cyber terrorism, online fraud-Legal frameworks: substantive criminal law, procedural aspects-Role of Interpol and CERT-In in cybercrime handling-Investigation methods: chain of evidence, seizure and search protocols-International cooperation in cybercrime investigation.

Unit – III	DIGITAL FORENSIC READINESS	6 Periods

Enterprise vs. law enforcement readiness-Frameworks and methodologies: NIST, ISO-Logging, alerting, and documentation practices-Proactive threat hunting strategies-Case handling policies and incident response planning

Unit – IV	IOS FORENSICS	6 Periods

iOS architecture: system security, sandboxing, data encryption-Jailbreaking methods and risks-Acquisition and analysis tools: Oxygen Forensics, MobilEdit, Elcomsoft iOS Toolkit-Data artifacts: SMS, call logs, GPS, WhatsApp, photos, app cache- Case study: iOS data leak investigation

Unit – V	ANDROID FORENSICS	6 Periods

Android OS structure, boot process, rooting techniques-File systems: ext3/ext4, YAFFS2-Tools: ADB, Oxygen, Cellebrite, Andriller-Android app analysis: decompiling APKs, Dalvik cache, SQLite databases- case study: WhatsApp & Telegram data reconstruction from rooted device.

TOTAL: 30 Periods

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PRACTICAL EXERCISES:

1. Installation of Sleuth Kit on Linux and analysis of disk images
2. Data extraction from call logs using Sleuth Kit
3. Data extraction from SMS and contacts using Sleuth Kit
4. Installation and usage of Mobile Verification Toolkit (MVT) for decrypting iOS backups
5. Processing and parsing records from iOS system
6. Extraction of installed applications from Android devices
7. Extraction of diagnostic information from Android devices via ADB
8. Generation of unified chronological timeline of extracted records

TOTAL: 30 Periods

TOTAL: 30 + 30 = 60 Periods

Text Books:	1. Eoghan Casey, Digital Evidence and Computer Crime, Academic Press, 3rd Edition. 2. Andrew Hoog, Android Forensics: Investigation, Analysis and Mobile Security for Google Android, Elsevier. 3. Chuck Easttom, "An In-depth Guide to Mobile Device Forensics", First Edition, CRC Press, 2022
Reference Books:	1. Vacca, J, Computer Forensics, Computer Crime Scene Investigation, 2nd Ed, Charles River Media, 2005, ISBN: 1-58450-389.
MOOC/Web Platforms:	https://nptel.ac.in/courses/106105217 https://www.udemy.com

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Explain the foundational concepts and legal framework of digital forensics.	Understand (K2)
CO2	Apply investigation procedures for cybercrimes and interpret legal implications.	Apply (K3)
CO3	Develop a digital forensic readiness strategy for enterprise and law enforcement needs.	Apply (K3)
CO4	Analyze iOS forensic tools and extract artifacts from mobile devices.	Analyze (K4)
CO5	Evaluate Android forensics tools and reconstruct communication data from devices.	Evaluate (K5)

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V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	2	-	-	2	2	-	-	-	1	-	2	3	2	-
CO-2	3	3	3	2	3	3	2	-	2	2	-	2	3	3	-
CO-3	2	3	3	3	2	2	-	-	2	1	-	2	3	3	-
CO-4	3	3	3	3	3	3	2	-	2	1	-	3	3	3	-
CO-5	3	3	3	3	3	3	2	-	2	2	-	3	3	3	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each

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I - Course Name: 23PCS09 SOCIAL NETWORK SECURITY

Prerequisite	Programme Name	Sem	Category	L	T	P	C
NIL	B.E/B.Tech. – Common to CSE, IT and AI&DS	V/VI/ VII	PEC	2	0	2	3

II - Course Objectives

1.	Understand the architecture and functioning of social networks and the privacy concerns associated with them.
2.	Explore various types of attacks on social networks and mechanisms for detection and mitigation.
3.	Study privacy-preserving algorithms, access control models, and secure communication mechanisms in social platforms.
4.	Familiarize students with tools and methods to analyze network structures and secure user data.
5.	Discuss real-world case studies and recent research trends in social network security and user profiling.

III - Course Content

Preamble: The rise of online social networks has enabled global connectivity while introducing critical challenges in security, privacy, and trust.This course explores network architectures, vulnerabilities, risk management, and privacy-preserving mechanisms.Students will gain practical skills using tools like Neo4j and Flask to analyze and secure social platforms.By integrating theory and practice, it prepares learners to design resilient and trustworthy social network systems.

Unit – I	Need of software Security	6 Periods

Web Intelligence Thinking and Intelligent Web Applications- Limitations of Today's Web - The Next Generation Web- Machine Intelligence- Semantic Web - Semantic Road Map- Logic on the Semantic Web - Social Network analysis- Development of Social Network Analysis- Key concepts and measures in network analysis - Major paradigms- for understanding privacy and security

Unit – II	Secure Software Design	6 Periods

Knowledge Representation for the Semantic Web Ontologies and their role in the semantic web- Ontologies Languages for the Semantic Web – Resource Description Framework(RDF) / RDF Schema- Ontology Web Language (OWL)- UML- XML/XML Schema

Unit – III	Security Risk Management	6 Periods

Extracting evolution of Web Community from a Series of Web Archive- Detecting communities in social networks- Evaluating communities- Methods for community detection and mining- Applications of community mining algorithms- Tools for detecting communities social network infrastructures and communities- Big data and Privacy

UNIT -IV	Security Testing	6 Periods

Understanding and predicting human behavior for social communities- User data Management- Inference and Distribution- Context- Awareness- Privacy in online social networks- Trust in online environment- What is Neo4j- Nodes- Relationships- Properties. - Identifying fraudulent entities in online social networks - Phishing in OSM & Identifying fraudulent entities in online social networks

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Unit – V	Secure Project Management	6 Periods
Understand the access control requirements for Social Network- Enforcing Access Control Strategies- Authentication and Authorization- Roles-based Access Control- Host- storage and network access control options- Firewalls- Authentication- and Authorization in Social Network- Identity & Access Management- Single Sign-on- Identity Federation - Case Study: An Analysis of Demographic and Behaviour Trends using Social Media: Facebook- Twitter and Instagram		

TOTAL: 30 Periods

PRACTICAL EXERCISES:

1. Design your own social media application
2. Create a Network model using Neo4j
3. Read and write Data from the Graph Database
4. Find "Friend of Friends" using Neo4j
5. Implement secure search in social media
6. Create a simple Security & Privacy detector
7. Mini Project using Flask / Neo4

TOTAL: 30 Periods

TOTAL: 30 + 30 =60 Periods

Text Books:	1. Aggarwal, C. C. (2011). Social network data analytics. Springer. 2. Zheleva, E. (2012). Privacy in social networks. Synthesis Lectures on Information Security. 3. Hansen, D., Schneiderman, B., & Smith, M. A. (2010). Analyzing social media networks with NodeXL. Elsevier.
Reference Books:	1. Boyd, D., & Ellison, N. B. (2007). Social network sites: Definition, history, and scholarship. Journal of Computer-Mediated Communication. 2. Gupta, B. B., Perez, G. M., & Agrawal, D. P. (2021). Social network security: Issues, challenges, and solutions. Springer. 3. Wasserman, S., & Faust, K. (1994). Social network analysis: Methods and applications. Cambridge University Press.
MOOC/Web Platforms:	https://www.coursera.org/learn/security-social-media https://www.edx.org/course/social-network-analysis https://www.smrfoundation.org/nodexl/

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IV - Course Outcome

On completion of the course the students will be able to		Bloom's Level Mapped
CO1	Describe security challenges and privacy issues in social networks.	Understand (K2)
CO2	Apply access control and privacy-preserving mechanisms in social media.	Apply (K3)
CO3	Analyze different types of attacks and their detection in OSNs.	Analyze (K4)
CO4	Evaluate privacy models and graph anonymization techniques.	Evaluate (K5)
CO5	Use security tools to investigate and protect social network platforms.	Create (K6)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	2	-	-	-	2	3	2	-	-	-	2	2	-	-
CO-2	3	3	2	-	-	-	-	-	-	-	-	3	2	-	-
CO-3	3	3	3	2	3	2	-	-	-	-	-	3	3	-	-
CO-4	3	3	2	3	3	-	-	-	-	-	-	3	2	-	-
CO-5	3	3	3	3	3	-	-	-	-	-	-	3	3	2	-

Mapping: 1-Low- 2-Medium- 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23PCS10 MODERN CRYPTOGRAPHY

Prerequisite	Programme Name	Sem	Category	L	T	P	C
NIL	B.E/B.Tech. – Common to CSE, IT and AI&DS	V/VI/ VII	PEC	2	0	2	3

II - Course Objectives

1.	Introduce the fundamental concepts and goals of modern cryptography
2.	Familiarize students with classical and modern encryption techniques used in securing digital data.
3.	Provide a deep understanding of symmetric key algorithms (e.g., AES) and public key cryptographic systems (e.g., RSA, ECC).
4.	Explore cryptographic hash functions, message authentication codes (MACs), and digital signatures.
5.	Examine key management strategies, key exchange protocols, and infrastructure such as Public Key Infrastructure (PKI).

III - Course Content

Preamble: Modern Cryptography provides the principles and practices of securing digital information through mathematical foundations and encryption techniques. The subject explores symmetric and asymmetric algorithms, hash functions, digital signatures, and key management.

Unit – I	Mathematical Foundations for Cryptography	6 Periods

Number Theory: Primes-GCD- Modular Arithmetic-Euler's Theorem-CRT- Algebraic Structures: Groups-Rings-Fields- Complexity Theory: P, NP-One-way functions-Trapdoor functions- probability and Randomness in Cryptographic Context.

Unit – II	Symmetric Key Cryptography	6 Periods

Classical Ciphers and Cryptanalysis (Caesar, Vigenère, Substitution-Block Ciphers: DES, AES, S-boxes, Key Scheduling-Modes of Operation: ECB, CBC, CFB, OFB, CTR, GCM-Stream Ciphers: RC4, Salsa20, ChaCha-Message Authentication Codes: HMAC, CMAC

Unit – III	Asymmetric Cryptography and Protocols	6 Periods

RSA, ElGamal, Diffie-Hellman Key Exchange -Digital Signatures: RSA, DSA, ECDSA-Elliptic Curve Cryptography (ECC): Group Law, Point Addition-Key Management and Distribution-Public Key Infrastructure (PKI), X.56 Certificates

UNIT – IV	Advanced Cryptographic Constructs	6 Periods

Cryptographic Hash Functions: Properties, MD5, SHA-2/3-Zero-Knowledge Proofs and Commitment Schemes-Homomorphic Encryption (Paillier, BGV - overview)-Secure Multi-party Computation (MPC) and Secret Sharing-Lattice-based and Post-Quantum Cryptography (NTRU, LWE, Ring-LWE)

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Unit – V	Applications, Trends & Security Practices	9 Periods
Blockchain, Cryptocurrencies (Bitcoin, Ethereum)-Quantum Cryptography and Quantum Key Distribution-Functional Encryption, Obfuscation (Overview)-TLS/SSL, VPNs, IPsec – Secure Communication Protocols-Cryptanalysis Techniques and Case Studies-Hands-on: OpenSSL, GPG, Practical Attacks (Timing, Padding Oracle)		

TOTAL: 30 Periods

PRACTICAL EXERCISES:

1. Implementation of Euclidean Algorithm and Extended Euclidean Algorithm for GCD.
2. Demonstration of Modular Arithmetic operations (addition, multiplication, inverse).
3. Implementation of Classical Ciphers – Caesar, Vigenère, Playfair, Substitution.
4. Cryptanalysis of classical ciphers using frequency analysis.
5. Implementation of DES algorithm with key scheduling and encryption/decryption.
6. Implementation of AES algorithm (128-bit key) with S-box operations.
7. Study and demonstration of stream cipher (RC4 or ChaCha20).
8. Implementation of RSA algorithm – key generation, encryption, and decryption.
9. Demonstration of Diffie–Hellman Key Exchange Protocol.
10. Implementation of Digital Signatures using RSA/DSA.

TOTAL: 30 Periods

TOTAL: 30 + 30 = 60 Periods

Text Books:	1. Stallings, W. (2017). Cryptography and network security: Principles and practice (7th ed.). Pearson. 2. Katz, J., & Lindell, Y. (2020). Introduction to modern cryptography (3rd ed.). CRC Press. 3. 3Paar, C., & Pelzl, J. (2010). Understanding cryptography: A textbook for students and practitioners. Springer.
Reference Books:	1. Schneier, B. (1996). Applied cryptography: Protocols, algorithms, and source code in C (2nd ed.). Wiley. 2. William Stallings, "Cryptography and Network Security: Principles and Practice", PHI 3rd Edition, 2006.. 3. Forouzan, B. A. (2008). Cryptography and network security. McGraw-Hill. 4. Mao, W. (2004). Modern cryptography: Theory and practice. Pearson Education.
MOOC/Web Platforms:	https://onlinecourses.nptel.ac.in/noc22_cs03/preview

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IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Explain symmetric and asymmetric cryptographic principles.	Apply (K3)
CO2	Apply classical and modern encryption techniques to secure communication.	Apply (K3)
CO3	Analyze cryptographic algorithms (e.g., AES, RSA, ECC) in terms of security and performance.	Analyze (K4)
CO4	Evaluate hash functions, signatures, and key protocols in secure systems.	Analyze (K4)
CO5	Implement crypto algorithms and solve practical security problems using tools/libraries.	Evaluate (K5)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	-	2	-	-	-	-	-	-	-	-	2	-	-
CO-2	3	3	2	-	-	-	-	-	-	-	-	-	3	-	-
CO-3	3	3	3	3	2	-	-	-	-	-	-	-	3	2	-
CO-4	3	3	2		2	-	-	-	-	-	-	-	3	2	-
CO-5	3	3		2	3	-	-	-	-	-	-	-	3	3	2

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23PCS11 ENGINEERING SECURE SOFTWARE SYSTEMS

Prerequisite	Programme Name	Sem	Category	L	T	P	C
NIL	B.E/B.Tech. – Common to CSE, IT and AI&DS	V/VI/ VII	PEC	2	0	2	3

II - Course Objectives

1.	Understand and analyze software security principles to identify potential vulnerabilities and threats in software systems.
2.	Explore secure software development lifecycle (SDLC) models and incorporate security practices throughout the software engineering process.
3.	Apply threat modeling and risk assessment techniques to design secure software architectures.
4.	Implement secure coding practices to mitigate common software vulnerabilities such as buffer overflows- injection attacks- and insecure data handling.
5.	Evaluate and verify software security using testing methods- static and dynamic analysis- and code reviews.
6.	Understand legal- ethical- and compliance aspects related to secure software development.

III - Course Content

Preamble: Engineering Secure Software Systems emphasizes the principles and practices of building software with security as a core requirement. The subject covers secure software design, threat modeling, vulnerability assessment, and defensive coding techniques. It integrates security across the software development life cycle (SDLC) to prevent flaws and attacks.

Unit – I	Foundations of Software Security	6 Periods
Software Assurance and Software Security-Threats to Software Security-Sources of Software Insecurity-Benefits of Detecting Software Security Issues Early-Properties of Secure Software-Memory-Based Attacks: Heap and Stack-Defense Mechanisms- Return-Oriented Programming (ROP)-Use-After-Free and Format String Vulnerabilities-Updated Tools & Examples (e.g.- GDB- Valgrind)		
Unit – II	**Secure Software Design Principles**	**6 Periods**
Requirements Engineering for Secure Software-SQUARE Process Model-Secure Design Principles-Threat Modeling-Stack Inspection-Buffer Overflow-Code Injection- Session Hijacking - OWASP Top 10 (2023) overview (A1–A10 vulnerabilities)-Secure Coding Practices in C/C++ and Java-Examples of Secure API Design		
Unit – III	**Security Risk Management**	**6 Periods**
Risk Management Life Cycle- Risk Profiling- Risk Exposure Factors- Risk Evaluation and Mitigation-Threat and Vulnerability Management- NIST 800-64 Secure SDLC Framework- Risk-based Prioritization using DREAD model- Case Study: Real-world incident response and mitigation		
UNIT IV	**Security Testing and Evaluation**	**6 Periods**
Traditional Software Testing-Secure Software Development Life Cycle-Risk-Based Security Testing-Penetration Testing – Planning and Scoping- Enumeration-Web Application Exploitation-Client-Side Attacks-Post Exploitation- Bypassing Firewalls and Avoiding Detection- Static and Dynamic Application Security Testing (SAST/DAST)- OWASP ZAP- Burp Suite- Fuzz Testing- Dependency Scanning		

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Unit – V	Secure Project and Process Management	6 Periods
Governance and Security- Enterprise Security Frameworks- Security and Project Management- Maturity of Practice- DevSecOps Principles& Pipeline Integration- Overview of Compliance Standards (e.g.- ISO 27001-GDPR)- Agile Security – Security in Scrum/CI-CD		

TOTAL: 30 Periods

PRACTICAL EXERCISES

1. Implement the SQL injection attack.
2. Implement the Buffer Overflow attack.
3. Implement Cross Site Scripting and Prevent XSS.
4. Perform Penetration testing on a web application to gather information about the system, then initiate XSS and SQL injection attacks using tools like Kali Linux.
5. Develop and test the secure test cases
6. Penetration test using kali Linux

TOTAL: 30 Periods

TOTAL: 30+30 = 60 Periods

Text Books:	1. Julia H. Allen- "Software Security Engineering"- Pearson Education- 2008 2. Evan Wheeler- "Security Risk Management: Building an Information Security Risk Management Program from the Ground Up"- First edition- Syngress Publishing- 2011
Reference Books:	1. Mike Shema, "Hacking Web Apps: Detecting and Preventing Web Application Security Problems", First edition, Syngress Publishing, 2012 2. Bryan Sullivan and Vincent Liu, "Web Application Security, A Beginner's Guide", Kindle Edition, McGraw Hill, 2012
MOOC/Web Platforms:	1. OWASP Official Resources: https://owasp.org/ 2. Secure Code Warrior: https://securecodewarrior.com/ 3. GitHub - OWASP Threat Dragon: https://github.com/OWASP/threat-dragon

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Describe secure software engineering lifecycle and threat modeling techniques.	Understand (K2)
CO2	Apply secure design principles and architecture strategies.	Apply (K3)
CO3	Identify and mitigate software vulnerabilities using secure coding practices.	Analyze (K4)
CO4	Evaluate source code using static/dynamic analysis tools.	Evaluate (K5)
CO5	Design and develop secure software modules with industry-compliant standards.	Create (K6)

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V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	2	-	2	-	3	-	2	-	-	-	2	2	-	-
CO-2	3	3	3	-	-	-	-	-	-	-	-	3	2	-	-
CO-3	3	3	3	3	3	-	-	-	-	-	-	3	3	-	-
CO-4	3	3	3	3	3	-	-	-	-	-	-	3	2	-	-
CO-5	3	3	3	3	3	-	-	-	-	-	-	3	3	2	-

Mapping: 1-Low- 2-Medium- 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23PCS12 CRYPTOCURRENCY AND BLOCKCHAIN TECHNOLOGIES

Prerequisite	Programme Name	Sem	Category	L	T	P	C
NIL	B.E/B.Tech. – Common to CSE, IT and AI&DS	V/VI/ VII	PEC	2	0	2	3

II - Course Objectives

1.	To understand the basics of Blockchain
2.	To learn Different protocols and consensus algorithms in Blockchain
3.	To learn the Blockchain implementation frameworks
4.	To learn the Blockchain implementation frameworks
5.	To experiment the Hyperledger Fabric, Ethereum networks

III - Course Content

Preamble: This course provides an in-depth exploration of Blockchain Technology, from its basic principles to its advanced applications. The course is structured to offer a solid understanding of Blockchain fundamentals, including the architecture, consensus mechanisms, and cryptographic foundations that underpin modern cryptocurrencies and decentralized systems.

Unit – I	INTRODUCTION TO BLOCKCHAIN	6 Periods

Introduction to Blockchain – Characteristics and Benefits – Distributed Ledger Technology – Public and Private Ledgers – Blockchain Architecture – Block Structure: Header, Metadata, and Transactions – Cryptographic Hash Function – Properties of Hash Functions – Hash Pointer and Merkle Tree – Types of Blockchain: Public, Private, Consortium – Permissioned and Permissionless Blockchains Signatures

Unit – II	BITCOIN AND CRYPTOCURRENCY	6 Periods

Introduction to Cryptocurrency – Creation of Coins – Payments and Double Spending – FORTH: The Precursor to Bitcoin Scripting – Bitcoin Scripts – Bitcoin Peer-to-Peer (P2P) Network – Transactions in the Bitcoin Network – Block Mining – Block Propagation and Block Relay-Smart Contracts and Use Cases in Blockchain

Unit – III	BITCOIN CONSENSUS	6 Periods

Bitcoin Consensus Mechanisms – Proof of Work (PoW): Hash cash PoW, Bitcoin PoW – Attacks on PoW: 51% Attack, Sybil Attack – Mining Difficulty and Incentives – Mining Pools and Centralization Risks – Monopoly Problem in Mining – Alternative Consensus Mechanisms: Proof of Stake (PoS), Proof of Burn (PoB), Proof of Elapsed Time (PoET) – Permissioned Blockchain Models and Use Cases

Unit – IV	HYPERLEDGER FABRIC & ETHEREUM	6 Periods

Hyperledger Fabric Architecture: Components (Peers, Orderers, Certificate Authorities) – Chaincode Development and Deployment – Membership Service Provider (MSP) – Channels and Private Data Collections – Transaction Flow and Endorsement Policies – Ethereum Network Overview – Ethereum Virtual Machine (EVM) – Ether and Gas: Concepts and Fee Mechanism – Smart Contract Development using Solidity – Ethereum Tools: Remix IDE, Truffle Suite, and Ganache

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Unit – V	BLOCKCHAIN APPLICATIONS	6 Periods
Smart Contracts – Development and Deployment using Truffle Suite – Decentralized Applications (DApps): Architecture and Use Cases – Non-Fungible Tokens (NFTs): Standards and Applications – Blockchain Applications in Supply Chain Management, Logistics, Smart Cities, Finance and Banking, Insurance, Healthcare, and Governance – Case Studies on Real-world Implementations-Decentralized Identity (DID) and Self-Sovereign Identity (SSI) – Integration of Blockchain with Emerging Technologies (AI, IoT, and Cloud)		

TOTAL: 30 Periods

PRACTICAL EXERCISES:

1. Install and understand Docker container, Node.js, Java and Hyperledger Fabric, Ethereum and perform necessary software installation on local machine/create instance on cloud to run.
2. Create and deploy a blockchain network using Hyperledger Fabric SDK for Java Set up and initialize the channel, install and instantiate chain code, and perform invoke and query on your blockchain network.
3. Interact with a blockchain network. Execute transactions and requests against a blockchain network by creating an app to test the network and its rules.
4. Deploy an asset-transfer app using blockchain. Learn app development within a Hyperledger Fabric network.
5. Use blockchain to track fitness club rewards. Build a web app that uses Hyperledger Fabric to track and trace member rewards.
6. Car auction network: A Hello World example with Hyperledger Fabric Node SDK and IBM Blockchain Starter Plan. Use Hyperledger Fabric to invoke chain code while storing results and data in the starter plan

TOTAL: 30 Periods

TOTAL: 30 + 30 = 60 Periods

Text Books:	1. Bashir and Imran, Mastering Blockchain: Deeper insights into decentralization, cryptography, Bitcoin, and popular Blockchain frameworks, 2017. 2. Andreas Antonopoulos, "Mastering Bitcoin: Unlocking Digital Cryptocurrencies", O'Reilly, 2014.
Reference Books:	1. Daniel Drescher, "Blockchain Basics", First Edition, Apress, 2017. 2. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder. Bitcoin and cryptocurrency technologies: a comprehensive introduction. Princeton University Press, 2016. 3. Melanie Swan, "Blockchain: Blueprint for a New Economy", O'Reilly, 2015 4. Handbook of Research on Blockchain Technology, published by Elsevier Inc. ISBN: 9780128198162, 2020
MOOC/Web Platforms:	https://onlinecourses.nptel.ac.in/noc22_cs44/preview

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IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand emerging abstract models for Blockchain Technology	Understand (K2)
CO2	Analyze cryptocurrency systems (e.g., Bitcoin, Ethereum) with respect to transactions, mining, security risks, and performance	Analyze (K4)
CO3	Apply smart contract programming and decentralized application (dApp) development using platforms like Ethereum and Hyperledger	Apply (K3)
CO4	Develop and deploy smart contracts on Ethereum using Solidity and related tools.	Evaluate (K5)
CO5	Design decentralized applications (dApps) using blockchain technologies and explain real-world use cases.	Create (K6)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	2	1	1	-	-	-	-	-	-	-	-	3	2	1
CO-2	-	3	3	3	1	-	-	-	-	-	-	-	3	3	2
CO-3	-	3	2	1	1	-	-	-	-	-	-	-	3	3	3
CO-4	-	-	3	3	1	-	-	-	-	-	-	-	3	1	0
CO-5	-	2	3	1	1	-	-	-	-	-	-	-	3	2	1

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23PCS13 NETWORK SECURITY

Prerequisite	Programme Name	Sem	Category	L	T	P	C
23AD404-Networking Essentials	B.E/B.Tech. – Common to CSE, IT and AI&DS	V/VI/ VII	PEC	2	0	2	3

II - Course Objectives

1.	Understand the basic concepts of security services, mechanisms, and attacks.
2.	Study and analyze symmetric and asymmetric cryptographic techniques.
3.	Learn about key distribution, authentication protocols, and digital signatures.
4.	Examine network security practices including firewalls, IDS, and IPsec.
5.	Explore web and email security measures including SSL/TLS, PGP, and S/MIME.

III - Course Content

Preamble: Network Security focuses on protecting data, devices, and communication across computer networks from threats and attacks. The subject covers cryptographic techniques, authentication, firewalls, intrusion detection, and secure protocols. It emphasizes risk analysis, prevention strategies, and resilience against evolving cyber threats. Students acquire practical skills to design and manage secure networked systems in real-world environments.

Unit – I	**INTRODUCTION**	**6 Periods**
Data Communication -Networks – Network Types-Network Topologies-Basics of cryptography- conventional and public-key cryptography- hash functions- authentication- and digital signatures.		
Unit – II	**Key Management and Distribution**	**6 Periods**
Symmetric Key Distribution- Distribution of Public Keys- X.56 Certificates- Public-Key Infrastructure emote User-Authentication Using Symmetric Encryption- Kerberos Systems- Remote User Authentication Using Asymmetric Encryption		
Unit – III	**ACCESS CONTROL AND SECURITY**	**6 Periods**
Network Access Control: Network Access Control- Extensible Authentication Protocol- IEEE 802.1X Port-Based Network Access Control - IP Security - Internet Key Exchange (IKE).- Transport Layer Security- HTTPS standard- Secure Shell (SSH) application		
UNIT -IV	**APPLICATION LAYER SECURITY**	**6 Periods**
Electronic Mail Security: Pretty Good Privacy- S/MIME- DomainKeys Identified Mail. Wireless Network Security: Mobile Device Security		
Unit – V	**COMMUNICATION TECHNIQUES AND SECURITY**	**6 Periods**
cellular Internet access – 3G- 4G- 5Gand beyond 6G – IDS- Firewalls- Digital Signatures –End Point Authentication – Future technologies-SDN(Software defined network)-Internet of Everything (IoE)		

TOTAL: 30 Periods

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PRACTICAL EXERCISES:

1. Implement symmetric key algorithms
2. Implement asymmetric key algorithms and key exchange algorithms
3. Implement digital signature schemes
4. Installation of Wire shark, tcpdump and observe data transferred in client-server communication using UDP/TCP and identify the UDP/TCP datagram.
5. Check message integrity and confidentiality using SSL
6. Experiment Eavesdropping, Dictionary attacks, MITM attacks
7. Experiment with Sniff Traffic using ARP Poisoning
8. Demonstrate intrusion detection system using any tool.
9. Explore network monitoring tools
10. Study to configure Firewall, VPN

TOTAL: 30 Periods

TOTAL: 30 + 30 = 60 Periods

Text Books:	1. Stallings, W. (2017). Cryptography and network security: Principles and practice (7th ed.). Pearson. 2. Katz, J., & Lindell, Y. (2020). Introduction to modern cryptography (3rd ed.). CRC Press. 3. Paar, C., & Pelzl, J. (2010). Understanding cryptography: A textbook for students and practitioners. Springer.
Reference Books:	1. Schneier, B. (1996). Applied cryptography: Protocols, algorithms, and source code in C (2nd ed.). Wiley. 2. Singh, S. (1999). The code book: The science of secrecy from ancient Egypt to quantum cryptography. Anchor Books. 3. Forouzan, B. A. (2008). Cryptography and network security. McGraw-Hill. 4. Mao, W. (2004). Modern cryptography: Theory and practice. Pearson Education.
MOOC/Web Platforms:	https://onlinecourses.nptel.ac.in/noc25_ee54/preview

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Describe security concepts, services, and mechanisms.	Understand (K2)
CO2	Apply symmetric and asymmetric encryption techniques.	Apply (K3)
CO3	Analyze and evaluate authentication and key management protocols.	Analyze (K4)
CO4	Illustrate secure communication practices in networks and the web.	Apply (K3)
CO5	Implement cryptographic techniques in simulated environments.	Evaluate (K5)

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V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	-	2	-	-	-	-	-	-	-	-	2	-	-
CO-2	3	3	2	-	-	-	-	-	-	-	-	-	3	-	-
CO-3	3	3	3	3	2	-	-	-	-	-	-	-	3	2	-
CO-4	3	3	2		2	-	-	-	-	-	-	-	3	2	-
CO-5	3	3	-	2	3	-	-	-	-	-	-	-	3	3	2

Mapping: 1-Low- 2-Medium- 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23PCS14 AUGMENTED REALITY/VIRTUAL REALITY

Prerequisite	Programme Name	Sem	Category	L	T	P	C
NIL	B.E/B.Tech. – Common to CSE,IT and AI&DS	V/VI/ VII	PEC	2	0	2	3

II - Course Objectives

1.	To understand the fundamental concepts of AR/VR technologies.
2.	To explore various tools and techniques used in developing AR/VR applications.
3.	To study the modeling and simulation techniques in AR/VR environments.
4.	To understand the interaction methods and hardware used in immersive systems.
5.	To analyze application domains, ethical challenges, and future directions in AR/VR.

III - Course Content

Preamble: This course introduces the fundamentals of Virtual Reality (VR) and Augmented Reality (AR), covering the concepts of immersive technologies, hardware/software systems, modeling and simulation, toolkits, and application domains including healthcare, education, military, and entertainment. It explores interaction techniques, case studies, ethical considerations, and emerging trends.

Unit – I	Fundamentals of AR/VR	6 Periods

Introduction to Virtual Reality and Augmented Reality –Introduction to Trajectories and Hybrid Space-Three I's of Virtual Reality – Virtual Reality Vs 3D Computer Graphics – Benefits of Virtual Reality – Components of VR System- Introduction to Immersive Technologies (AR, VR, MR, XR)- – Graphics Display -3D Position Trackers – Types of Trackers – Navigation and Manipulation Interfaces – Gesture Interfaces – Types of Gesture Input Devices – Human Visual System – Personal Graphics Displays – Large Volume Displays – Sound Displays – Human Auditory System - Applications of AR/VR

Unit – II	3D Object Modeling and Simulation in VR	6 Periods

Geometric Modeling- Virtual Object Shape- Kinematics Modeling- Transformation Matrices- Development Basics of 3D Graphics and Game Engines- Development Basics of 3D Graphics and Game Engines- Object Hierarchies – Viewing the 3D World – Physical Modeling – Collision Detection – Surface Deformation – Force Computation – Force Smoothing and Mapping

Unit – III	VR Toolkits and AR Interaction Techniques	6 Periods

VR Programming – Toolkits and Scene Graphs – World Tool Kit – Java 3D – Comparison of World Tool Kit and Java 3D-Augmented Reality Introduction to Augmented Reality-Computer vision for AR-Interaction-Modeling and Annotation Navigation-Wearable devices.

Unit – IV	Case Studies and Emerging Trends	6 Periods

Analysis of successful AR/VR applications in gaming, education, healthcare, and retail-Discussion on ethical considerations and challenges in AR/VR-Future directions and research opportunities in AR/VR

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Unit – V	Applications	6 Periods
Human Factors in VR – Methodology and Terminology – VR Health and Safety Issues – VR and Society- Medical Applications of VR – Education, Arts and Entertainment – Military VR Applications – Emerging Applications of VR – VR Applications in Manufacturing – Applications of VR in Robotics – Information Visualization – VR in Business – VR in Entertainment – VR in Education.		

TOTAL: 30 Periods

PRACTICAL EXERCISES:

1. Study of tools like Unity, Maya, 3DS MAX, AR toolkit, Vuforia and Blender.
2. Use the primitive objects and apply various projection types by handling camera.
3. Download objects from asset store and apply various lighting and shading effects.
4. Model three dimensional objects using various modeling techniques and apply textures over them.
5. Create three dimensional realistic scenes and develop simple virtual reality enabled mobile applications which have limited interactivity.
6. Add audio and text special effects to the developed application.
7. Develop VR enabled applications using motion trackers and sensors incorporating full haptic interactivity.
8. Develop AR enabled applications with interactivity like E learning environment, Virtual walkthroughs and visualization of historic places.
9. Develop AR enabled simple applications like human anatomy visualization, DNA/RNA structure visualization and surgery simulation.
10. Develop simple MR enabled gaming applications.

TOTAL : 30 Periods

TOTAL: 30 + 30 = 60 Periods

Text Books:	1. Alan B. Craig, Understanding Augmented Reality: Concepts and Applications, Morgan Kaufmann. 2. Grigore C. Burdea and Philippe Coiffet, Virtual Reality Technology, Wiley-IEEE Press.
Reference Books:	1. Dieter Schmalstieg and Tobias Hollerer, Augmented Reality: Principles and Practice, Addison-Wesley. 2. Jason Jerald, The VR Book: Human-Centered Design for Virtual Reality, ACM Books.
MOOC/Web Platforms:	Introduction to Augmented Reality and ARCore – by Google Virtual Reality Specialization – by University of London

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IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the basic concepts of AR and VR	Understand (K2)
CO2	Understand the tools and technologies related to AR/VR	Understand (K2)
CO3	Explain the working principle of AR/VR related Sensor devices	Understand (K2)
CO4	Design of various models using modeling techniques CO5:Develop AR/VR applications in different domains	Apply (K3)
CO5	Understand the basic concepts of AR and VR	Understand (K2)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	2	-	-	3	-	-	-	-	-	-	-	3	-	-
CO-2	3	3	2	-	3	-	-	-	-	-	-	-	3	2	-
CO-3	3	2	2	2	3	-	-	-	-	-	-	-	2	3	-
CO-4	3	2	3	2	3	-	-	-	-	-	-	-	3	2	2
CO-5	3	3	3	2	3	2	-	-	2	2	-	2	3	3	3

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23PCS1S MULTIMEDIA AND ANIMATION

Prerequisite	Programme Name	Sem	Category	L	T	P	C
NIL	B.E/B.Tech. – Common to CSE,IT and AI&DS	V/VI/ VII	PEC	2	0	2	3

II - Course Objectives

1.	Introduce the fundamental components of multimedia systems such as text, images, audio, video, and animation, along with their formats and real-world applications
2.	Provide foundational knowledge of 2D and 3D computer graphics, including raster/vector graphics, basic drawing algorithms, transformations, projections, and color models
3.	Explain key animation principles and demonstrate techniques used in 2D and 3D environments including frame-by-frame animation, tweening, rigging, and key framing
4.	Familiarize students with multimedia authoring tools and scripting languages for integrating and developing interactive multimedia content
5.	Expose students to emerging trends such as Virtual Reality (VR), Augmented Reality (AR), visual effects (VFX), and their applications in gaming, advertising, and e-learning industries

III - Course Content

Preamble: Multimedia and Animation combine text, graphics, audio, video, and interactivity to create engaging digital content. This subject introduces fundamental concepts of multimedia systems, animation techniques, and design principles. It enables students to develop creative skills for producing interactive applications, games, and visual effects. The course bridges technology and creativity, preparing learners for careers in digital media and entertainment industries.

Unit – I	Introduction to Multimedia Systems	6 Periods

Components of multimedia: Text, images, audio, video, animation Multimedia system architecture Multimedia applications: e-learning, entertainment, advertising File formats and standards (MPEG, MP3, JPEG, PNG, MP4, GIF) Overview of multimedia authoring tools and platforms

Unit – II	Computer Graphics Fundamentals	6 Periods

Raster vs vector graphics2D graphics: Line/circle drawing (DDA, Bresenham), transformations, clipping 3D graphics basics: Modeling, transformations (translation, scaling, rotation), projections Color theory: RGB, HSV, CMYK Basics of image processing (filtering, noise removal, histogram)

Unit – III	Principles and Techniques of Animation	6 Periods

12 Principles of Animation (e.g., squash and stretch, anticipation, timing) 2D Animation: Frame-by-frame, tweening, morphing 3D Animation: Modeling, rigging, skinning, key framing Stop motion and experimental animation Case studies of animation in cinema, gaming, and mobile apps

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Unit – IV	Multimedia Authoring and Scripting	6 Periods
Timeline and scripting-based authoring models Tools: Adobe Animate, Flash, Unity basics for animation Integration of text, audio, video, animation in interactive applications Multimedia project design: User interface, interactivity, usability Basics of Action Script/JavaScript for interactivity		
Unit – V	Emerging Trends and Industry Practice	6 Periods
Visual effects (VFX): Compositing, Roto scoping, Chroma keying Virtual Reality (VR) and Augmented Reality (AR) in multimedia Game design principles and interactive storytelling Portfolio building and demo reel preparation Case studies of multimedia projects in advertising, gaming, ed-tech		

TOTAL: 30 Periods

PRACTICAL EXERCISES:

1. 2D & 3D animation mini-projects using Blender, Maya or Pencil2D
2. Interactive multimedia application using authoring tools
3. Image and video processing exercises using Python/OpenCV
4. VFX compositing using After Effects or DaVinci Resolve
5. Final project: Build a multimedia story/game/interactive app

TOTAL : 30 Periods

TOTAL:30+30 = 60 Periods

Text Books:	1. Ze-Nian Li, Mark S. Drew, Jiangchuan Liu, Fundamentals of Multimedia", Third Edition, Springer Texts in Computer Science, 2021. (UNIT-I, II, III)
Reference Books:	1. Gerald Friedland, Ramesh Jain, "Multimedia Computing", Cambridge University Press, 2018
MOOC/Web Platforms:	https://www.coursera.org https://nptel.ac.in/courses/117105083?utm_source=chatgpt.com

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Co1: Understand the components of multimedia systems and their real-world applications.	Understand (K3)
CO2	Apply basic computer graphics techniques for 2D and 3D multimedia content creation	Apply (K3)
CO3	Demonstrate animation principles and techniques in both 2D and 3D environment	Apply (k3)
CO4	Use multimedia authoring tools and scripting to create interactive multimedia conten	Analyze (k4)
CO5	Analyze emerging trends such as AR/VR and visual effects and apply industry practices in project development	Analyze (k4)

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V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	2	-	-	-	2	-	-	-	-	-	-	3	-	-	-
CO-2	3	2	3	-	3	-	-	-	-	-	-	3	2	-	2
CO-3	3	2	3	-	2	-	-	2	-	-	-	3	3	2	2
CO-4	2	2	3	2	3	-	-	2	2	-	-	3	3	2	2
CO-5	2	3	3	3	3	2	1	2	2	1	2	3	3	3	3

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23PCS16 VIDEO CREATION AND EDITING

Prerequisite	Programme Name	Sem	Category	L	T	P	C
NIL	B.E/B.Tech. – Common to CSE,IT and AI&DS	V/VI/ VII	PEC	2	0	2	3

II - Course Objectives

1.	Understand the Fundamentals and Evolution of Filmmaking
2.	Analyze the Impact of Editing on Storytelling
3.	Gain Technical Knowledge of Digital Editing Tools and Processes
4.	Learn and Apply Digital Storytelling Techniques
5.	Understand the Science of Lightning Transients (Cross-disciplinary Knowledge)

III - Course Content

Preamble: Video Creation and Editing focuses on the fundamentals of capturing, producing, and refining digital video content. The subject introduces techniques in shooting, editing, transitions, effects, and audio integration. It enhances creative and technical skills using professional editing tools and work flows. Students gain the ability to produce high-quality videos for media, education, and industry applications.

Unit – I	**Fundamentals of Filmmaking**	**6 Periods**

Fundamentals Evolution of filmmaking – linear editing – non-linear digital video -colour images– Economy of Expression – risks associated with altering reality through editing

Unit – II	**Storytelling in the Digital Age**	**6 Periods**

Zero-crossings of the second derivative; Scale in image processing-Storytelling styles in a digital world through jump cuts, L-cuts, match cuts, cutaways, dissolves, split edits – Consumer and pro NLE systems – digitizing images – managing resolutions -mechanics of digital editing – pointer files – media management

Unit – III	**Lightning Transients**	**6 Periods**

Theories of cloud formation - mechanism of lightning discharges and characteristics of lightning strokes – model for lightning stroke - factors contributing to good line design - protection using ground wires - tower footing resistance - Interaction between lightning and power system.

Unit – IV	**Working with Final Cut Pro**	**6 Periods**

Working with clips and the Viewer – working with sequences, the Timeline, and the canvas – Basic Editing – Adding and Editing Testing Effects – Advanced Editing and Training Techniques – Working with Audio – Using Media Tools – Viewing and Setting Preferences.

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Unit – V	Working With Avid Xpress Dv 4	6 Periods
Starting Projects and Working with Project Window – FaceNet for Face Recognition- Using Basic Tools and Logging – Preparing to Record and Recording – Importing Files – Organizing with Bins – Viewing and Making Footage -Using Timeline and Working in Trim Mode – Working with Audio – Output Options.		

TOTAL: 30 Periods

PRACTICAL EXERCISES:

1. Write a Movie Synopsis (Individual/Team Writing)
2. Present team stories in class.
3. Script/Storyboard Writing(Individual Assignment)
4. Pre-Production: Personnel, budgeting, scheduling, location scouting, casting, contracts & agreements
5. Production: Single camera production personnel & equipment, Documentary Production
6. Writing The Final Proposal: Overview, Media Treatments, Summary, Pitching
7. Write Documentary &Animation Treatment 8. Post-production: Editing, Sound design, Finishing

TOTAL : 30 Periods

TOTAL: 30 + 30 = 60 Periods

Text Books:	1. Avid Xpress DV 4 User Guide, 2007. 2. Final Cut Pro 6 User Manual, 2004. 3. Keith Underdahl, "Digital Video for Dummies", Third Edition, Dummy Series, 2001.
Reference Books:	In the Blink of an Eye" by Walter Murch Final Cut Pro X 10.4 - Apple Pro Training Series" by Brendan Boykin
MOOC/Web Platforms:	www.nofilmschool.com www.nofilmschool.com

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Explain the evolution of filmmaking and differentiate between linear and non-linear editing techniques	Understand) (k2)
CO2	Analyze the impact of editing techniques (e.g., jump cuts, L-cuts) on storytelling in digital media	Analyse (k4)
CO3	Apply digital editing tools and processes including media management and resolution handling.	Apply (k3)
CO4	Demonstrate proficiency in using Final Cut Pro and Avid Xpress DV 4 for editing video projects	Apply (k3)
CO5	Evaluate risks associated with altering reality through editing and propose ethical solutions.	Evaluate (k5)

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V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	2	1	-	-	-	-	-	1	-	-	-	3	-	2	1
CO-2	-	3	2	-	-	-	-		1	-	-	3	2	-	3
CO-3	-	2	3	1	-	-	-	1	-	-	-	3	3	-	2
CO-4	-	-	3	2	-	-	-	2	1	-	-	3	3	-	-
CO-5	2	3	-	-	3	2	-	1	-	-	-	2	-	2	3

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23PCS17 DIGITAL MARKETING

Prerequisite	Programme Name	Sem	Category	L	T	P	C
NIL	B.E/B.Tech. – Common to CSE,IT and AI&DS	V/VI/ VII	PEC	2	0	2	3

II - Course Objectives

1.	Understand the fundamentals of digital marketing and its ecosystem.
2.	Gain knowledge of tools used for website creation and content marketing.
3.	Learn about SEO, SEM, and how to optimize online presence.
4.	Explore effective techniques in email, mobile, and social media marketing.
5.	Analyze campaign performance using digital analytics tools.

III - Course Content

Preamble: This course introduces students to core digital marketing strategies and tools. It emphasizes practical exposure through real-time assignments to design, optimize, and analyze digital campaigns across multiple platforms.

Unit – I	Introduction	6 Periods

Introduction to Online Market- Online Market Space fundamentals- Digital Marketing Strategy & Components- Website Planning and Creation with tools (e.g., Wix, Word Press)- Introduction to Content Marketing using blogs, info graphics-Real-time: Design and launch a basic website project with branding elements

Unit – II	Search Engine Optimization	6 Periods

Keyword Research using Google Keyword Planner-On-page SEO: Meta tags, Headings, URL structure-Off-page SEO: Back linking, Directory submission-SEM: PPC campaigns using Google Ads- Real-time: Run a live SEO audit and Google Ads campaign

Unit – III	Email & Mobile Marketing	6 Periods

Designing Email Campaigns with Mail chimp or Send in blue- Email Automation and Analytic-Mobile Marketing: SMS campaigns, App-based Ads- Real-time: Launch an email series + set up SMS alert promotions

Unit – IV	Social Media Marketing (SMM)	6 Periods

Use of platforms: Facebook, Instagram, LinkedIn, Twitter- Creating and managing brand pages- Influencer collaboration strategies- Real-time: Run a 5-day paid campaign on Meta Ads (Facebook/Instagram) and measure engagement

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Unit – V	Digital Transformation & Analytics	6 Periods
Google Analytics for Web & Campaign tracking- ROI measurement of campaigns- Integrating multiple channels (Email, Mobile, Web)- Real-time: Prepare and present a Digital Performance Report based on simulated campaign data		

TOTAL: 30 Periods

PRACTICAL EXERCISES:

1. Website Creation and Optimization
2. Search Engine Optimization (SEO) Basics
3. Search Engine Marketing (SEM) – Google Ads
4. Social Media Marketing (SMM)
5. Email Marketing
6. Content Marketing & Blogging
7. Web Analytics (Google Analytics / Matomo)
8. Affiliate Marketing & Influencer Marketing
9. Video Marketing (YouTube/Instagram Reels)
10. Online Reputation Management (ORM)
11. E-Commerce and Digital Payments
12. Case Study & Campaign Performance Analysis

TOTAL : 30 Periods

TOTAL: 30+30=60 Periods

Text Books:	1. Philip Kotler, Hermawan Kartajaya, Iwan Setiawan, Digital Marketing: Strategy, Implementation and Practice, Pearson, Latest Edition. 2. Seema Gupta, Digital Marketing, McGraw Hill Education, Latest Edition.
Reference Books:	1. Dave Chaffey, Fiona Ellis-Chadwick, Digital Marketing, Pearson Education. 2. Ryan Deiss and Russ Henneberry, Digital Marketing for Dummies, Wiley. 3. Debra Zahay, Digital Marketing Management, Routledge.
MOOC/Web Platforms:	https://learndigital.withgoogle.com https://www.coursera.org/specializations/digital-marketing https://academy.hubspot.com

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IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Explain the fundamentals and strategies of digital marketing.	Understand (k2)
CO2	Design and develop a website with content marketing tools.	Apply (k3)
CO3	Implement SEO, SEM, email, and mobile marketing strategies.	Apply (k3)
CO4	Manage social media campaigns and measure engagement metrics.	Analyse (k4)
CO5	Evaluate the effectiveness of digital campaigns using analytics and reporting tools.	Evaluate (k5)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	2	1	1	2	1	1	-	2	2	-	1	2	-	-
CO-2	2	2	3	2	3	1	1	-	2	3	-	2	3	1	-
CO-3	3	3	3	2	3	2	-	-	2	2	-	2	3	2	-
CO-4	2	2	2	3	3	1	-	-	3	2	-	2	3	2	-
CO-5	2	3	3	3	3	2	-	-	3	3	-	3	3	3	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23PCS20 MULTIMEDIA DATA COMPRESSION AND STORAGE

Prerequisite	Programme Name	Sem	Category	L	T	P	C
NIL	B.E/B.Tech. – Common to CSE,IT and AI&DS	V/VI/VII	PEC	2	0	2	3

II - Course Objectives

1.	To introduce the fundamental concepts of data compression techniques
2.	To explain various image and video compression standards
3.	To understand the architecture and models of multimedia data storage
4.	To learn disk scheduling techniques for efficient data retrieval
5.	To explore real-time libraries and platforms used in multimedia compression and storage

III - Course Content

Preamble: This course focuses on understanding, applying, and analyzing techniques for compressing and storing multimedia data. It includes hands-on exposure to real-time tools and platforms used in industry for compressing text, images, videos, and managing data on storage systems.

Unit – I	**Basics of Data Compression**	**6 Periods**
Introduction- Lossless and Lossy Compression- Huffman coding- Arithmetic coding- Dictionary techniques- Context-based compression- Applications-Explore open-source compression libraries (e.g., Zlib, Brotli) Case study: Compression in mobile messaging apps		
Unit II	**Image Compression**	**6 Periods**
JPEG, CALIC, JPEG-LS- Prediction using conditional averages- Progressive transmission- Lossless formats- Applications- Facsimile encoding-Real-time image compression with OpenCV		
Unit – III	**Video Compression**	**6 Periods**
Motion compensation- Video signal representation- Standards: H.261, MPEG-1, MPEG-2, H.263-Case study: YouTube or Netflix video encoding		
Unit – IV	**Data Placement on Disks**	**6 Periods**
Statistical/constraint-based allocation- Striping, Replication- Tertiary storage- Hierarchical storage system- Research AWS Glacier and multi-tiered storage		
Unit – V	**Disk Scheduling Methods**	**6 Periods**
Scheduling algorithms for disk requests- Feasibility of concurrent streams- Request stream management- Analyze SSD vs HDD behavior in scheduling		

TOTAL: 30 Periods

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PRACTICAL EXERCISES:

1. Implement image compression using JPEG algorithm
2. Audio compression using Huffman Coding
3. Implement Run-Length Encoding (RLE)
4. Video compression using Motion Estimation
5. LZW Compression on text/image data
6. Discrete Cosine Transform (DCT) on images
7. Wavelet Transform-based image compression
8. Comparative study: Lossy vs Lossless
9. Implement MPEG Encoder basics
10. Mini Project: Build a multimedia compressor

TOTAL : 30 Periods

TOTAL: 30+30=60 Periods

Text Books:	1. Khalid Sayood, Introduction to Data Compression, 5th Edition, Morgan Kaufmann Publishers, 2017. 2. David Salomon, Data Compression: The Complete Reference, Springer, 4th Edition, 2007.
Reference Books:	1. Ze-Nian Li, Mark S. Drew, Fundamentals of Multimedia, Pearson Education, 2nd Edition, 2014. 2. Toby Berger, Rate Distortion Theory: A Mathematical Basis for Data Compression, Prentice Hall. 3. Rafael C. Gonzalez, Richard E. Woods, *Digital Image Processing*, Pearson, 4th Edition, 2018.
MOOC/Web Platforms:	https://nptel.ac.in/courses/117105083 https://www.coursera.org/learn/image-processing https://www.edx.org/course/introduction-to-data-compression

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the basics of text, image, and video compression	Understand (K2)
CO2	Apply and evaluate various multimedia compression algorithms.	Apply (K3)
CO3	Explore and implement video compression techniques and applications.	Apply (K3)
CO4	Develop understanding of multimedia storage systems and placement strategies.	Understand (K2)
CO5	Analyze and simulate scheduling methods for multimedia data retrieval.	Analyze (K4)

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V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	2	-	-	2	1	-	-	-	1	-	1	3	2	-
CO-2	3	3	3	2	3	2	-	-	2	2	-	2	3	2	-
CO-3	3	3	3	2	2	2	-	-	2	1	-	2	3	3	-
CO-4	2	2	2	1	2	1	-	-	2	1	-	2	2	2	-
CO-5	3	3	2	3	3	2	-	-	2	2	-	3	3	3	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23PCS19 GAME DEVELOPMENT

Prerequisite	Programme Name	Sem	Category	L	T	P	C
NIL	B.E/B.Tech. – Common to CSE,IT and AI&DS	V/VI/VII	PEC	2	0	2	3

II - Course Objectives

1.	Explain the concepts of 2D and 3d Graphics
2.	Design game design documents.
3.	Implementation of gaming engines.
4.	Survey gaming environments and frameworks
5.	Implement a simple game in Pygame

III - Course Content

Preamble: This course introduces the foundations of 2D and 3D graphics, game design principles, and interactive storytelling for developing engaging digital games .It equips students with skills in game engine architecture, rendering techniques, collision detection, and AI-driven gameplay mechanics. Learners will gain hands-on experience with game development platforms like Pygame, Unity, and Unreal Engine for both 2D and 3D games. The course bridges creativity and technology, enabling students to design, develop, and deploy innovative single-player and multiplayer games.

Unit – I	Fundamentals of 3D Graphics in Game Development	6 Periods

Introduction to 2D and 3D graphics, including avatars and game components - Understanding 2D and 3D transformations - Study of different projection techniques in graphics -Analysis of color models used in game graphics - Basics of lighting and shader models- Controller-based animation methods

Unit – II	Core Concepts and Strategies in Game Design	6 Periods

Creating compelling game characters - Developing storyboards for games -Designing and narrating game scripts -Ensuring fair and engaging gameplay- Understanding fundamental game mechanics - Principles of designing game levels - Writing for preproduction, production, and post-production phases

Unit – III	Architecture and Development of Game Engines	6 Periods

Understanding rendering techniques- Differences between software and hardware rendering - Techniques for efficient rendering - Algorithms used in game engines- Methods for detecting collisions in games - Implementing game rules and logic - Basics of game AI and path finding.

Unit – IV	Introduction to Game Development Platforms and Tools	6 Periods

Introduction to game development using Pygame - Exploring Unity for game development - Writing scripts in Unity - Developing games for mobile platforms - Utilizing Game Studio for game development - Creating single-player and multiplayer games

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Unit – V	Building Games with Pygame	6 Periods
Install and explore Unity or Unreal Engine - Create and animate game characters - Design game levels and environments - Develop a 2D game using Pygame- Create a puzzle game - Design and implement menus for mobile games - 3D Game Development: Develop a 3D game using Unreal Engine - Multiplayer Game Development: Create a multiplayer game using Unity		

TOTAL: 30 Periods

PRACTICAL EXERCISES:

1. Implementing Advanced Character Animations
2. Developing AI-Driven NPCs.
3. Creating Dynamic Weather Systems
4. Implementing Day-Night Cycles
5. Designing Procedural Level Generation
6. Integrating Multiplayer Networking.
7. Implementing Augmented Reality (AR) Features
8. Optimizing Game Performance
9. Conducting User Experience (UX) Testing
10. Developing Cross-Platform Games

TOTAL : 30 Periods

TOTAL: 30+30=60 Periods

Text Books:	1. Sanjay Madhav, "Game Programming Algorithms and Techniques: A Platform Agnostic Approach", Addison Wesley,2013. 2. Will McGugan, "Beginning Game Development with Python and Pygame: From Novice to Professional", Apress,2007.
Reference Books:	1. Paul Craven, "Python Arcade games", Apress Publishers,2016. 2. David H. Eberly, "3D Game Engine Design: A Practical Approach to Real-Time Computer Graphics", Second Edition, CRC Press,2006.
MOOC/Web Platforms:	Coursera/ CrazyGames Developer Portal

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IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Explain the concepts of 2D and 3D graphics in game development	Understand (k2)
CO2	Design detailed game design documents including characters, storyboards, and game scripts.	Apply (k3)
CO3	Implement and analyze game engine architecture and rendering techniques	Apply (k3)
CO4	Survey and evaluate various game development platforms and tools such as Pygame, Unity, and Unreal Engine	Evaluate (k5)
CO5	Develop a simple 2D game using Pygame and create interactive game features	Create (k6)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	-	-	-	2	-	-	-	-	-	-	3	-	3	-
CO-2	2	2	3	-	2	-	-	1	2	-	-	3	3	2	2
CO-3	3	2	3	2	3	-	-	-	-	1	-	3	3	3	2
CO-4	2	2	2	2	3	-	-	-	2	-	-	2	3	2	2
CO-5	3	2	3	2	3	-	-	-	2	1	1	3	3	3	2

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23PCS18 VISUAL EFFECTS

Prerequisite	Programme Name	Sem	Category	L	T	P	C
NIL	B.E/B.Tech. – Common to CSE,IT and AI&DS	V/VI/ VII	PEC	2	0	2	3

II - Course Objectives

1.	Apply principles and techniques of 2D/3D animation and motion graphics.
2.	Implement CGI workflows, color grading, lighting, and rendering in VFX.
3.	Create special effects and particle systems using graphics programming and tools.
4.	Execute camera tracking, motion capture, and advanced compositing techniques.
5.	Perform professional post-production tasks including video editing, audio mixing, and VR/AR content creation.

III - Course Content

Preamble: Visual Effects (VFX) explores techniques for creating realistic and imaginative visuals using digital tools. The subject introduces compositing, motion graphics, 3D effects, and simulation methods. It develops creativity and technical expertise in enhancing film, animation, and multimedia content. Students acquire skills to design professional visual effects for entertainment and industry applications.

Unit – I	ANIMATION BASICS AND INTRODUCTION TO VISUAL EFFECTS	6 Periods

VFX Production Pipeline and Workflow-Principles of Animation (Squash & Stretch, Anticipation, Timing)-Animation Techniques: Key frame, Kinematics, Rotoscoping, Stop Motion, Pixilation-Rigging, Shape Keys, Motion Paths-Basics of Computer Graphics and GUI-Display Devices and Input Systems-Introduction to Graphics Algorithms: Bresenham's Line, DDA, Circle Drawing-Overview of Animation Software: Blender, Adobe Animate

Unit – II	CGI, COLOR, LIGHT, AND GEOMETRIC TRANSFORMATIONS	6 Periods

CGI Concepts: Virtual Worlds, Photorealism, Physical and Functional Realism-3D Modeling & Rendering Pipeline- Color Theory Color Spaces (RGB, HSV, CMYK), Color Grading, HDRI-Lighting Techniques: Area, Mesh, Image-based, Photometric, PBR Lights-Affine Transformations in 2D and 3D (Translation, Rotation, Scaling, Shearing) Camera Models and Viewing Pipelines (Perspective, Orthographic, Isometric)-Scan Conversion, Clipping, and Solid Modeling (Wireframe, Octrees, CSG)

Unit – III	SPECIAL EFFECTS, GRAPHICS PROGRAMMING & MULTIMEDIA COMPONENTS	6 Periods

Special Effects: Particle Systems (Wind, Rain, Fire, Smoke), Schüfftan Process-OpenGL Primitives & Pipeline for 2D/3D Graphics-Hidden Surface Removal Techniques: Z-buffer, Painter's Algorithm, BSP Trees-Multimedia Components: Text, Image, Audio, Video, Animation Integration-Audio Fundamentals: Formats, Channels, Mixing Basics Introduction to Multimedia Authoring Tools

Unit – IV	VISUAL EFFECTS TECHNIQUES & ADVANCED ILLUMINATION	6 Periods

Motion Capture Technologies and Pipeline-Matte Painting, Match -Moving, Rotoscoping, Planar Tracking Camera Reconstruction and Calibration Techniques-Shading Models: Phong, Gouraud, Shadows-Curves and Surfaces: Bezier, B-Splines, NURBS Introduction to VR/AR: Unity Basics, Creating Virtual Environments, 360° Video, Immersive Experiences Image-Based Rendering, Depth of Field, Image Morphing

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Unit – V	COMPOSITING, POST-PRODUCTION & EMERGING TRENDS	6 Periods
Compositing Techniques: Chroma Keying, Alpha Compositing, Deep Image CompositingVFX Tools: Blender, Natron, GIMP, Adobe After Effects Video Editing and Formats: Adobe Premiere Pro, Final Cut Pro X Audio Editing: Adobe Audition, Multi-track Mixing Advanced Texture Mapping: Bump, Displacement, Environmental Maps, Procedural Noise Animation Types: Soft Object Modeling, Soft Body Simulation Emerging Trends: Image Stitching/Mosaics, Novel View Synthesis, Immersive VR Content Production		

TOTAL: 30 Periods

PRACTICAL EXERCISES:

1. Animation Fundamentals and Keyframe Practice
2. 2D/3D Geometric Transformations and Rendering
3. Color Theory and Lighting Experiment
4. Particle Systems and Special Effects Simulation
5. Rotoscoping, Matte Painting, and Match-Moving
6. Compositing and Chroma Keying
7. Soft Body Simulation and Texture Mapping
8. VR/AR Environment and Immersive Content Creation

TOTAL: 30 Periods

TOTAL: 30+30=60 Periods

Text Books:	1. "Digital Lighting and Rendering" by Jeremy Birn 2. "The Animator's Survival Kit" by Richard Williams
Reference Books:	1. Jon Gress, *Digital Visual Effects and Compositing*, New Riders Press, 2014Jasmine Katatikarn, Michael Tanzillo, Lighting for Animation: The Art of Visual Storytelling, Routledge, 2016 2. Foley, van Dam, Feiner, and Hughes, Computer Graphics: Principles and Practice, 3rd Edition 3. Donald Hearn & M. Pauline Baker, Computer Graphics with OpenGL, 4th Edition 4. Peter Shirley et al., Fundamentals of Computer Graphics 5. Maxin Jago, Adobe Premiere Pro CC Classroom in a Book
MOOC/Web Platforms:	**Coursera** – www.coursera.org

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IV - Course Outcome

	On completion of the course, the students will be able to	Bloom's Level Mapped
CO1	Apply the principles of 2D/3D animation and motion graphics using industry-standard tools	Apply (K3)
CO2	Implement CGI workflows including modeling, rendering, lighting, and color grading techniques	Apply (K3)
CO3	Develop special effects using graphics programming and particle systems	Create (K6)
CO4	Analyze and execute VFX techniques like camera tracking, motion capture, and compositing	Analyse (K4)
CO5	Perform post-production tasks including video/audio editing and immersive content creation	Apply (K3)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	-	2	-	3	-	-	-	2	-	-	3	-	3	-
CO-2	3	-	3	-	3	-	-	-	2	-	-	3	2	3	-
CO-3	3	2	3	2	3	-	-	-	2	-	-	3	3	3	2
CO-4	3	3	3	3	3	-	-	-	2	-	-	3	3	3	3
CO-5	3	-	3	-	3	-	-	2	3	-	-	3	3	3	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23PAD05 NEURAL NETWORKS AND DEEP LEARNING

Prerequisite	Programme Name	Sem	Category	L	T	P	C
NIL	B.E/B.Tech. – Common to CSE,IT and AI&DS	V/VI/ VII	PEC	2	0	2	3

II - Course Objectives

1.	To understand the fundamentals, architectures, and applications of artificial neural networks.
2.	To explore associative memory models and unsupervised neural networks like SOM, LVQ, and ART.
3.	To apply advanced deep learning architectures such as CNNs, SNNs, and ELMs for computer vision tasks.
4.	To implement deep feedforward neural networks using gradient-based optimization techniques.
5.	To understand and apply RNN architectures for temporal data, NLP, and image generation.

III - Course Content

Preamble: This course offers an in-depth understanding of neural networks and advanced deep learning architectures. It covers foundational and cutting-edge topics such as associative memory models, convolutional and recurrent networks, autoencoders, and spiking neural networks. Students will gain hands-on experience in applying neural networks to real-world tasks in image processing and NLP using modern deep learning frameworks

Unit – I	Introduction	6 Periods

Neural Networks-Application Scope of Neural Networks-Artificial Neural Network: An Introduction Evolution of Neural Networks-Basic Models of Artificial Neural Network- Important Terminologies of ANNs-Supervised Learning – Network-Artificial Neural Network, activation function, multi-layer neural network.

Unit – II	Associative Memory Models and Unsupervised Neural Networks	6 Periods

Training Algorithms for Pattern Association-Autoassociative Memory Network-Heteroassociative Memory Network-Bidirectional Associative Memory (BAM)-Hopfield Networks-Iterative Autoassociative Memory Networks-Temporal Associative Memory Network-Fixed Weight Competitive Nets-Kohonen Self-Organizing Feature Maps-Learning Vector Quantization-Counter propagation Networks-Adaptive Resonance Theory Network- Case study of ImageNet challenge -LeNet, AlexNet.

Unit – III	Advanced Neural Architectures	6 Periods

Spiking Neural Networks-Convolutional Neural Networks (CNNs)-Deep Learning Neural Networks-Extreme Learning Machine Models-CNN Operations: Convolution, Pooling, and Variants-Applications: Computer Vision, Image Generation, Image Compression. Case study – RoI cropping in CT images and Cervical Images

Unit – IV	Deep Feedforward Networks	6 Periods

History of Deep Learning- A Probabilistic Theory of Deep Learning- Deep Feed Forward network,training deep models, dropouts-Gradient Learning – Chain Rule and Backpropagation – Regularization: Dataset Augmentation – Noise Robustness -Early Stopping, Bagging and Dropout – batch normalization- VC Dimension and Neural Nets.

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Unit – V	Recurrent Neural Networks	6 Periods
Recurrent Neural Networks: Introduction – Recursive Neural Networks – Bidirectional RNNs -Deep Recurrent Networks – Applications: Image Generation, Image Compression, Natural Language Processing. Complete Auto encoder, Regularized Autoencoder, Stochastic Encoders and Decoders, Contractive Encoders.- Frameworks for Deep Learning - PyTorch, TensorFlow, Keras, Theano, Caffe, Nvidia DGX machines for DL applications		

TOTAL: 30 Periods

PRACTICAL EXERCISES:

1. Implement a simple perceptron for a binary classification problem.
2. Build and train an MLP on a dataset (e.g., Iris or MNIST subset).
3. Manually implement backpropagation for a small neural network.
4. Use frameworks like TensorFlow or PyTorch to build deeper networks.
5. Implement a CNN for image classification using datasets like MNIST or CIFAR-10.
6. Implement simple RNN and LSTM models for sequence prediction (e.g., text generation or time series forecasting).
7. Build undercomplete autoencoders for dimensionality reduction or denoising.
8. Use pre-trained models (e.g., VGG, ResNet) for image classification tasks.
9. Implement a basic GAN for image generation.
10. Evaluate model performance using accuracy, precision, recall, confusion matrix.

TOTAL: 30 Periods

TOTAL: 30+30=60 Periods

Text Books:	1. François Chollet, Deep Learning with Python, 2nd Edition, Manning Publications, 2021. 2. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press, 2016
Reference Books:	1. Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn and TensorFlow", Oreilly, 2018. 2. Josh Patterson, Adam Gibson, "Deep Learning: A Practitioner's Approach", O'Reilly Media, 2017. 3. Charu C. Aggarwal, "Neural Networks and Deep Learning: A Textbook", Springer International Publishing, 1st Edition, 2018.
MOOC/Web Platforms:	https://www.coursera.org/learn/introduction-Neural

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IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the basics of neural networks and learning rules of deep neural networks.	Understand (K2)
CO2	Understand and implement associative memory and unsupervised learning networks.	Understand (K2)
CO3	Apply the CNN variants for suitable applications.	Apply (K3)
CO4	Analyze and train deep neural networks for various tasks.	Apply (K3)
CO5	Implement auto encoders and generative models effectively	Apply (K3)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	2	2	1	2	-	-	-	-	1	2	1	2	2	2	1
CO-2	2	2	2	2	2	-	-	-	1	2	1	2	2	2	2
CO-3	2	2	2	2	2	-	-	-	1	2	1	2	2	3	2
CO-4	2	2	2	2	2	-	-	-	1	2	1	2	3	3	2
CO-5	2	2	2	2	3	-	-	-	1	3	2	2	3	3	3

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23PCS21 CYBER SECURITY

Prerequisite	Programme Name	Sem	Category	L	T	P	C
NIL	B.E/B.Tech. – Common to CSE,IT and AI&DS	V/ VI/ VII	PEC	2	0	2	3

II - Course Objectives

1.	Understand fundamental cyber security concepts, threats, and risk management principles
2.	Apply cryptographic techniques and network security protocols to safeguard data and communications.
3.	Analyze system and application vulnerabilities and implement security controls.
4.	Demonstrate skills in digital forensics and incident response to handle cybersecurity breaches.
5.	Evaluate emerging cybersecurity technologies and challenges in blockchain, AI, and IoT domains.

III - Course Content

Preamble: This course equips learners with essential knowledge and practices to safeguard digital systems, networks, and data. It covers principles of security, cryptography, risk management, ethical hacking, and incident response. By addressing both technical and organizational aspects, the course prepares students to counter threats and ensure confidentiality, integrity, and availability of information.		
Unit – I	**FOUNDATIONS OF CYBERSECURITY**	**5 Periods**
CIA Triad: Confidentiality, Integrity, Availability, Types of Cyber Threats and Attacks, Security Policies and Risk Management, Introduction to Cyber Laws and Ethics.		
Unit – II	**CRYPTOGRAPHY AND NETWORK SECURITY**	**6 Periods**
Symmetric and Asymmetric Encryption Techniques, Hash Functions and Digital Signatures, Network Protocols and Security Measures, Firewalls, VPNs, and Intrusion Detection Systems.		
Unit – III	**SYSTEM AND APPLICATION SECURITY**	**7 Periods**
Operating System Security: Access Controls, Patching, Web Application Security: SQL Injection, XSS, Secure Software Development Lifecycle (SSDLC), Mobile and Cloud Security Fundamentals.		
Unit – IV	**CYBER FORENSICS AND INCIDENT RESPONSE**	**6 Periods**
Digital Forensics: Data Acquisition and Analysis, Incident Detection and Response Strategies, Malware Analysis and Reverse Engineering Basics, Legal Procedures and Chain of Custody.		
Unit – V	**EMERGING TRENDS IN CYBERSECURITY**	**6 Periods**
Blockchain and Cryptocurrency Security, Artificial Intelligence in Threat Detection, Internet of Things (IoT) Security Challenges, Cybersecurity in Critical Infrastructure and Smart Grids.		

TOTAL: 30 Periods

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PRACTICAL EXERCISES:

1 . Explore different types of cyber attacks (phishing, DoS, malware) using simulation tools (Ex: Cyber Range platforms).
2. Risk assessment and threat modeling of a sample IT system using frameworks like STRIDE or DREAD.
3. Implement symmetric key encryption and decryption algorithms (e.g., AES) in Python.
4. Capture and analyze network packets using Wireshark; identify protocols and potential vulnerabilities.
5. Configure and test firewall rules on a Linux system (iptables or UFW).

TOTAL: 30 Periods

TOTAL: 30+30=60 Periods

Text Books:	1. William Stallings, "Cryptography and Network Security: Principles and Practice", 8th Edition, Pearson, 2020 2. Joseph Migga Kizza, "Guide to Computer Network Security", 3rd Edition, Springer, 2017 3. Michael E. Whitman & Herbert J. Mattord, "Principles of Information Security", 7th Edition, Cengage, 2021. 4. Debra Littlejohn Shinder & Michael Cross, "Scene of the Cybercrime: Computer Forensics Handbook", 3rd Edition, Syngress, 2012.
Reference Books:	1. Andress, Jason, "The Basics of Information Security: Understanding the Fundamentals of InfoSec in Theory and Practice", 3rd Edition, Syngress, 2014. 2. Ross Anderson, "Security Engineering: A Guide to Building Dependable Distributed Systems", 3rd Edition, Wiley, 2020. 3. Christopher D. Manning & Prateek Joshi, "Artificial Intelligence in Cybersecurity: Emerging Trends and Applications", 2022. 4. Eric Cole, "Network Security Bible", 2nd Edition, Wiley, 2019. 5. Sundararajan, "Cyber Security: Emerging Trends and Technologies", CRC Press, 2021.
MOOC/Web Platforms:	https://onlinecourses.swayam2.ac.in/nou19_cs08/preview?utm_source=chatgpt.com https://onlinecourses.nptel.ac.in/noc24_cs108/preview?utm_source=chatgpt.com https://nptel.ac.in/courses/106105031?utm_source=chatgpt.com

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IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand fundamental cyber security concepts, threats, and risk management principles.	Understand (K2)
CO2	Apply cryptographic techniques and network security protocols to safeguard data and communications.	Apply (K3)
CO3	Analyze system and application vulnerabilities and implement security controls.	Analyze (K4)
CO4	Demonstrate skills in digital forensics and incident response to handle cybersecurity breaches.	Apply (K3)
CO5	Evaluate emerging cybersecurity technologies and challenges in blockchain, AI, and IoT domains.	Evaluate (K5)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	2	1	2	2	2	1	3	1	2	2	2	2	1	-
CO-2	2	3	3	2	3	2	1	3	2	2	3	3	3	2	-
CO-3	2	3	3	3	2	2	1	3	2	2	3	3	3	2	-
CO-4	2	3	3	2	3	2	1	3	3	2	3	3	3	2	-
CO-5	2	3	3	3	2	2	1	3	2	2	3	3	3	3	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23PCS22 QUANTUM COMPUTING

Prerequisite	Programme Name	Sem	Category	L	T	P	C
NIL	B.E/B.Tech. – Common to CSE,IT and AI&DS	V/VI/VII	PEC	2	0	2	3

II - Course Objectives

1.	To gain knowledge and skills related to 3D printing technologies.
2.	To learn the selection of material, equipment and development of a product for Industry 4.0 environment.
3.	To understand the various software tools, process and techniques for digital manufacturing
4.	To understand the various process and techniques for digital manufacturing
5.	To apply these techniques into various applications.

III - Course Content

Preamble: This course explores the principles of quantum mechanics applied to computation. It introduces quantum bits, superposition, entanglement, and quantum algorithms that promise exponential speedups for certain classes of problems. Learners will gain insight into emerging technologies, tools, and applications of quantum computing in fields like cryptography, optimization, and machine learning.

Unit – I	**QUANTUM COMPUTING BASIC CONCEPTS**	**5 Periods**
Complex Numbers - Linear Algebra - Matrices and Operators - Global Perspectives Postulates of Quantum Mechanics – Quantum Bits - Representations of Qubits – Super positions		
Unit – II	**QUANTUM GATES AND CIRCUITS**	**7 Periods**
Universal logic gates - Basic single qubit gates - Multiple qubit gates - Circuit development - Quantum error correction		
Unit – III	**QUANTUM SEARCH ALGORITHMS**	**7 Periods**
Quantum parallelism - Deutsch's algorithm - The Deutsch–Jozsa algorithm - Quantum Fourier transform and its applications - Quantum Search Algorithms: Grover's Algorithm		
Unit - IV	**QUANTUM INFORMATION THEORY**	**6 Periods**
Data compression - Shannon's noiseless channel coding theorem - Schumacher's quantum noiseless channel coding theorem - Classical information over noisy quantum channels		
Unit – V	**QUANTUM MACHINE LEARNING**	**5 Periods**
Introduction -QML Models- Introduction to Quantum Simulator(Qiskit)- Programming using Qiskit.		

TOTAL: 30 Periods

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PRACTICAL EXERCISES:

1. Single qubit gate simulation - Quantum Composer
2. Multiple qubit gate simulation - Quantum Composer
3. Composing simple quantum circuits with q-gates and measuring the output into classical bits.
4. IBM Qiskit Platform Introduction
5. Implementation of Shor's Algorithms
6. Implementation of Grover's Algorithm
7. Implementation of Deutsch's Algorith
8. Implementation of Deutsch-Jozsa's Algorithm
9. Integer factorization using Shor's Algorithm
10. QKD Simulation
11. Mini Project such as implementing an API for efficient search using Grover's Algorithms

TOTAL: 30 Periods

TOTAL: 30+30=60 Periods

Text Books:	1. Parag K Lala, Mc Graw Hill Education, "Quantum Computing, A Beginners Introduction", First edition (1 November 2020). 2. 2. P. Kaye, R. Laflamme and M. Mosca, "An Introduction to Quantum Computing", Oxford University Press (2006).
Reference Books:	NPTEL course on "Introduction to Quantum Computing: Quantum Algorithms and Qiskit" by IBM and IIT Madras.
MOOC/Web Platforms:	https://quantumzeitgeist.com/10-coursera-online-quantum-courses-for-learning-quantum-computing-in-2025/

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the basics of quantum computing	Understand (K2)
CO2	Understand the background of Quantum Mechanics.	Understand (K2)
CO3	Analyze the computation models.	Analyze (K4)
CO4	Model the circuits using quantum computation. environments and frameworks.	Apply (K3)
CO5	Understand the quantum operations such as noise and error–correction	Understand (K2)

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V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	1	1	2	2	1	1	1	2	1	-	-	1	2	3
CO-2	3	2	1	1	1	1	1	1	1	1	-	-	2	3	2
CO-3	2	3	2	1	1	1	1	1	1	2	-	-	2	2	3
CO-4	2	2	3	2	3	2	1	2	1	2	-	-	1	3	2
CO-5	2	3	2	3	2	1	1	1	1	2	-	-	2	2	3

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I-Course Name: 23PCS23 3D PRINTING AND DESIGN

Prerequisite	Programme Name	Sem	Category	L	T	P	C
NIL	B.E/B.Tech. – Common to CSE,IT and AI&DS	V/V/VII	PEC	2	0	2	3

II - Course Objectives

1.	To introduce the fundamentals, history, and workflow of 3D Printing and Additive Manufacturing (AM).
2.	To provide knowledge of AM processes, material selection, and characterization techniques.
3.	To familiarize students with system design aspects, including printer hardware, control systems, and material formulations.
4.	To develop an understanding of metal AM technologies, hybrid manufacturing, and their industrial relevance.
5.	To expose students to post-processing, testing methods, standards, safety norms, and industrial applications of AM.

III - Course Content

Preamble: This course introduces the fundamentals, materials, processes, and applications of additive manufacturing and 3D printing, emphasizing design, workflow, and industrial practices.

Unit – I	Fundamentals of 3D - Printing and AM Workflow	5 Periods

History and Evolution of 3D Printing -Design Considerations: Resolution, Layer Height, Material Compatibility -3D Modeling & Viewing: Digital Design Tools, File Formats (STL, AMF, OBJ) - Scanning Technologies: Structured Light, CT & Laser Scanning -3D Printing Workflow: Slicing, Toolpath Generation, Support Structures -CAD Preprocessing and Simulation Tools for Printability Assessment

Unit – II	Materials and Processes in AM	6 Periods

Additive Manufacturing Processes: Extrusion, Binder Jetting, Vat Polymerization, Material Jetting, Powder Bed Fusion (PBF), Directed Energy Deposition (DED), Sheet Lamination - Material Selection Criteria: Polymers, Metals, Ceramics, Biomaterials, Composites, Hydrogels - Characterization Techniques: Rheology, Flow Characteristics, Microstructure, Porosity, Mechanical Properties Process-Property-Relationships and Design Limitations

Unit – III	System Design and Inkjet/Extrusion Technologies	6 Periods

Printer Hardware: Print Head Types (Thermal, Piezoelectric, CIJ), Print Bed, Motion Systems -Control Systems: Sensors, Feedback Loops, Actuators -DIY Printer Design: Chassis, Extruder Mechanisms, Embedded Systems (Arduino/RPi) -Material Formulations for Jetting & Extrusion

Unit - IV	Metal Additive Manufacturing & Hybrid Techniques	6 Periods

Classification Based on ASTM Standards -Metal AM Technologies: Direct Metal Laser Sintering (DMLS), Selective Laser Melting (SLM), Electron Beam Melting(EBM), Laser-DED -Differences between AM vs. Casting vs. CNC Machining -Case Studies: Aerospace Brackets, Biomedical Implants, Turbine Components Hybrid Manufacturing -Approaches and Design for Metal AM

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Unit – V	Postprocessing, Testing, and Industrial Applications	6 Periods
Surface Treatment: Machining, Sanding, Thermal, Chemical, Plasma, Electrochemical - Heat Treatment & Microstructure Optimization -Testing Methods: NDT, Surface Roughness, Dimensional Accuracy, Microhardness, XRD, FESEM -Standards & Safety: -ASTM, ISO, Regulatory Norms- Industrial Applications: Medical (Bioprinting, Implants), Aerospace, Automotive, Architecture, Fashion -Future Trends: 4D Printing, Smart Materials, AI in AM		

TOTAL: 30 Periods

PRACTICAL EXERCISES:

1. 3D CAD Modeling & Slicing – Designing a sample model and generating G-code.
2. Polymer Extrusion Printing – Printing a simple 3D object using FDM.
3. Support Structures & Toolpath Optimization – Analyzing print accuracy with/without supports.
4. Material Testing – Polymers – Tensile/impact test of 3D printed specimens.
5. Surface Finishing & Post-Processing – Sanding, chemical, or thermal finishing of prints.
6. Metal AM Simulation – Process simulation of DMLS/SLM using software tools.
7. Quality Testing in AM – Measuring surface roughness, dimensional accuracy, microhardness.
8. Case Study Implementation – Printing a biomedical implant/aerospace bracket prototype.

TOTAL : 30 Periods

TOTAL: 30+30=60 Periods

Text Books:	1.Ian Gibson et al., Additive Manufacturing Technologies, Springer, 2015. 2.Joshi et al., Additive Manufacturing with Metals, Springer, 2023.
Reference Books:	1. Patri Venuvinod, Weiyin Ma, Rapid Prototyping: Laser-based and Other Technologies, Springer, 2004. 2. D.T. Pham, S.S. Dimov, Rapid Manufacturing, Springer, 2001. 3. Joan Horvath, Mastering 3D Printing, APress, 2014.
MOOC/Web Platforms:	https://onlinecourses.swayam2.ac.in/

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IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Introduce the fundamentals and design principles of 3D Printing/Additive Manufacturing (AM)	Remember (K1)
CO2	To develop competency in AM workflows, material selection, and process simulation.	Apply (K3)
CO3	To explore post-processing, quality testing, and application areas aligned with industrial practices.	Analyze (K4)
CO4	To familiarize students with recent advancements in metal AM and hybrid systems.	Understand (K2)
CO5	Apply surface treatments, testing methods, standards, and safety practices in AM, and evaluate their industrial applications and future trends.	Apply (K3)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	2	-	1	2	-	-	-	-	2	-	1	-	-	-
CO-2	2	3	2	2	3	1	-	-	-	2	-	2	-	-	-
CO-3	2	2	3	3	3	-	-	-	-	2	1	2	-	-	-
CO-4	2	2	2	3	2	-	1	-	-	2	-	2	-	-	-
CO-5	2	3	-	1	2	-	-	-	-	2	-	1	-	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I Course Name: 23PAD14 AUTONOMOUS SYSTEMS AND DRONES

Prerequisite	Programme Name	Sem	Category	L	T	P	C
NIL	B.Tech. – AI&DS	V/VI/VII	PEC	2	0	2	3

II - Course Objectives

1.	Understand drone fundamentals, history, and ecosystem components.
2.	To learn and understand the fundamentals of design, fabrication and programming of drone
3.	To impart the knowledge of an flying and operation of drone
4.	To know about the various applications of drone
5.	To understand the safety risks and guidelines of fly safety

III - Course Content

Preamble: This course introduces the fundamentals of drone technology, covering design, fabrication, and autonomous control. Students will gain hands-on experience with modern tools, simulation platforms, and flight operations.It explores real-world applications in sectors like agriculture, logistics, and surveillance. Emphasis is placed on safety, regulations, and emerging trends in autonomous aerial systems.

Unit – I	INTRODUCTION TO DRONE TECHNOLOGY	6 Periods

Drone Concept and Terminologies, History and Evolution of Drones, Propulsion-based Drone Classification, Drone Impact on Business and Industry, Entrepreneurship Opportunities and Employability, Introduction to Unmanned Aerial Systems (UAS), Overview of Drone Ecosystem: Components and Services, Industry Case Studies: Zipline (Medical), DJI (Commercial), AgEagle (AgriTech), Introduction to National and International Drone Policies (DGCA, FAA)

Unit – II	DRONE DESIGN, FABRICATION AND PROGRAMMING	6 Periods

Classification of UAVs and Component Overview, Assembly of Drones and Power Sources, Programming Basics for Drones (Arduino, Python), Wi-Fi Connectivity, Multi-rotor Stabilization, Drone Design using CAD Tools (Fusion 360), Open Source Firmware: PX4, ArduPilot Basics, Integration of Sensors (GPS, Lidar, IMU), Energy Management and Battery Safety

Unit – III	DRONE FLYING AND OPERATION	6 Periods

Basic Flight Modes and Pre-Flight Checklist, Operating Micro Drones in Controlled Environments, Onboard and Removable Storage Devices, Sensor-based Controls and Mobile App Integration, Hands-on Simulator Practice using AirSim, Webots, Radio Frequency Communication Principles, Crash Analysis and Maintenance Log Automation, Role of AI in Autonomous Flying

Unit - IV	DRONE COMMERCIAL APPLICATIONS	6 Periods

Drone Use in Agriculture, Delivery, Insurance, Filming, Drone Selection Based on Application-Precision Agriculture and Smart Farming with Drones, Drone Mapping and 3D Terrain Modeling (Pix4D, DroneDeploy).

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Infrastructure Monitoring (Pipelines, Bridges), Legal Compliance in Commercial Drone Use		
Unit – V	**FUTURE DRONES AND SAFETY**	**6 Periods**
Aviation Regulations, Drone License, and Miniaturization, Drone Swarm Concepts and Safety Risks, Integration of AI and Edge Computing in UAVs, Future Trends: EVTOLs, Hybrid Drones, Swarm Coordination using ROS and Gazebo, Cybersecurity Challenges in UAV Networks		

TOTAL: 30 Periods

PRACTICAL EXERCISES:

1.Basic Drone Assembly and Component Identification
2.Flight Controller Configuration and Calibration (PID Tuning)
3.Manual and Assisted Flight Operations (Take-off, Hovering, Landing)
4.Autonomous Navigation Using GPS Waypoints
5.Object Detection and Tracking Using Onboard Camera
6.Path Planning and Obstacle Avoidance Using Sensors (Ultrasonic/LiDAR)
7.Simulating Drone Missions in Gazebo / AirSim / DJI Simulator

TOTAL: 30 Periods

TOTAL : 30+30=60 Periods

Reference Books:	1.Reg Austin – Unmanned Aircraft Systems UAV Design, Development and Deployment, Wiley, 2023 2. Paul G. Fahlstrom & Thomas J. Gleason – Introduction to UAV Systems, Wiley, 5th Ed., 2021 Kimon P. Valavanis – Advances in Unmanned Aerial Vehicles, Springer, 2022
MOOC/Web Platforms:	https://onlinecourses.nptel.ac.in/ https://www.edx.org/learn/drones

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand drone fundamentals, history, and ecosystem components.	Understand (K2)
CO2	Apply drone design, fabrication, and programming using modern tools and firmware.	(pply (K3)
CO3	Perform drone flight operations with simulators, communication, and AI-based control.	Apply (K3)
CO4	Analyze commercial drone applications and ensure legal compliance	Analyze (K4)
CO5	Explore future drone technologies, safety, and cyber security challenges.	Apply (K3)

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V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	1	1	2	1	1	1	1	1	2	1	1	1	1	1	2
CO-2	2	3	3	3	3	2	2	1	1	3	2	2	3	3	3
CO-3	2	2	3	2	2	1	2	1	1	2	1	3	2	2	2
CO-4	2	2	3	3	2	1	2	1	1	2	1	3	3	2	2
CO-5	1	2	2	2	3	-	2	1	1	2	1	1	3	2	2

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23PAD12 BIO-INSPIRED OPTIMIZATION TECHNIQUES

Prerequisite	Programme Name	Sem	Category	L	T	P	C
NIL	B.Tech(AI&DS)	V/VI/ VII	PEC	3	0	0	3

II - Course Objectives

1.	To understand fundamental topics in bio-inspired optimization techniques
2.	To Learn the collective systems such as ACO, PSO, and BCO
3.	To develop skills in biologically inspired algorithm design with an emphasis on solving real world problems
4.	To understand the most appropriate types of algorithms for different data analysis problems and to introduce some of the most appropriate implementation strategies.
5.	To implement the Bio-inspired technique with other traditional algorithms

III - Course Content

Preamble: This course introduces the fundamentals of optimization and the significance of nature-inspired computing. It covers key algorithms including evolutionary, swarm intelligence, and other bio-inspired approaches. Emphasis is placed on their principles, working mechanisms, and comparative advantages. Selected applications in engineering and machine learning are discussed with focused case studies.

Unit – I	Introduction to Optimization and Nature-Inspired Computing	9 Periods

Fundamentals of optimization: Definitions, types, and applications, Introduction to bio-inspired computing: Concepts and significance, Overview of nature-inspired algorithms: Characteristics and classifications, Overview and classification of nature-inspired algorithms., Simplified comparison of traditional vs. bio-inspired techniques.

Unit – II	Evolutionary Algorithms	9 Periods

Genetic Algorithms (GA): Basic encoding, selection (roulette wheel), crossover (single-point), mutation, and fitness evaluation. Differential Evolution (DE): Core strategy parameters (DE/rand/1/bin) and variants overview. Evolution Strategies (ES): Basic mutation and selection mechanisms. Simple applications examples in engineering optimization.

Unit – III	Swarm Intelligence-Based Algorithms	9 Periods

Particle Swarm Optimization (PSO): Velocity and position update basics, parameter roles.Ant Colony Optimization (ACO): Pheromone updating and path selection principles. Artificial Bee Colony (ABC): Roles of bee types and simplified algorithm workflow. Selected simple application examples (routing, scheduling, design).

Unit – IV	Other Bio-Inspired Algorithms and Hybrid Approaches	9 Periods

Firefly Algorithm: Basic attraction and movement rules.. Cuckoo Search Algorithm: Levy flight basics and nest selection.Bat Algorithm: Basic echolocation concept and frequency tuning. Brief comparative discussion of these algorithms and basic hybrid strategies.

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Unit – V	Applications and Case Studies	9 Periods
Overview of applications in engineering: design optimization, control systems, and basic machine learning tuning.Selected case studies -bio-inspired algorithm implementation in real-world problems.		

TOTAL: 45 Periods

Text Books:	1. E. Elben and J. E. Smith, "Introduction to Evolutionary Computing", Springer, 2020. 2. Floreano D. and Mattiussi C., "Bio-Inspired Artificial Intelligence: Theories, Methods, and Technologies", MIT Press, Cambridge, MA, 2019. 3. Leandro Nunes de Castro, " Fundamentals of Natural Computing, Basic Concepts, Algorithmsand Applications", Chapman & Hall/ CRC, Taylor and Francis Group, 2020
Reference Books:	1. Eric Bonabeau, Marco Dorigo, Guy Theraulaz, "Swarm Intelligence: From Natural to Artificial Systems", Oxford University press, 2000. 2. Christian Blum, Daniel Merkle (Eds.), "Swarm Intelligence: Introduction and Applications",Springer Verlag, 2008.
MOOC/Web Platforms:	https://www.classcentral.com/course/udemy-bio-inspired-artificial-intelligence-algorithms-for-optimization-402671?utm_source=chatgpt.com

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand bio-inspired optimization techniques to solve complex real-world problems.	Understand (K2)
CO2	Apply algorithms to solve optimization problems.	Apply (K3)
CO3	Explore swarm intelligence methods and their engineering applications.	Understand (K2)
CO4	Develop implementing nature-inspired algorithms	Apply (K3)
CO5	Recent advancements in bio-inspired computing.	Understand (K2)

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V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	2	2	1	2	1	1	1	1	1	1	1	1	3	2	1
CO-2	3	3	3	2	2	1	1	1	2	1	1	1	2	3	1	1
CO-3	2	2	3	3	3	1	1	1	2	2	2	1	2	3	3	2
CO-4	2	2	3	3	3	2	2	1	1	2	2	2	2	3	3	3
CO-5	2	1	2	2	2	2	2	1	1	2	1	2	3	2	2	2

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23PAD03 HEALTH CARE ANALYTICS

Prerequisite	Programme Name	Sem	Category	L	T	P	C
NIL	B.Tech(AI&DS)	V/VI/ VII	PEC	3	0	0	3

II - Course Objectives

1.	To understand the role of data analytics in healthcare systems.
2.	To apply machine learning and deep learning techniques for healthcare applications.
3.	To explore healthcare data formats, standards, and systems.
4.	To analyze healthcare policies, economic factors, and cost-effectiveness.
5.	To build predictive models for clinical and genomic data integration

III - Course Content

Preamble: This course introduces the concepts and applications of healthcare analytics. It covers healthcare systems, standards, data management, and emerging technologies. The course integrates machine learning, deep learning, and natural language processing to provide predictive and prescriptive solutions for healthcare. Students will gain skills to analyze real-world healthcare datasets and design analytics-driven healthcare applications.

Unit – I	Fundamentals of Healthcare Systems and Analytics	9 Periods

History and Overview of Healthcare Analytics- Health Information Systems and Standards (ICD, CPT, HL7, FHIR)- Electronic Health Records (EHR): Components, Benefits, and Challenges- Health Policy and Economic Principles in Healthcare- Standardized Code Sets and Data Formats (HL7, DICOM)- Introduction to Machine Learning in Healthcare- Tree-Based Reasoning, Bayesian Networks- Weighted Sum and Probabilistic Reasoning.

Unit – II	Machine Learning for Healthcare	9 Periods

Machine Learning Pipeline for Healthcare- Data Preprocessing and Transformation Techniques- Feature Selection, Dimensionality Reduction- Model Evaluation: Accuracy, ROC, AUC, Sensitivity, Specificity, F1 Score- Healthcare-Specific Metrics: PPV, NPV, FPR- Python for Healthcare Analytics: Pandas, NumPy, Scikit-Learn, Matplotlib.

Unit – III	Advanced Data Management and Visual Analytics	9 Periods

Healthcare Data Storage: SQL vs NoSQL, Cloud Systems- Interoperability and Data Integration (FHIR, HL7) Internet of Medical Things (IoMT), Wearables and Smart Sensors- Decision Support Systems and Clinical Prediction Models- Visual Analytics in Healthcare: Dashboards, Heatmaps, Timelines- Encryption and Privacy: RC6, Histogram Shifting, Access Control Models- Social Media Analytics in Health (sentiment analysis of outbreaks).

Unit – IV	Deep Learning and NLP in Healthcare	9 Periods

Introduction to Deep Learning: Neural Networks, CNN, RNN, LSTM- Biomedical Image and Signal Analysis (X-ray, ECG, EEG, MRI)- Natural Language Processing for Clinical Notes- Tokenization, Named Entity Recognition (NER), De-identification- Survival Models and Time-to-Event Prediction- Mobile Imaging and

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Edge AI for Healthcare- Clinical Decision Support using AI.		
Unit – V	**Applications and Emerging Trends**	**9 Periods**
Fraud Detection in Healthcare Claims-AI in Drug Discovery and Telemedicine-Emerging Trends: Pervasive Health, Wearables, Federated Learning-Predicting Mortality in Cardiology Practice-Smart Ambulance System using IoT-Hospital Acquired Conditions (HAC) Program-Pharmaceutical Discoveries and Clinical Decision Support Systems		

TOTAL: 45 Periods

Text Books:	1.Nilanjan Dey et al., Healthcare Data Analytics and Management, Academic Press, 2018
Reference Books:	1. Hui Yang, Eva K. Lee, Healthcare Analytics: From Data to Knowledge to Healthcare Improvement, Wiley, 2016. 2.Vikas Kumar, Health Care Analysis Made Simple, Packt Publishing, 2018.
MOOC/Web Platforms:	SWAYAM – Introduction to Health Care analytics (IIT Kharagpur)

IV - Course Outcome

On completion of the course, the students will be able to		**Bloom's Level Mapped**
CO1	Understand the role of data analytics in healthcare systems.	Understand (K2)
CO2	Apply machine learning and deep learning algorithms for healthcare data analysis.	Apply (K3)
CO3	Explore real-world healthcare data formats, standards, and systems.	Understand (K2)
CO4	Analyze healthcare policies, economic factors, and cost-effectiveness.	Apply (K3)
CO5	Build predictive models for clinical and genomic data integration.	Understand (K2)

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V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	2	-	-	1	-	-	-	-	-	-	2	3	3	2	1
CO-2	2	3	2	2	2	-	-	-	-	-	-	2	2	2	2	2
CO-3	3	3	3	2	2	-	-	-	-	-	-	2	3	2	3	2
CO-4	2	2	3	2	3	-	-	-	-	-	-	2	2	2	3	2
CO-5	3	3	3	2	3	-	-	-	-	-	-	2	3	2	3	2

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23PAD10 OPTIMIZATION TECHNIQUES

Prerequisite	Programme Name	Sem	Category	L	T	P	C
NIL	B.E/B.Tech. – Common to CSE,IT and AI&DS	V/VI/VII	PEC	2	0	2	3

II - Course Objectives

1.	To introduce classical and modern optimization methods with a focus on solving real-world engineering and management problems.
2.	To formulate and solve Linear Programming Problems (LPP) using graphical and simplex-based techniques, including integer programming.
3.	To analyze and optimize project networks using CPM, PERT, and understand their cost implications.
4.	To apply techniques for solving constrained and unconstrained optimization problems using analytical methods.
5.	To understand the fundamentals of queuing theory and analyze various queuing models with practical case studies.

III - Course Content

Preamble: This course introduces techniques to model and solve real-world optimization problems in engineering and management. It covers linear programming, network models, queuing theory, and both classical and modern optimization methods.

Unit – I	LINEAR MODELS	6 Periods
Optimization - classical optimization, Optimality criteria – Necessary and sufficient conditions for existence of extreme point Introduction of Operations Research - mathematical formulation of LPP- Graphical Methods to solve LPP- Simplex Method- Two-Phase method.		
Unit – II	**INTEGER PROGRAMMING AND TRANSPORTATION PROBLEMS**	**6 Periods**
Integer programming: Branch and bound method- Transportation and Assignment problems - Traveling salesman problem.		
Unit – III	**PROJECT SCHEDULING**	**6 Periods**
Project network -Diagram representation – Floats - Critical path method (CPM) – PERT- Cost considerations in PERT and CPM - Non-traditional algorithms		
Unit – IV	**CLASSICAL OPTIMIZATION THEORY**	**6 Periods**
Constrained optimization - Unconstrained problems – necessary and sufficient conditions - Newton-Raphson method, Constrained problems – equality constraints – inequality constraints - Kuhn-Tucker conditions.		

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Unit – V	QUEUING MODELS	6 Periods
Introduction, Queuing Theory, Operating characteristics of a Queuing system, Constituents of a Queuing system, Service facility, Queue discipline, Single channel models, multiple service channels - Case studies		

TOTAL: 30 Periods

PRACTICAL EXERCISES:

1. Solving simplex maximization problems using R programming.
2. Solving simplex minimization problems using R programming.
3. Solving mixed constraints problems – Big M & Two phase method using TORA.
4. Solving transportation problems using R.
5. Solving assignment problems using R.
6. Solving optimization problems using LINGO.
7. Studying Primal-Dual relationships in LP using TORA.
8. Sensitivity & post optimality analysis using LINGO.
9. Solving shortest route problems using optimization software
10. Solve single server queuing model using simulation software package.
11. Solve multi server queuing model using simulation software package.

TOTAL : 30 Periods

TOTAL: 30+30=60 Periods

Text Books:	1. Hamdy A Taha, Operations Research: An Introduction, Pearson, 10th Edition, 2017.
Reference Books:	1. ND Vohra, Quantitative Techniques in Management, Tata McGraw Hill, 4th Edition, 2011. 2. J. K. Sharma, Operations Research Theory and Applications, Macmillan, 5th Edition, 2012.
MOOC/Web Platforms:	.

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Formulate and solve linear programming problems (LPP)	Understand (K2)
CO2	Evaluate Integer Programming Problems, Transportation and Assignment Problems.	Understand (K2)
CO3	Obtain a solution to network problems using CPM and PERT techniques.	Apply (K3)
CO4	Able to optimize the function subject to the constraints.	Understand (K2)
CO5	Identify and solve problems under Markovian queuing models	Understand (K2)

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V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	2	2	2	-	-	-	-	2	-	2	3	2	2	3
CO-2	3	3	2	2	2	-	-	-	-	2	-	2	3	2	2	3
CO-3	2	3	3	3	2	-	2	2	3	2	2	2	2	3	2	2
CO-4	3	3	3	3	2	-	-	-	-	2	-	2	3	2	2	3
CO-5	3	3	2	2	2	-	-	-	-	2	-	2	3	2	2	3

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23PAD11 GAME THEORY

Prerequisite	Programme Name	Sem	Category	L	T	P	C
NIL	B.Tech - AI&DS	V/VI/VII	PEC	2	0	2	3

II - Course Objectives

1	To introduce students to games, their solution concepts, and basic tools of game theory, with examples like electronic trading markets.
2	To explain strategic thinking and rational decision-making using game theory.
3	To show how game theory connects with computer science and economics, including computational aspects.
4	To present modern topics in game theory and its applications.
5	To develop skills for analyzing decisions in situations with multiple interacting agents.

III - Course Content

Preamble: This course on Game Theory introduces students to fundamental concepts such as strategic games, Nash equilibrium, dominance, mixed strategies, cooperative games, and mechanism design. By exploring both classical and modern approaches, students will gain insight into decision-making processes in multi-agent environments

Unit – I	INTRODUCTION	9 Periods

Making rational choices: basics of Games — strategy — preferences — payoffs — Mathematical basics — Game theory — Rational Choice — Basic solution concepts-non cooperative versus cooperative games — Basic computational issues — finding equilibria and 190 learning in games- Typical application areas for game theory (e.g. Google's sponsored search- eBay auctions- electricity trading markets).

Unit – II	GAMES WITH PERFECT INFORMATION	9 Periods

Games with Perfect Information — Strategic games — prisoner's dilemma- matching pennies - Nash equilibria —mixed strategy equilibrium — potential games- games with infinite strategy space - Braess paradox- price of anarchy.

Unit – III	STATIC GAMES WITH INCOMPLETE INFORMATION	9 Periods

Mixed and Behavioral strategies -Games with Imperfect Information — Bayesian Games — Motivational Examples — General Definitions — Information aspects — Illustrations — Extensive Games with Imperfect — Information — Strategies — definition- examples- games of imperfect information- games of incomplete information- repeated games- the folk theorem of average payoffs. —Repeated Games — The Prisoner's Dilemma — Bargaining

Unit – IV	NON-COOPERATIVE GAME THEORY	9 Periods

Non-cooperative Game Theory — Self-interested agents — Games in normal form — Analyzing games: from optimality to equilibrium — Computing Solution Concepts of Normal — Form Games — Computing Nash equilibria of two-player- zero-sum games —Computing Nash equilibria of twoplayer- general- sum games —

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Identifying dominated strategies		
Unit – V	MECHANISM DESIGN	9 Periods
Aggregating Preferences — Social Choice — Formal Model — Voting — Existence of social functions — Ranking systems — Protocols for Strategic Agents: Mechanism Design — Mechanism design with unrestricted preferences- Fair division- stable matching and allocation- auctions- truthful auctions in win/lose settings		

TOTAL: 30 Periods

PRACTICAL EXERCISES:

1. Payoff Matrix Construction – Create payoff matrices for simple games like Prisoner's Dilemma and Matching Pennies.
2. Find Nash Equilibrium – Determine pure and mixed strategy Nash equilibria for 2-player games.
3. Dominance Analysis – Identify dominated strategies and simplify games using iterative elimination.
4. Mixed Strategy Simulation – Analyze games with incomplete information using mixed strategies.
5. Repeated Game Simulation – Simulate iterated games and observe strategy adaptation.
6. Voting & Preference Aggregation – Conduct voting exercises and analyze outcomes for fairness.

TOTAL : 30 Periods

TOTAL: 30+30=60 Periods

Text Books:	1. M. J. Osborne- An Introduction to Game Theory. Oxford University Press- 2012
Reference Books:	1. M. Machler- E. Solan- S. Zamir- Game Theory- Cambridge University Press- 2013. 2. Zhu Han- DusitNiyato- WalidSaad- TamerBasar and Are Hjorungnes- "Game Theory in Wireless and Communication Networks"- Cambridge University Press- 2012.

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IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Explain the notion of a strategic game and equilibria and identify the characteristics of main applications of these concepts.	Understand (K2)
CO2	Apply key examples like the Prisoner's Dilemma, matching pennies, and their Nash equilibria	Apply (K3)
CO3	Explain mixed and behavioral strategies in games with imperfect or incomplete information	Understand (K2)
CO4	Apply solution concepts to normal-form games, including two-player zero-sum and general-sum games	Apply (K3)
CO5	Explain the fundamentals of social choice, preference aggregation, and voting model	Understand (K2)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ Pos	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	2	-	-	1	-	-	-	-	-	2	3	3	2	1
CO-2	2	3	2	2	2	-	-	-	-	-	2	2	2	2	2
CO-3	3	3	3	2	2	-	-	-	-	-	2	3	2	3	2
CO-4	2	2	3	2	3	-	-	-	-	-	2	2	2	3	2
CO-5	3	3	3	2	3	-	-	-	-	-	2	3	2	3	2

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23PAD13 COGNITIVE SCIENCE

Prerequisite	Programme Name	Sem	Category	L	T	P	C
NIL	B.Tech AI&DS	V/VI/VII	PEC	2	0	2	3

II - Course Objectives

1.	To know the theoretical background of cognition.
2.	To understand the link between cognition and computational intelligence
3.	To explore probabilistic programming language
4.	To study the computational inference models of cognition
5	To study the computational learning models of cognition.

III - Course Content

Preamble: This course introduces students to the fundamental theories, models, and experimental methods used to study cognition. It examines how humans acquire, process, and represent knowledge, and how these processes can be modeled computationally. Topics include perception, memory, attention, problem-solving, language acquisition, and cognitive development.

Unit – I	Philosophy, Psychology, and Neuroscience	9 Periods

Foundations of Cognitive Science: Mental-Physical Relation, Materialism to Mental Science Psychology's role within Cognitive Science -Science of Information Processing Cognitive Neuroscience: Brain Anatomy and Functions Perception, Decision-Making, Learning, MemoryLanguage Understanding and Processing

Unit – II	Computational Intelligence	9 Periods

Machines and Cognition Overview-Artificial Intelligence basics Architectures of Cognition Knowledge-Based Systems Logical Representation and Reasoning-Logical Decision Making-Learning, Language, and Vision in Cognitive Systems

Unit – III	Probabilistic Programming and Information Processing Models	9 Periods

Introduction to Probabilistic Programming Languages (WebPPL)-Syntax and usage of WebPPL and Javascript libraries-Physical Symbol System HypothesisLanguage of Thought Theory Neural Networks and Distributed Information Processing

Unit – IV	Inference Models of Cognition	9 Periods

Generative Models and Conditioning-Causal and Statistical Dependence-Modular architectures of the mind-Neuroscience methods for cognitive study

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Unit – V	Learning Models of Cognition and Advanced Topics	9 Periods
Learning as Conditional Inference-Hierarchical Models and Mixture Models-Dynamical Systems in Cognitive Science-Situated Cognition and BiorboticsGlobal Workspace Theory of Consciousness-Artificial Brain Systems		

TOTAL : 30 Periods

PRACTICAL EXERCISES:

1. Use online brain-mapping tools (e.g., 3D Brain) to identify regions involved in perception, memory, and decision-making, and prepare a short report..
2. Conduct a simple Stroop Test or Memory Recall test using Python/Excel to analyze attention and recall performance.
3. Implement a rule-based system to simulate simple decision-making (e.g., if-then reasoning).
4. Design a small semantic network or ontology to represent relationships in a knowledge domain (e.g., animals, tools).
5. Write a WebPPL program to model probabilistic decision-making (e.g., predicting outcomes of dice rolls or coin tosses).
6. Build a basic feedforward neural network to recognize simple patterns (e.g., XOR problem or digit classification using MNIST subset).
7. Use a Bayesian generative model (with PyMC3/Stan/WebPPL) to demonstrate causal inference in a simple dataset.
8. Implement a hierarchical clustering or mixture model on a dataset (e.g., grouping handwritten digits or words).
9. Simulate situated cognition using a robotics environment (e.g., NetLogo or Python robotics library) to model navigation and learning.

TOTAL : 30 Periods

TOTAL : 30+30=60 Periods

Text Books:	1. Vijay V Raghavan,Venkat N.Gudivada, VenuGovindaraju, C.R. Rao, Cognitive Computing: Theory and Applications: (Handbook of Statistics 35), Elsevier publications, 2016 2. Judith Hurwitz, Marcia Kaufman, Adrian Bowles, Cognitive Computing and Big Data Analytics, Wiley Publications, 2015 3. Robert A. Wilson, Frank C. Keil, "The MIT Encyclopedia of the Cognitive Sciences",The MIT Press, 1999. 4. Jose Luis Bermúdez, Cognitive Science -An Introduction to the Science of the Mind, Cambridge University Press 2020
Reference Books:	1. Noah D. Goodman, Andreas Stuhlmuller, "The Design and Implementation of Probabilistic Programming Languages", Electronic version of book, https://dippl.org/. 2. Noah D. Goodman, Joshua B. Tenenbaum, The ProbMods Contributors, "Probabilistic Models of Cognition", Second Edition, 2016, https://probmods.org/.
MOOC/Web Platforms:	https://onlinecourses.nptel.ac.in/noc22_ee122/preview

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IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Demonstrate cognitive neuroscience concepts like brain functions, perception, and memory	Understand (K2)
CO2	Apply probabilistic programming to model cognitive processes	Apply (K3)
CO3	Develop AI-based cognitive models such as generative and hierarchical models	Apply (K3)
CO4	Implement neural network simulations for cognitive tasks like language learning	Apply (K3)
CO5	Analyze experimental data using inference and dynamical systems methods.	Analyze (K4)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	2	3	3	1	-	-	-	1	2	1	1	3	1	1
CO-2	2	1	1	2	1	-	-	-	1	2	1	1	3	3	1
CO-3	2	3	1	1	3	-	-	-	2	1	1	2	3	2	2
CO-4	3	1	3	3	2	-	-	-	2	2	3	1	2	1	3
CO-5	3	1	1	3	3	-	-	-	2	3	3	3	1	3	3

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23PAD15 MACHINE INTELLIGENCE FOR MEDICAL IMAGE ANALYSIS

Prerequisite	Programme Name	Sem	Category	L	T	P	C
NIL	B.Tech AI&DS	V/VI/VII	PEC	2	0	2	3

II - Course Objectives

1.	Understand fundamental concepts of medical imaging and human anatomy across multiple scales.
2.	Apply classical image processing techniques for segmentation, enhancement, and statistical analysis.
3.	Analyze complex medical imaging modalities using reconstruction and registration algorithms.
4.	Evaluate speckle-prone and frequency-domain images such as ultrasound and OCT.
5	Design and implement machine learning and deep learning models for classification, segmentation, and synthesis of medical images.

III - Course Content

Preamble: This course introduces students to the principles of medical imaging, image processing foundations, imaging modalities, speckle and frequency-domain imaging, and deep learning for medical image analysis. It covers both classical approaches and state-of-the-art deep learning techniques, with applications to healthcare and clinical systems.

Unit – I	Fundamentals of Medical Imaging and Anatomy	9 Periods

Overview of human anatomy for imaging - Imaging modalities: Macro, Mesoscopic, and Microscopic scales - Basics of PACS (Picture Archiving and Communication Systems), DICOM standards - Introduction to medical imaging datasets (BraTS, ChestX-ray14, etc.) - 3D/4D visualization, time-lapse imaging - GPU computing in medical image analysis

Unit – II	Image Processing and Machine Learning Foundations	9 Periods

Shape modeling and anatomical priors - Region growing, clustering, and watershed segmentation - Texture analysis and image statistics - Image denoising and enhancement techniques - Supervised and unsupervised learning models - Feature extraction and dimensionality reduction (PCA, LDA, t-SNE)

Unit – III	Imaging Modalities – X-RAY, MRI, CT, PET	9 Periods

Image formation principles of X-ray, MRI, CT, PET, and SPECT - Digital Mammography and Angiography - Tomographic reconstruction algorithms - Image and volume registration techniques - Multimodal image fusion

Unit – IV	Speckle Imaging and Frequency Domain Methods	9 Periods

Principles of ultrasound imaging (A-/B-/M-modes) - Doppler imaging, tissue harmonic imaging - Speckle reduction, compound imaging, and beamforming - Optical Coherence Tomography (OCT) - Cardiovascular and ophthalmic imaging applications

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Unit – V	Deep Learning for Medical Image Analysis	9 Periods
Neural Network architectures (VGG, ResNet, DenseNet) for classification - U-Net, Attention U-Net for medical image segmentation - Transfer learning, pretrained models - Generative models: GANs and VAEs in medical image synthesis - Object detection and localization (YOLO, Faster-RCNN) - Explainability (Grad-CAM), ethical and deployment issues in healthcare		

TOTAL : 30 Periods

PRACTICAL EXERCISES:

1. Loading and visualizing medical image datasets (BraTS, ChestX-ray14, etc.)
2. Implementing PACS/DICOM image reading and preprocessing
3. Image enhancement using filtering techniques (spatial and frequency domain)
4. Segmentation using region growing, clustering, and watershed algorithms
5. Feature extraction and dimensionality reduction (PCA, LDA, t-SNE)
6. Tomographic image reconstruction and registration
7. Speckle reduction and ultrasound image preprocessing
8. Implementing CNN-based classification (VGG/ResNet/DenseNet)
9. Medical image segmentation using U-Net and Attention U-Net
10. Generative models (GANs/VAEs) for medical image synthesis and augmentation

TOTAL : 30 Periods

TOTAL : 30+30=60 Periods

Text Books:	1. Rafael C. Gonzalez & Richard E. Woods, Digital Image Processing, Pearson, 3rd Edition, 2008. 2. G. R. Sinha & B. C. Patel, Medical Image Processing: Concepts and Applications, PHI, 2014.
Reference Books:	1. Atam P. Dhawan, Medical Image Analysis, Wiley Publications, 2010. 2.G.Dougherty, Digital Image Processing for Medical Applications, Cambridge, 2009.

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IV - Course Outcome

	On completion of the course, the students will be able to	Bloom's Level Mapped
CO1	Demonstrate knowledge of anatomical and imaging systems across multiple biological scales.	Understand (K2)
CO2	Apply classical image processing techniques for segmentation, enhancement, and statistical analysis.	Apply (K3)
CO3	Analyze medical imaging modalities using reconstruction and registration algorithms.	Apply (K3)
CO4	Evaluate speckle-prone and frequency-domain imaging techniques for ultrasound and OCT.	Apply (K3)
CO5	Design and implement deep learning models for classification, segmentation, and synthesis of medical images.	Analyze (K4)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	2	3	3	1	1	2	1	1	2	1	1	3	1	1
CO-2	2	1	1	2	1	1	2	1	1	2	1	1	3	3	1
CO-3	2	3	1	1	3	1	1	1	2	1	1	2	3	2	2
CO-4	3	1	3	3	2	2	2	1	2	2	3	1	2	1	3
CO-5	3	1	1	3	3	1	1	2	2	3	3	3	1	3	3

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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XIV OPEN ELECTIVES

I - Course Name: 23OCE01 CARTOGRAPHY & GIS

Prerequisite	Programme Name	Semester	Category	L	T	P	C
NIL	All programmes except B.E - Civil Engineering	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1	To understand the fundamental elements of cartography including types of maps, map projections, coordinate systems, and their applications.
2	To learn the principles of map design, symbolization, color usage, lettering, and the processes involved in map production and reproduction.
3	To introduce the basic concepts, components, and data models of Geographic Information Systems (GIS), including spatial and attribute data structures.
4	To explore the methods of spatial data input, georeferencing, coordinate transformations, and understand topological relationships in GIS.
5	To assess data quality parameters, understand GIS standards and metadata, and learn about spatial data output through maps and graphical representations.

III - Course Content

Unit – I	ELEMENTS OF CARTOGRAPHY	9 Periods
Definition of Cartography – Maps – Functions – Uses and Types of Maps – Map Scales and Contents – Map Projections – Shape, Distance, Area and Direction Properties – Perspective and mathematical Projections – Indian Maps and Projections – Map Co-ordinate System – UTM and UPS References.		
Unit – II	**MAP DESIGN AND PRODUCTION**	**9 Periods**
Map and Mapping concepts -Map Design Fundamentals – Symbols and Conventional Signs – Graded and Ungraded Symbols – Color Theory – Colours and Patterns in Symbolization – Map Lettering – Map Production – Map Printing – Colours and Visualization – Map Reproduction – Map Generalization – Geometric Transformations – Bilinear and Affine Transformations.		
Unit – III	**BASICS OF GIS**	**9 Periods**
Introduction to GIS – Definitions – History of GIS – Components of a GIS – Hardware, Software, Data, People, Methods – Introduction to data quality – Types of data – Spatial, Attribute data – types of attributes – scales/levels of measurements – spatial data models – Raster Data Structures – Raster Data Compression – Vector Data Structures – Raster Vs Vector Models – TIN and GRID data models.		
Unit – IV	**DATA INPUT AND TOPOLOGY**	**9 Periods**
Scanner – Raster Data Input – Raster Data File Formats – Georeferencing– Vector Data Input – Digitizer– Datum Projection and Reprojection – Coordinate Transformation – Topology - Adjacency, Connectivity and containment – Topological Consistency – Non topological file formats – Attribute Data Linking – Linking External Databases – GPS Data Integration – Raster to Vector and Vector to Raster Conversion.		

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Unit – V	DATA QUALITY AND OUTPUT	9 Periods
Assessment of Data Quality - Basic Aspects - Completeness, Logical Consistency, Positional Accuracy, Temporal Accuracy, Thematic Accuracy and Lineage – Metadata – GIS Standards – Interoperability – OGC - Spatial Data Infrastructure – Data Output – Map Compilation – Chart / Graphs.		

Total: 45 Periods

Text Books:	1. Arthur H. Robinson et al, "Elements of Cartography", 7th Edition, Wiley, 2002. 2. Kang – Tsung Chang, "Introduction to Geographic Information Systems", McGraw Hill Publishing, Fourth Edition, 2017. 3. Ian Heywood, Sarah Cornelius, Steve Carver, Srinivasa Raju, "An Introduction to Geographical Information Systems, Pearson Education, Fourth Edition, 2011.
Reference Books:	1. John Campbell, "Introductory Cartography", Wm. C.BrownPublishers,3rd Edition,2004 2. Chor Pang LO, Albert K. W. Yeung, "Concepts and Techniques of Geographic Information Systems", Pearson Education, 2nd Edition, November 2016. ISBN: 9789332581883
MOOC/Web Platforms:	https://www.my-mooc.com/en/categorie/gis https://www.my-mooc.com/en/mooc/fundamentals-of-gis

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand map types, scales, projections, and coordinate systems used in cartography.	Understand (K2)
CO2	Apply map design principles, symbolization, and transformation techniques for map production.	Apply (K3)
CO3	Explain GIS components, data types, and spatial data models.	Understand (K2)
CO4	Perform data input, georeferencing, and establish topology in GIS.	Apply (K3)
CO5	Assess GIS data quality and generate spatial outputs using standards and metadata.	Apply (K3)

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V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	-	3	-	-	-	-	2	-	-	1	-
CO2	3	1	-	-	3	-	-	-	-	2	-	-	1	-
CO3	3	1	-	-	3	-	-	-	-	2	-	-	1	-
CO4	3	1	-	-	3	-	-	-	-	2	-	-	1	-
CO5	3	1	-	-	3	-	-	-	-	2	-	-	1	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23OCE02 ENVIRONMENT, HEALTH & SAFETY

Prerequisite	Programme Name	Semester	Category	L	T	P	C
NIL	All programmes except B.E - Civil Engineering	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1	To understand the need for EHS systems in workplaces and interpret international and national EHS regulations, policies, and ergonomics principles
2	To learn occupational health hazards, exposure pathways, and apply appropriate control measures including personal protective equipment.
3	To understand safety features in workplace design and implement safety systems for physical, chemical, and construction-related hazards.
4	To be familiarize with workplace hazards, conduct job safety analyses, and develop effective risk management and emergency response plans.
5	To understand and apply the components of an EHS management system based on national and international standards like BIS and ISO 45001.

III - Course Content

Unit – I	INTRODUCTION	9 Periods
Need for developing Environment, Health and Safety systems in work places- International initiatives, National Policy and Legislations on EHS in India - Regulations and Codes of Practice - Role of trade union safety representatives - Ergonomics.		
Unit – II	**OCCUPATIONAL HEALTH AND HYGIENE**	**9 Periods**
Definition of occupational health and hygiene - Categories of health hazards – Exposure pathways and human responses–Exposure Assessment-occupational exposure limits - Hierarchy of control measures - Role of personal protective equipment and the selection criteria.		
Unit – III	**WORKPLACE SAFETY AND SAFETY SYSTEMS**	**9 Periods**
Features of Satisfactory and Safe design of work premises – good housekeeping - Training methods and strategies -types of training. Evaluation and review of training -lighting and color, Ventilation and Heat Control, Noise, Chemical and Radiation Safety – Electrical Safety – Fire Safety – Safety at Construction sites, ETP – Machine guarding – Process Safety, Working at different levels		
Unit – IV	**HAZARDS AND RISK MANAGEMENT**	**9 Periods**
Safety appraisal – Job Safety Analysis-Control techniques – plant safety inspection – Accident investigation - Analysis and Reporting – Hazard and Risk Management Techniques –Onsite and Offsite emergency Plans. Employee Participation- Education and Training- Case Studies		

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Unit – V	ENVIRONMENTAL HEALTH AND SAFETY MANAGEMENT	9 Periods
Concept of Environmental Health and Safety Management – Elements of Environmental Health and Safety Management Policy and implementation and review – Bureau of Indian standards on safety and health 14489 - 1998 and 15001 - ISO 45001-Strucure and Clauses-Case Studies.		

Total: 45 Periods

Text Books:	1. Industrial Health and Safety Acts and Amendments, by Ministry of Labour and Employment, Government of India 2. Fundamentals of Industrial Safety and Health by Dr.K.U.Mistry, Siddharth Prakashan, 2012
Reference Books:	1. The Facility Manager's Guide to Environmental Health and Safety by Brian Gallant, Government Inst Publ., 2007. 2. Effective Environmental, Health, and Safety Management Using the Team Approach by Bill Taylor, Culinary and Hospitality Industry Publications Services, 2005. 3. Environmental and Health and Safety Management by Nicholas P.Cheremisinoff and Madelyn L. Graffia, William Andrew Inc. NY, 1995
MOOC/Web Platforms:	https://www.coursera.org/courses?query=environmental%20health https://moocs.anuonline.ac.in/quality-health-safety-environment.html

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the need for EHS in industries and related Indian regulations.	Understand (K2)
CO2	Identify workplace health hazards and apply assessment and control methods.	Understand (K2)
CO3	Analyze safety systems used in industrial environments.	Apply (K3)
CO4	Prepare emergency plans and conduct accident investigations.	Apply (K3)
CO5	Understand EHS Management System and its key elements.	Understand (K2)

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V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	1	2	3	-	-	-	-	-	-	-
CO2	3	-	-	-	1	2	3	-	-	-	-	-	-	-
CO3	3	-	-	-	1	2	3	-	-	-	-	-	-	-
CO4	3	-	-	-	1	2	3	-	-	-	-	-	-	-
CO5	3	-	-	-	1	2	3	-	-	-	-	-	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23OCE03 ENVIRONMENT IMPACT ASSESSMENT

Prerequisite	Programme Name	Semester	Category	L	T	P	C
NIL	All programmes except B.E - Civil Engineering	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1	To introduce the fundamentals, historical development, and legal aspects of Environmental Impact Assessment (EIA).
2	To apply methodologies and analytical tools for environmental impact prediction and evaluation.
3	To assess socio-economic impacts of developmental projects on individuals, families, and communities.
4	To analyze and propose mitigation measures for impacts on natural, cultural, and economic environments.
5	To gain practical insights into EIA through real-world industrial and infrastructure case studies.

III - Course Content

Preamble: This course provides an in-depth understanding of Environmental Impact Assessment (EIA), its methodologies, and regulatory frameworks, equipping students to evaluate and mitigate environmental consequences of developmental projects.

Unit – I	INTRODUCTION	9 Periods

Historical development of Environmental Impact Assessment (EIA). Environmental Clearance- EIA in project cycle. legal and regulatory aspects in India – types and Methods of categorization of industries for EIA limitations of EIA –EIA process screening – scoping - terms of reference in EIA- setting – analysis – mitigation.– public hearing in EIA- EIA consultant accreditation.

Unit – II	COMPONENTS AND QUALITY ANALYSIS	9 Periods

Matrices networks – checklists – cost benefit analysis – analysis of alternatives – expert systems in EIA. prediction tools for EIA – mathematical modelling for impact prediction – assessment of impacts – air – water – soil – noise – biological — cumulative impact assessment

Unit – III	SOCIO-ECONOMIC IMPACT ASSESSMENT	9 Periods

Socio-economic impact assessment - relationship between social impacts and change in community and institutional arrangements. factors and methodologies- individual and family level impacts communities transition

Unit – IV	PREDICTION, ASSESSMENT AND MITIGATION	9 Periods

Methods for Prediction and assessment of impacts on Air, Water, Soil and Noise - Biological, Cultural, Social and Economic environments - Standards and guidelines for evaluation - Options for mitigation of impacts - Policies for decision making.

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Unit – V	CASE STUDIES	9 Periods
Mining, power plants, cement plants, highways, petroleum refining industry, storage & handling of hazardous chemicals, common hazardous waste facilities, CETPs, CMSWMF, building and construction projects		

Total: 45 Periods

Text Books:	1. Morris, P. and Therivel, R., Environmental Impact Assessment: Theory and Practice, 2nd Edition, Routledge, London, 2021. 2. Glasson, J., Therivel, R. and Chadwick, A., Introduction to Environmental Impact Assessment, 5th Edition, Routledge, London, 2019. 3. Fonseca, A. (Ed.), Handbook of Environmental Impact Assessment, Edward Elgar Publishing, Cheltenham, 2022. 4. Morris, P. and Therivel, R., Methods of Environmental Impact Assessment, 4th Edition, Routledge, London, 2020. 5. Gilpin, A. (Ed.), Environmental Impact Assessment: Cutting Edge for the 21st Century, Revised Reprint, Routledge, London, 2020.
Reference Books:	1. Canter, L.W., Environmental Impact Assessment, 2nd Edition, McGraw-Hill, New York, 1996. 2. Lawrence, D.P., Impact Assessment – Practical Solutions to Recurrent Problems and Contemporary Challenges, 2nd Edition, Wiley, New Jersey, 2014. 3. Kolluru, R., Bartell, S., Pitblado, R. and Stricoff, R., Risk Assessment and Management Handbook, McGraw-Hill Inc., New York, 1996.
MOOC/Web Platforms:	https://onlinecourses.nptel.ac.in/noc22_ar07/preview https://www.futurelearn.com/courses/environmental-impact-assessment https://cursos.iadb.org/en/topics/management-social-and-environmental-risk/principles-reviewing-environmental-impact-assessments

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the principles, process, and regulatory framework of Environmental Impact Assessment.	Understand (K2)
CO2	Apply analytical methods and prediction tools for assessing environmental impacts.	Apply (K3)
CO3	Evaluate socio-economic consequences of developmental projects on communities.	Apply (K3)
CO4	Recommend suitable mitigation measures and policies for sustainable project development.	Apply (K3)
CO5	Analyze real-world case studies to integrate theory with practical EIA applications.	Apply (K3)

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V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	2	2	-	-	2	-	-	-	-
CO2	3	2	3	3	2	-	-	-	-	-	-	2	-	-
CO3	-	2	-	-	-	3	2	2	-	2	-	-	-	-
CO4	-	-	3	-	-	3	3	3	-	3	2	-	-	-
CO5	3	-	3	2	-	2	3	-	2	3	-	2	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23OCE04 INDUSTRIAL WASTE WATER MANAGEMENT

Prerequisite	Programme Name	Semester	Category	L	T	P	C
NIL	All programmes except B.E - Civil Engineering	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1	To introduce the sources, characteristics, and environmental impacts of industrial wastewater.
2	To provide knowledge on regulatory requirements and the importance of pollution prevention and waste minimization in industries.
3	To familiarize students with various physical, chemical, and biological treatment methods used in industrial wastewater management.
4	To develop understanding on reuse strategies, residuals management, and zero discharge concepts.
5	To enable students to analyze real-life case studies and recommend suitable wastewater treatment and pollution control strategies for specific industries.

III - Course Content

Preamble: This course provides comprehensive knowledge of industrial wastewater treatment with emphasis on environmental impact, pollution prevention, treatment technologies, and residual management. Students will gain insight into regulatory frameworks, reuse strategies, and specific industrial case studies that promote sustainable water management and pollution control practices.

Unit – I	INDUSTRIAL WASTEWATER TREATMENT INTRODUCTION	8 Periods

Industrial scenario in India– Industrial activity and Environment - Uses of Water by industry – Sources and types of industrial wastewater – Nature and Origin of Pollutants - Industrial wastewater and environmental impacts – Regulatory requirements for treatment of industrial

Unit – II	INDUSTRIAL POLLUTION PREVENTION &WASTE MINIMISATION	8 Periods

Prevention vis a vis Control of Industrial Pollution – Benefits and Barriers – Waste management Hierarchy - Source reduction techniques – Periodic Waste Minimisation. Methods and materials changes – Waste minimization strategies – Zero discharge concept.

Unit – III	INDUSTRIAL WASTEWATER TREATMENT	10 Periods

Flow and Load Equalisation – Solids Separation – Removal of Fats, Oil & Grease- Neutralisation- Removal of Inorganic Constituents – Precipitation, Heavy metal removal, Nitrogen & Phosphorousremoval, Ion exchange, Adsorption, Membrane Filtration, Difficulties and Remedial Measures, Rotating Biological Contactors. Suspended Growth Processes

Unit – IV	WASTEWATER REUSE AND RESIDUAL MANAGEMENT	9 Periods

Individual and Common Effluent Treatment Plants – Joint treatment of industrial and domestic wastewater - Zero effluent discharge systems - Quality requirements for Wastewater reuse Industrial reuse, Present status and issues. Residuals of industrial wastewater treatments – Individual and common effluent treatment plants.

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Unit – V	CASE STUDIES	10 Periods
Industrial manufacturing process description, wastewater characteristics, source reduction options and waste treatment flow sheet for Textiles – Tanneries – Pulp and paper – metal finishing – Sugar and Distilleries		

Total: 45 Periods

Text Books:	1. Wastewater Treatment – Concepts and Design Approach, by G L Karia and R A Christian, Prentice Hall of India, 2006 2. Environmental Engineering by Gerard Kiely, McGraw Hill Education (India) Pvt Ltd, 2013 3. Environmental Engineering – A Design Approach by A. P. Sincero and G A Sincero, Prentice Hall of India, 2014
Reference Books:	1. "Industrial wastewater management, T reatment & disposal, Water Environment" Federation Alexandria Virginia, Third Edition, 2008. 2. Lawrance K. Wang,Yung Tse Hung, Howard H.Lo and Constantine Yapijakis "handlook of Industrial and Hazardous waste Treatment", Second Edition, 2004. 3. Metcalf & Eddy, Inc., George Tchobanoglous, Franklin L. Burton and H. David Stensel, Wastewater engineering, treatment and reuse, Fourth Edition, McGraw-Hill, 2017 4. Nelson Leonard Nemerow, "industrial waste Treatment", Elsevier, 2007. 5. Wesley Eckenfelder W., "Industrial Water Pollution Control", Second Edition, Mc Graw Hill, 2000. 6. Paul L. Bishop, Pollution Prevention: -Fundamentals and Practice", Mc-Graw Hill International, Boston, 2000. 7. Waste water Treatment for pollution control and reuse by Soli. J. Arceivala, Shyam. R. Asolekar, Tata McGraw Hill, 2007
MOOC/Web Platforms:	https://onlinecourses.nptel.ac.in/noc24_ce53/preview https://nptel.ac.in/courses/105105350 https://onlinecourses.nptel.ac.in/noc25_ce116/preview

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IV - Course Outcome

	On completion of the course, the students will be able to	Bloom's Level Mapped
CO1	Explain the source and types of industrial wastewater and their environmental impacts and choose the regulatory laws pertaining to environmental protection	Understand (K2)
CO2	Apply industrial wastewater pollution and implement pollution prevention, waste minimization in industries	Apply (K3)
CO3	Apply knowledge and skills to design industrial wastewater treatment schemes	Analyze (K4)
CO4	Analyze environmental performance of industries to internal, external client, regulatory bodies and design water reuse management techniques	Apply (K3)
CO5	Apply research to develop effective management systems for industrial wastewater that are technically sound, economically feasible and socially acceptable	Apply (K3)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	3	2	2	-	-	-	2	-	-
CO2	3	2	3	2	2	2	2	-	-	-	-	2	-	-
CO3	3	3	3	3	2	3	-	-	-	-	-	3	-	-
CO4	3	2	3	3	3	3	2	-	-	-	-	3	-	-
CO5	3	3	3	3	3	3	2	-	-	-	-	3	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23OCE05 REMOTE SENSING CONCEPTS

Prerequisite	Programme Name	Semester	Category	L	T	P	C
NIL	All programmes except B.E - Civil Engineering	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1	To help students understand the basic concepts and components of remote sensing, including the principles of radiation.
2	To understand how electromagnetic radiation interacts with the Earth's surface and atmosphere.
3	To learn about different satellite orbits, types of platforms, and the applications of nano-satellites.
4	To understand how various remote sensors work and their characteristics.
5	To learn how to use satellite data, interpret images, and apply cloud-based tools like Google Earth Engine for analysis.

III - Course Content

Unit – I	REMOTE SENSING AND ELECTROMAGNETIC RADIATION	9 Periods
Definition – components of Remote Sensing – History of Remote Sensing – Merits and demerits of data collation between conventional and remote sensing methods – Electromagnetic Spectrum – Radiation principles – Wave theory, Planck's law, Wien's Displacement Law, Stefan's Boltzmann law, Kirchoff's law – Radiation sources: active & passive – Radiation Quantities		
Unit – II	**EMR INTERACTION WITH ATMOSPHERE AND EARTH MATERIAL**	**9 Periods**
Standard atmospheric profile – Main atmospheric regions and their characteristics – Interaction of radiation with atmosphere – Scattering, absorption and refraction – Atmospheric windows – Energy balance equation – Specular and diffuse reflectors – Spectral reflectance & emittance – Spectroradiometer – Spectral Signature concepts – Typical spectral reflectance curves for vegetation, soil, and water – Solid surface scattering in microwave region – Introduction to drone-based hyperspectral remote sensing and thermal mapping		
Unit – III	**ORBITS AND PLATFORMS**	**9 Periods**
Motions of planets and satellites – Newton's law of gravitation – Gravitational field and potential – Escape velocity – Kepler's laws of planetary motion – Orbit elements and types – Orbital perturbations and maneuvers – Types of remote sensing platforms – Ground-based, airborne, and spaceborne platforms – Classification of satellites – Sun-synchronous and geosynchronous satellites – Lagrange orbit – Latest nano-satellite applications		
Unit – IV	**SENSING TECHNIQUES**	**9 Periods**
Classification of remote sensors – Resolution concept : spatial, spectral, radiometric and temporal resolutions - Scanners - Along and across track scanners – Optical-infrared sensors – Thermal sensors – microwave sensors – Calibration of sensors - High Resolution Sensors - LIDAR , UAV – Orbital and sensor characteristics of live Indian earth observation satellites		
Unit – V	**DATA PRODUCTS AND INTERPRETATION**	**9 Periods**
Photographic and digital products – Types, levels and open source satellite data products – selection and		

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procurement of data– Visual interpretation: basic elements and interpretation keys -Digital interpretation – Concepts of Image rectification, Image enhancement and Image classification - Cloud-based access (Google Earth Engine), and real-time analytics tools

Total: 45 Periods

Text Books:	1. Thomas M.Lillesand, Ralph W. Kiefer and Jonathan W. Chipman, Remote Sensing and Image interpretation, John Wiley and Sons, Inc, New York,2015. 2. George Joseph and C Jeganathan, Fundamentals of Remote Sensing,Third Edition Universities Press (India) Private limited, Hyderabad, 2018
Reference Books:	1. Janza, F.Z., Blue H.M. and Johnson,J.E. Manual of Remote Sensing. Vol.I, AmericanSociety of Photogrametry, Virginia, USA, 2002. 2. Verbyla, David, Satellite Remote Sensing of Natural Resources. CRC Press, 1995 3. Paul Curran P.J. Principles of Remote Sensing. Longman, RLBS, 1988. 4. Introduction to Physics and Techniques of Remote Sensing , Charles Elachi and JacobVan Zyl, 2006 Edition II, Wiley Publication

IV - Course Outcome

	On completion of the course, the students will be able to	Bloom's Level Mapped
CO1	Understand the basic concepts, components, and radiation principles of remote sensing.	Understand (K2)
CO2	Understand how electromagnetic radiation interacts with the atmosphere and Earth's surface materials.	Understand (K2)
CO3	Understand satellite orbits, different types of platforms, and nano-satellite applications.	Understand (K2)
CO4	Understand the working of different remote sensors and their characteristics.	Understand (K2)
CO5	Understand satellite data types, interpretation methods, and use of cloud tools like Google Earth Engine.	Understand (K2)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	1	1	1	1	-	-	-	-	1	1	-
CO2	3	1	-	1	1	1	1	-	-	-	-	1	1	-
CO3	3	1	-	1	1	1	1	-	-	-	-	1	1	-
CO4	3	1	-	1	1	1	1	-	-	-	-	1	1	-
CO5	3	1	-	1	1	1	1	-	-	-	-	1	1	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23OEC01 ANTENNA FUNDAMENTALS

Prerequisite	Programme Name	Sem	Category	L	T	P	C
NIL	All programmes except B.E - ECE	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1	Understand and analyze key antenna parameters and matching techniques to evaluate antenna performance.
2	Design and analyze linear and phased antenna arrays for directional radiation control
3	Learn techniques for accurate measurement of antenna parameters and overcome practical limitations.
4	Explore the principles and applications of frequency-independent and modern specialized antennas.
5	Understand antenna requirements and designs for contemporary wireless, satellite, and radar systems.

III - Course Content

Unit – I	ANTENNA FUNDAMENTALS AND RADIATION	9 Periods
Definition of antenna parameters – Gain, Directivity, Effective aperture, Radiation Resistance, Band width, Beam width, Input Impedance. Matching – Baluns, Polarization mismatch, Antenna noise temperature.		
Unit – II	**ANTENNA ARRAYS**	**9 Periods**
N element linear array, Pattern multiplication, Broadside and End fire array – Concept of Phased arrays, Adaptive array		
Unit – III	**ANTENNA MEASUREMENTS**	**9 Periods**
Drawbacks in measurement of antenna parameters – methods to overcome drawbacks in antenna measurements - measurement ranges - Impedance - Gain - Radiation pattern - Beam width, Radiation resistance - Antenna efficiency - Directivity - Polarization and phase Measurements.		
Unit – IV	**SPECIAL ANTENNAS**	**9 Periods**
Principle of frequency independent antennas – Spiral antenna, Helical antenna, Log periodic. Modern antennas- Reconfigurable antenna, Reflector Antenna, Patch Antenna.		
Unit – V	**ANTENNAS FOR MODERN WIRELESS COMMUNICATIONS**	**9 Periods**
Antennas for Terrestrial mobile communication - mobile handsets and base stations. Antennas for Satellite Communication, Radar systems, RFID, MEMS antenna, MIMO antenna.		

Total: 45 Periods

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Reference Books:	1. John D Kraus, "Antennas for all Applications", McGraw Hill, 5thEdition, 2005. R.E. Collin, "Antennas and Radio wave propagation", McGraw Hill, 1985. 2. Constantine. A. Balanis, "Antenna Theory Analysis and Design", Wiley student edition, 3rd Edition, 2009. 3. Annapurna Das and Sisir K Das, Microwave Engineering, Tata McGraw Hill Publishing Company Ltd., New Delhi, Second Edition, 2009 4. Edward C. Jordan and Keith G.Balmain, "Electromagnetic Waves and Radiating Systems", Prentice Hall of India, 2006 5. S. Drabowitch, "Modern Antennas", Springer Publications, 2nd Edition, 2007 6. Robert S. Elliott, "Antenna theory and Design", Wiley student edition, 2010. 7. H. Sizun, "Radio Wave Propagation for Telecommunication Applications", First Indian Reprint, Springer Publications, 2007

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Comprehend antenna parameters and the radiation mechanism of simple antennas to complex antenna structures.	Understand (K2)
CO2	Design antennas for given specifications and perform array synthesis.	Apply (K3)
CO3	Elaborate the radiation mechanism of aperture antennas.	Understand (K2)
CO4	Acquire knowledge on the operation of antennas designed for specific applications and the measurement procedures	Understand (K2)
CO5	Explain the selection of modern antennas for various applications	Understand (K2)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	-	-	-	-	-	-	-	1		-	-
CO2	3	3	3	-	-	-	-	-	-	-	1		-	-
CO3	3	3	3	-	-	-	-	-	-	-	1		-	-
CO4	3	3	3	-	-	-	-	-	-	-	1		-	-
CO5	3	3	3	-	-	-	-	-	-	-	1		-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23OEC02 CONSUMER ELECTRONICS

Prerequisite	Programme Name	Sem	Category	L	T	P	C
NIL	All programmes except B.E - ECE	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	To provide foundational knowledge of the consumer electronics industry, including classification of products, key components, ergonomic design principles, and power supply technologies.
2.	To understand the working principles and technologies behind modern audio and video systems, including analog/digital formats, display technologies, and streaming media platforms.
3.	To explore the internal architecture and control systems of household appliances, and introduce smart home integration with voice-controlled and energy-efficient technologies
4.	To examine the role of IoT architecture, wireless communication protocols, and AI/ML in enhancing functionality, connectivity, and intelligence of modern consumer devices.
5.	To impart practical knowledge on safety standards, maintenance, fault diagnosis, and to introduce emerging innovations and sustainable practices in consumer electronics.

III - Course Content

Unit - I	**INTRODUCTION TO CONSUMER ELECTRONICS**	**9 Periods**
Overview of consumer electronics industry- Classification: audio-video-communication-home appliances-Key components and block diagrams-Power supplies and batteries- Ergonomics and design aspects		
Unit - II	**AUDIO AND VIDEO SYSTEMS**	**9 Periods**
Microphones-loudspeakers-amplifiers Analog and digital audio systems-Smart TVs-OLED-QLED-Set-top boxes, IPTV, streaming systems- Digital cameras, camcorders- imaging technologies		
Unit - III	**HOME AND SMART APPLIANCES**	**9 Periods**
Washing machines-microwave ovens- air conditioners-refrigerators-Embedded control systems in appliances-Energy efficiency and inverter technology-Introduction to Smart Homes and connected devices-Voice assistants-Amazon Alexa-Google Assistant.		
Unit - IV	**IOT, AI, AND COMMUNICATION IN CONSUMER ELECTRONICS**	**9 Periods**
IoT architecture and sensors in consumer devices-Wireless standards: Wi-Fi- Zigbee- Bluetooth-NFC AI and ML applications in consumer products-Smartphone technologies and wearable devices-Security-privacy and interoperability.		
Unit - V	**TROUBLESHOOTING, MAINTENANCE AND EMERGING TRENDS**	**9 Periods**
Safety standards, regulations (BIS, IEC, RoHS)-Installation and maintenance practices-Fault diagnosis techniques-E-waste management and green electronics-Emerging trends: foldable tech- 8K- AR/VR-sustainable devices		

Total : 45 Periods

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Reference Books:	1. S.P. Bali, "Consumer Electronics", Pearson Education, 2nd Edition, 2010. 2. R.G. Gupta, "Audio and Video Systems", Tata McGraw-Hill, 2nd Edition, 2010. 3. N.P. Bhatt, "Consumer Electronics: Servicing and Maintenance", McGraw Hill, 2nd Edition, 2010. 4. Robert Sobot, "Wireless Communication Electronics: Introduction to RF Circuits and Design", Springer, 2nd Edition, 2021. 5. Dogan Ibrahim, "Internet of Things with PIC Microcontrollers", Newnes, 1st Edition, 2020.

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the principles and features of audio and video systems used in consumer electronics.	Understand (K2)
CO2	Explain the operation of home appliances and their subsystems.	Understand (K2)
CO3	Demonstrate knowledge of digital and smart consumer devices, including IoT-enabled products.	Apply (K3)
CO4	Apply safety, troubleshooting, and maintenance procedures for consumer electronics.	Apply (K3)
CO5	Enumerate emerging trends and technologies such as AI, ML, and sustainability in consumer electronics.	Apply (K3)

(Action verb of each CO to be matched with the next mapping table)

V -Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO-2	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO-3	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO-4	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO-5	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23OEC03 DISPLAY DEVICES FUNDAMENTALS

Prerequisite	Programme Name	Sem	Category	L	T	P	C
NIL	All programmes except B.E - ECE	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1	To understand the fundamental principles of display systems, human visual perception, and key display parameters.
2	To explore the structure, operation, and applications of transmissive and reflective displays including LCDs and e-paper.
3	To study emissive and projection display technologies such as OLED, QLED, CRT, and various projection systems.
4	To examine near-eye and wearable displays including AR/VR systems, holographic optics, and eye-tracking mechanisms.
5	To analyze advanced and 3D display technologies including light field, volumetric, autostereoscopic, and touch screen displays.

III - Course Content

Unit – I	DISPLAY FUNDAMENTALS	9 Periods
Introduction to Displays, Requirements of Displays, Overview of Display Technologies: CRT, Flat Panel, Advanced Displays, Cathode Ray Tube (CRT), Flat Panel Displays, Human Visual System, Colorimetry, Depth Perception and Motion Perception Fundamentals, Fundamental Display Parameters.		
Unit – II	**TRANSMISSIVE AND REFLECTIVE DISPLAYS**	**9 Periods**
Introduction to transmissive Displays, Liquid Crystal Display (LCD), Types of LCD, LED Backlighting in LCDs, Reflective Displays, Electronic Paper (E-Ink), Digital Micromirror Device (DMD), Electrowetting and Electrofluidic Displays, Practical applications of Transmissive and Reflective Displays.		
Unit – III	**EMISSIVE AND PROJECTION DISPLAYS**	**9 Periods**
Emissive Displays, Cathode Ray Tube (CRT), OLED and AMOLED Displays, Quantum Dot LEDs (QLED, Field Emission Displays, Projection Display, Types of Projectors, Holographic Projection, Common Applications of Emissive and Projection Displays.		
Unit – IV	**NEAR-EYE AND WEARABLE DISPLAYS**	**9 Periods**
Near-Eye Displays (NED), Head-Mounted Displays (HMD), Combiner Mirrors and Basic Optical Principles, On-Axis and Off-Axis Near-Eye Displays, Smart NEDs and Augmented Reality, Light Field Displays and Holographic NEDs, Contact Lens Displays, Adaptive Displays, Eye Tracking:		
Unit – V	**ADVANCED DISPLAY TYPES AND 3D DISPLAYS**	**9 Periods**
Introduction to 3D Displays and Their Significance, Spatial and Spectroscopic Displays, Autostereoscopic Displays, Parallax Barrier Displays, Volumetric Displays, Light Field Display, Computer-Generated Holograms (CGH), HDTV and LED Displays, Touch Screen Displays.		

Total: 45 Periods

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Reference Books:	1. R G Gupta, Television Engineering and Video Systems, McGraw Hill, India, 2011 (Second Edition). 2. A Veeralakshmi and R Srivel, "Television and Video Engineering", Ane Books, 2013. 3. E.H. Stupp, M. S. Brennesholtz, "Projection Displays", Wiley, 2008 (Second Edition). 4. Joseph A. Castellano, "Handbook of Display Technology", Elsevier, 1992.

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand and explain the fundamental principles and requirements of various display technologies including CRT, flat panel, and advanced displays.	Understand (K2)
CO2	Describe the human visual system and its impact on display design, including concepts of colorimetry, depth perception, and motion perception.	Understand (K2)
CO3	Differentiate transmissive and reflective display technologies such as LCD, E-Ink, DMD, and their practical applications.	Understand (K2)
CO4	Explain the working principles and applications of emissive and projection displays, including OLED, AMOLED, QLED, and holographic projectors.	Understand (K2)
CO5	Understand near-eye and wearable displays, advanced 3D display technologies, and their significance in modern electronic systems.	Understand (K2)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	-	-	-	-	-	-	-	-		-	-
CO2	3	3	3	-	-	-	-	-	-	-	-		-	-
CO3	3	3	3	-	-	-	-	-	-	-	-		-	-
CO4	3	3	3	-	-	-	-	-	-	-	-		-	-
CO5	3	3	3	-	-	-	-	-	-	-	-		-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

Chairperson-Board of Studies,
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I - Course Name 23OEC04 BASICS OF EMBEDDED SYSTEMS

Prerequisite	Programme Name	Sem	Category	L	T	P	C
NIL	All programmes except B.E - ECE	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1	To introduce the fundamentals of embedded systems and the architecture, programming, and features of the 8051 microcontroller.
2	To understand ARM processor architecture, programming, exceptions, and performance analysis techniques.
3	To study the architecture and functionalities of the MSP430 microcontroller and its peripheral interfaces.
4	To explore real-time operating systems, task scheduling, interprocess communication, and multiprocessing in embedded systems.
5	To analyze embedded system design through real-world applications like vending machines, digital cameras, and USB interfaces.

III - Course Content

Unit – I	INTRODUCTION TO EMBEDDED SYSTEMS AND MICROCONTROLLER	9 Periods
Introduction to Embedded Systems –Structural units in Embedded processor - selection of processor –8/16 bit Microprocessors – Microcontroller for an Embedded System- 8051 Microcontroller – Architecture, Addressing Modes, Instruction Set.		
Unit – II	**ARM PROCESSOR**	**9 Periods**
ARM Processor – Instruction Set Preliminaries – CPU – Programming Input and Output – Supervisor Mode – Exceptions and Trap – Models for programs – Assembly, Linking and Loading – Compilation Techniques – Program Level Performance Analysis.		
Unit – III	**MSP430 MICROCONTROLLER**	**9 Periods**
Functional Block diagram of MSP-EXP430F5529LP - Memory Mapped CPU, Exceptions, Architecture of MSP430 - Addressing Modes - Instruction Set, Interrupts, Digital in - outs, Timer, Communication interfaces.		
Unit – IV	**PROCESSES AND OPERATING SYSTEMS**	**9 Periods**
Structure of a real time system, Task Assignment and Scheduling, Multiple Tasks and Multiple Processes, Pre-emptive real time Operating systems, Priority based scheduling, Distributed Embedded Systems, MPSoCs and shared memory multiprocessors.		
Unit – V	**EMBEDDED SYSTEM APPLICATIONS**	**9 Periods**
Embedded System Design Process – Model train controller, Chocolate Vending Machine, Digital camera, ATM machine and simple USB back channel.		

Total: 45 Periods

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Reference Books:	1. The 8051 Microcontroller: Architecture, Programming, and Applications, Kenneth Ayala, West Publishing Company, 2007 (Unit – I) 2. Marilyn Wolf, Computers as Components – Principles of Embedded Computing System Design, 3rd Edition, Morgan Kaufmann, 2012. (Unit – II, IV, V) 3. John H Davies, MSP430 Microcontroller Basics, Elsevier, 2008.Unit – III, V). 4. Raj Kamal, 'Embedded System-Architecture, Programming, Design', Mc Graw Hill, 2013. 5. Lyla B.Das, Embedded Systems: An Integrated Approach, Pearson Education, 2013. 6. Jane.W.S .Liu, Real – Time Systems, Pearson Education, 2003

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Explain the architecture and features of 8051.	Understand (K2)
CO2	Explain ARM processor architecture and programming concepts.	Understand (K2)
CO3	Explain MSP430 microcontrollers concepts.	Understand (K2)
CO4	Understand the principles of real-time operating systems.	Understand (K2)
CO5	Apply embedded systems programming, design, and development skills.	Apply (K3)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO5	3	3	3	-	-	-	-	-	-	-	-	-	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23OEC05 BASICS OF NANO ELECTRONICS

Prerequisite	Programme Name	Sem	Category	L	T	P	C
NIL	All programmes except B.E - ECE	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1	To introduce the fundamental concepts of nanoelectronics, including quantum effects, nanostructures, and material properties.
2	To explore bottom-up synthesis techniques for nanomaterials such as sol-gel, CVD, epitaxy, and self-assembly.
3	To study top-down nanofabrication methods including lithography, ball milling, and vapor phase deposition techniques.
4	To understand various characterization techniques for nanomaterials including microscopy and spectroscopy tools.
5	To examine the applications of nanoelectronics in MEMS/NEMS, healthcare, energy, electronics, and transportation sectors.

III - Course Content

Unit – I	INTRODUCTION TO NANO ELECTRONICS	9 Periods
Nano electronics in recent scenario - Crystal Structure –Semiconductors- Band theory– Donors - Acceptors and Deep traps, Mobility – Excitons, Electron confinement - Quantum dots, wires and well, 1D, 2D and 3D Nano structured materials, metal Oxides- Physical, Chemical and Optical properties		
Unit – II	**SYNTHESIS OF NANO MATERIALS - BOTTOM-UP APPROACHES**	**9 Periods**
Sol-gel, Self-assembled monolayer, Physical and Chemical vapour deposition, thin films, epitaxy-Lithography Top-down Approaches-Grinding, high energy ball milling, Injection molding		
Unit – III	**NANO MATERIALS - TOP-DOWN APPROACHES**	**9 Periods**
Fundamentals of nano–thin film growth; Vapor phase deposition methods - Physical and chemical vapor phase methods; Langmuir-Blodgett Films; Electrochemical Deposition; laws of electrolysis and deposition		
Unit – IV	**NANO MATERIALS CHARACTERIZATION**	**9 Periods**
X-ray diffraction, Powder diffraction, Structural analysis, Scanning Electron Microscopy, FESEM, AFM, Transmission Electron Microscope, Spectroscopic techniques: UV-Visible, Infra-red Spectroscopy, rotational, vibrational photo luminescence (PL)		
Unit – V	**APPLICATIONS OF NANO ELECTRONICS**	**9 Periods**
Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS), Application in Electronics, Medical and Health Care, energy saving and for Transportation		

Total: 45 Periods

Chairperson-Board of Studies,
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Reference Books:	1.Hanson, Fundamentals of Nanoelectronics, Pearson education, 2009 2.Mircea Dragoman and Daniela Dragoman, Nanoelectronics: Principles and Devices, Artech House, 2009 3.Robert Puers, Livio Baldi, Marcel Van de Voorde and Sebastiaan E. Van Nooten, Nanoelectronics: Materials, Devices, Applications, Wiley, 2017

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the basics of nano electronics including quantum wires, dots and wells.	Understand (K2)
CO2	Explain the bottom-up approaches to synthesize the nano materials.	Understand (K2)
CO3	Explain the top-down approaches to synthesize the nano materials.	Understand (K2)
CO4	Identify the nano material characterization method.	Apply (K3)
CO5	Explain the use of nano devices for various applications.	Understand (K2)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO5	3	3	3	-	-	-	-	-	-	-	-	-	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23OEC06 FUNDAMENTALS OF IMAGE PROCESSING

Prerequisite	Programme Name	Sem	Category	L	T	P	C
NIL	All programmes except B.E - ECE	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1	To introduce the basic concepts, components, and fundamental steps in digital image processing including image acquisition and representation.
2	To understand image enhancement techniques in the spatial domain using histogram operations and various spatial filters.
3	To apply frequency domain techniques for image enhancement and restoration using Fourier transforms and noise reduction filters.
4	To study color image processing, edge detection, and image segmentation methods for feature isolation and analysis.
5	To explore image and video compression techniques and introduce basic feature extraction and pattern recognition methods.

III - Course Content

Unit – I	INTRODUCTION TO IMAGE PROCESSING	9 Periods
Fundamental Steps in Digital Image Processing, Components of Image Processing System Image Acquisition and Sampling Quantization and Resolution. **Digital Image Fundamentals** - Image Representation (2D functions, pixels) Image Types (Binary, Grayscale, Color), Basic Relationships between Pixels, Neighbors, Connectivity, Distance Metrics. Image File Formats (JPEG, PNG, BMP, TIFF)		
Unit – II	**IMAGE ENHANCEMENT IN THE SPATIAL DOMAIN**	**9 Periods**
Histogram Processing, Histogram Equalization, Matching, Spatial Filtering Smoothing Filters (Mean, Gaussian), Sharpening Filters (Laplacian, Sobel)		
Unit – III	**IMAGE ENHANCEMENT IN THE FREQUENCY DOMAIN**	**9 Periods**
Fourier Transform and its Properties, Discrete Fourier Transform (DFT), Filtering in Frequency Domain, Ideal, Butterworth, Gaussian Filters, High-pass and Low-pass Filtering. **Image Restoration** Model of Image Degradation/Restoration, Noise Models (Gaussian, Salt & Pepper, Speckle), Restoration Techniques, Inverse Filtering, Wiener Filtering.		
Unit – IV	**COLOR IMAGE PROCESSING**	**9 Periods**
Color Models (RGB, CMY, HSV, HSI), Color Transformations, Pseudocolor Image Processing, Full-color Image Processing Color Image Smoothing and Sharpening. **Image Segmentation** - Point, Line, and Edge Detection, Roberts, Prewitt, Sobel, Canny Thresholding (Global, Adaptive),Region-based Segmentation, Watershed Segmentation		
Unit – V	**IMAGE COMPRESSION**	**9 Periods**
Need for Compression, Lossless Compression Techniques (Huffman, Run-length), Lossy Compression Techniques (JPEG, Transform Coding), Basics of Video Compression (MPEG). Feature Extraction (SIFT, SURF, HOG), Pattern Recognition Basics		

Total: 45 Periods

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Reference Books:	1.Rafael C. Gonzalez and Richard E. Woods," Digital Image Processing", Pearson Education, 4th Edition 2.Anil K. Jain," Fundamentals of Digital Image Processing", Prentice Hall.

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the fundamentals of digital images and image processing systems.	Understand (K2)
CO2	Apply spatial and frequency domain techniques for image enhancement.	Apply (K3)
CO3	Analyze and implement image restoration and noise reduction techniques.	Analyze (K4)
CO4	Perform color image processing and understand color model.	Apply (K3)
CO5	Understand and apply image compression methods.	Understand (K2)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO5	3	3	3	-	-	-	-	-	-	-	-	-	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23OEC07 INTERNET OF THINGS

Prerequisite	Programme Name	Sem	Category	L	T	P	C
NIL	All programmes except B.E - ECE	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1	To understand the evolution, architectures, and core functional stack of the Internet of Things including fog, edge, and cloud computing.
2	To explore the key components of an IoT ecosystem such as sensors, actuators, control units, and communication modules.
3	To study IoT protocols, wireless sensor networks, and enabling technologies including big data and cloud computing.
4	To learn IoT deployment and programming on platforms like Raspberry Pi and Arduino, including interfacing and cloud connectivity.
5	To analyze various IoT applications across smart cities, industry, health, environment, agriculture, and home automation.

III - Course Content

Unit – I	INTRODUCTION TO INTERNET OF THINGS	9 Periods
Evolution of Internet of Things – Enabling Technologies – IoT Architectures: oneM2M, IoT World Forum (IoTWF) and Alternative IoT Models – Simplified IoT Architecture and Core IoT Functional Stack – Fog, Edge and Cloud in IoT.		
Unit – II	**COMPONENTS IN INTERNET OF THINGS**	**9 Periods**
Functional Blocks of an IoT Ecosystem – Sensors, Actuators, and Smart Objects – Control Units - Communication modules (Bluetooth, Zigbee,Wifi, GPS, GSM Modules).		
Unit – III	**PROTOCOLS AND TECHNOLOGIES BEHIND IoT**	**9 Periods**
IoT Protocols - IPv6, 6LoWPAN, MQTT, CoAP - RFID, Wireless Sensor Networks, Big Data Analytics, Cloud Computing, Embedded Systems.		
Unit – IV	**OPEN PLATFORMS AND PROGRAMMING**	**9 Periods**
IoT deployment for Raspberry Pi /Arduino platform-Architecture –Programming – Interfacing – Accessing GPIO Pins – Sending and Receiving Signals Using GPIO Pins – Connecting to the Cloud.		
Unit – V	**IoT APPLICATIONS**	**9 Periods**
Business models for the internet of things, Smart city, Smart mobility and transport, Industrial IoT, Smart health, Environment monitoring and surveillance – Home Automation – Smart Agriculture.		

Total: 45 Periods

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Reference Books:	1. Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", CISCO Press, 2017 2. Samuel Greengard, The Internet of Things, The MIT Press, 2015. 3. Perry Lea, "Internet of things for architects", Packt, 2018. 4. Olivier Hersent, David Boswarthick, Omar Elloumi , "The Internet of Things – Key applications and Protocols", Wiley, 2012. 5. Olivier Hersent, David Boswarthick, Omar Elloumi , "The Internet of Things – Key applications and Protocols", Wiley, 2012. 6. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), "Architecting the Internet of Things", Springer, 2011. 7. ArshdeepBahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, 2015

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Explain the concept of IoT.	Understand (K2)
CO2	Understand the communication models and various protocols for IoT.	Understand (K2)
CO3	Design portable IoT using Arduino/Raspberry Pi /open platform.	Understand (K2)
CO4	Apply data analytics and use cloud offerings related to IoT.	Analyze (K4)
CO5	Explain applications of IoT in real time scenario.	Apply (K3)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO5	3	3	3	-	-	-	-	-	-	-	-	-	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23OEC08 SENSORS AND ACTUATORS

Prerequisite	Programme Name	Sem	Category	L	T	P	C
NIL	All programmes except B.E - ECE	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1	To understand sensor functions, classifications, calibration methods, and principles of transduction with error analysis.
2	To study the principles, construction, and applications of variable resistance and inductance sensors like strain gauges and LVDTs.
3	To explore variable capacitance sensors, piezoelectric, Hall effect, semiconductor sensors, and environmental sensors.
4	To examine various automotive actuators including electromechanical and fluid-mechanical types and their machine ratings.
5	To analyze different actuators used in automatic temperature control systems and their operational characteristics.

III - Course Content

Unit – I	**INTRODUCTION TO MEASUREMENTS AND SENSORS**	**9 Periods**
Sensors: Functions- Classifications- Main technical requirement and trends Units and standards Calibration methods- Classification of errors- Error analysis- Limiting error- Probable error Propagation of error- Odds and uncertainty- principle of transduction-Classification.		
Unit – II	**VARIABLE RESISTANCE AND INDUTANCE SENSORS**	**9 Periods**
Principle of operation- Construction details- Characteristics and applications of resistive potentiometer- Strain gauges- Resistive thermometers- Thermistors- Piezoresistive sensors Inductive potentiometer and LVDT.		
Unit – III	**VARIABLE AND OTHER SPECIAL SENSORS**	**9 Periods**
Variable Resistance Sensors, Variable Capacitance and variable permittivity type- capacitor microphone Piezoelectric, Magnetostrictive, Hall Effect, semiconductor sensor- digital transducers-Humidity Sensor. Rain sensor, climatic condition sensor, solar, light sensor, antiglare sensor.		
Unit – IV	**AUTOMOTIVE ACTUATORS**	**9 Periods**
Electromechanical actuators- Fluid-mechanical actuators- Electrical machines- Direct-current machines- Three-phase machines- Single-phase alternating-current Machines - Duty-type ratings for electrical machines.		
Unit – V	**AUTOMATIC TEMPERATURE CONTROL ACTUATORS**	**9 Periods**
Different types of actuators used in automatic temperature control- Fixed and variable displacement temperature control		

Total: 45 Periods

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Reference Books:	1. Ernest O. Doebelin, Dhanesh N.Manik Doebelin's Measurement Systems: 7th Edition (SIE), McGraw Hill Publishers, 2019. 2. Robert Brandy, " Automotive Electronics and Computer System", Prentice Hall,2001 3. William Kimberley," Bosch Automotive Handbook", 6th Edition, Robert Bosch GmbH, 2004. 4. Bosch Automotive Electrics and Automotive Electronics Systems and Components, Networking and Hybrid Drive, 5th Edition, 2007, ISBN No: 978-3-658-01783-5. 5. James D Halderman, " Automotive Electrical and Electronics", Prentice Hall, USA, 2013 6. Tom Denton, "Automotive Electrical and Electronics Systems," Third Edition, 2004, SAE International. 7. Patranabis.D, " Sensors and Transducers", 2nd Edition, Prentice Hall India Ltd, 2003 8. William Ribbens, "Understanding Automotive Electronics -An Engineering Perspective", 7th Edition, Elsevier Butterworth-Heinemann Publishers, 2012.

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	List common types of sensor and actuators used in vehicles.	Understand (K2)
CO2	Design measuring equipment's for the measurement of pressure force, temperature and flow.	Apply (K3)
CO3	Generate new ideas in designing the sensors and actuators for automotive application.	Apply (K3)
CO4	Understand the operation of the sensors, actuators and electronic control.	Understand (K2)
CO5	Explain temperature control actuators for vehicles.	Apply (K3)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO5	3	3	3	-	-	-	-	-	-	-	-	-	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

Chairperson-Board of Studies,
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I - Course Name: 23OEC09 FUNDAMENTALS OF WEARABLE DEVICES

Prerequisite	Programme Name	Sem	Category	L	T	P	C
NIL	All programmes except B.E - ECE	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1	To introduce wearable devices, their evolution, types, sensors, applications, and industry trends.
2	To understand physiological and motion data, basic wearable sensors, biological signals, and user interaction techniques.
3	To explore wireless health systems, body area networks, integration with smartphones/cloud, and security concerns.
4	To study wearable applications in healthcare, fitness, rehabilitation, and assistive technologies for special needs.
5	To examine wearable technology in defense, environmental monitoring, smart lifestyles, and advanced wearable robotics.

III - Course Content

Unit – I	INTRODUCTION TO WEARABLE DEVICES	9 Periods
Introduction to wearable devices – Evolution of wearable computing – Types of wearable devices: Smart watches, Fitness trackers, Smart garments, AR/VR devices – Basic classification of wearable sensors – Applications in healthcare, sports, education, safety, and entertainment – Overview of industry trends and future scope.		
Unit – II	**WEARABLE DATA AND USER INTERFACE**	**9 Periods**
Physiological and motion data: heart rate, steps, sleep, temperature – Introduction to basic sensors: Accelerometers, Gyroscopes – Overview of biological signals: ECG, EEG, EMG – Data visualization techniques – User interaction: Haptic feedback, Gesture and Voice control – Mobile app interfaces and feedback system.		
Unit – III	**WIRELESS HEALTH SYSTEMS**	**9 Periods**
Wireless technologies: Bluetooth, Wi-Fi, NFC – Overview of Body Area Networks (BAN) – Integration with smartphones and cloud platforms – Wearable system components: Processing units, batteries, displays – Data synchronization and storage – Privacy and security in wearable systems – Popular wearable platforms		
Unit – IV	**HEALTHCARE, FITNESS AND ASSISTIVE APPLICATIONS**	**9 Periods**
Wearable devices in healthcare – ECG, EEG, EMG monitoring – Chronic disease and elderly care – Smart patches and glucose monitoring – Fitness tracking: step count, heart rate, calorie burn – Gait and posture analysis – Physiotherapy and rehabilitation – Assistive wearables for visually and hearing-impaired – Industrial wearables: fatigue sensors, gas detectors, smart helmets.		
Unit – V	**DEFENSE, ENVIRONMENT AND SMART LIFESTYLE APPLICATIONS**	**9 Periods**
Wearables in military and defense – Smart uniforms – Soldier health monitoring – Wearable GPS and tracking – Body-worn cameras – Exosuits and wearable robotics – Environmental monitoring: UV, gas, and pollution – Smart textiles and LED garments – Haptic wearables for VR and gaming – Navigation aids and safety devices for visually impaired, children, and elderly.		

Total: 45 Periods

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Reference Books:	1.Ramfis Nieto, "Designing Wearable Systems: Concepts and Implementation", McGraw-Hill, 2019. 2.John A. Rogers and Roozbeh Ghaffari, "Bio-integrated Electronics: Materials, Systems, and Applications", Cambridge University Press, 2019.

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the fundamentals and evolution of wearable technology.	Understand (K2)
CO2	Explain the types of data and sensors used in wearable systems.	Understand (K2)
CO3	Explain the system components and connectivity of wearable devices.	Understand (K2)
CO4	Recognize smart textile concepts and user-centered wearable designs.	Understand (K2)
CO5	Analyze real-world applications and future developments in wearables.	Understand (K2)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO5	3	3	3	-	-	-	-	-	-	-	-	-	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23OEC010 WIRELESS SENSOR NETWORKS

Prerequisite	Programme Name	Sem	Category	L	T	P	C
NIL	All programmes except B.E - ECE	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1	To introduce wireless sensor networks, their architectures, node components, topologies, and short-range wireless standards.
2	To study MAC and routing protocols tailored for wireless sensor networks with an emphasis on energy efficiency and performance trade-offs.
3	To understand the 6LoWPAN architecture and integration of IPv6 in low power and lossy networks including routing and mobility support.
4	To explore application design issues, QoS requirements, energy management, and middleware protocols in WSNs.
5	To learn simulation tools and programming frameworks such as TinyOS, NesC, Contiki OS, and their use in WSN development and testing.

III - Course Content

Unit – I	INTRODUCTION	9 Periods
Introduction to Wireless Sensor Networks – Motivation, Applications, and Challenges, Comparison with Ad Hoc Networks, Node Architecture – Sensor Node Components, Network Architecture – Types of Topologies, Design Principles, Service Interfaces, and Gateway Concepts, Short Range Wireless Communication Standards: IEEE 802.15.4, Zigbee, Bluetooth, Physical Layer and Transceiver Design Considerations.		
Unit – II	**MAC AND ROUTING PROTOCOLS**	**9 Periods**
MAC Protocols – Fundamentals, Low Duty Cycle Protocols, Wakeup Concepts Contention and Schedule-Based Protocols – SMAC, BMAC, TRAMA Routing Protocols – Design Requirements, Classification SPIN, Directed Diffusion, LEACH, PEGASIS Routing Metrics and Performance Trade-offs.		
Unit – III	**6LoWPAN AND IPV6 INTEGRATION**	**9 Periods**
6LoWPAN Architecture – Protocol Stack and Adaptation Layer Link Layer Addressing and Routing (Mesh-Under, Route-Over) Header Compression – Stateless & Context-Based Fragmentation and Reassembly Mobility Support: Mobile IPv6, Proxy Mobile IPv6, Proxy Home Agent Routing for Low Power and Lossy Networks – ROLL, Border Routing, MANET Integration		
Unit – IV	**Application Design Issues**	**9 Periods**
Application Design Issues – End-to-End, Real-Time Streaming, Publish/Subscribe Web Services and Middleware Protocol Paradigms Common Protocols – MQTT-S, ZigBee CAP, SNMP.		
Unit – V	**QoS/Energy Management**	9 Periods
Real-time Transport QoS Requirements – Delay, Reliability, Throughput Energy Management – Power-aware MAC and Routing, Battery and Transmission Management Trade-offs Between QoS and Energy Efficiency.		

Total: 45 Periods

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Reference Books:	1. Holger Karl , Andreas willig, "Protocol and Architecture for Wireless Sensor Networks", John Wiley Publication, 2006. 2. Anna Forster, "Introduction to Wireless Sensor Networks", Wiley, 2017. 3. Zach Shelby Sensinode and Carsten Bormann, " 6LoWPAN: The Wireless Embedded Internet" John Wiley and Sons, Ltd, Publication, 2009. 4. Philip Levis, "TinyOS Programming", 2006 –www.tinyos.net. 5. The Contiki Operating System. http://www.sics.se/contiki.

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	To be able to design solutions for WSNs applications.	Apply (K3)
CO2	To be able to develop efficient MAC and Routing Protocols	Analyze (K4)
CO3	To be able to design solutions for 6LOWPAN applications.	Apply (K3)
CO4	To be able to develop efficient layered protocols in 6LOWPAN	Analyze (K4)
CO5	To be able to use Tiny OS and Contiki OS in WSNs and 6LOWPAN applications	Apply (K3)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO5	3	3	3	-	-	-	-	-	-	-	-	-	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

Chairperson-Board of Studies,
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I - Course Name: 23OEE01 AI WITH MAT LAB

Prerequisite	Programme Name	Semester	Category	L	T	P	C
NIL	All programmes except B.E - EEE	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1	To introduce the fundamentals of Artificial Intelligence and its real-world applications.
2	To familiarize students with the MATLAB environment for AI development.
3	To develop the ability to implement AI algorithms such as search methods, knowledge representation, and reasoning.
4	To apply machine learning techniques using MATLAB toolboxes.
5	To enable students to design and simulate AI-based systems using MATLAB.

III - Course Content

Preamble: This course introduces core concepts of Artificial Intelligence and equips students with practical skills to implement AI techniques using MATLAB for real-world problem solving.		
Unit – I	**Introduction to AI and MATLAB**	**9 Periods**
Basics of Artificial Intelligence – History, Applications, and Challenges- Overview of MATLAB – Environment, Scripts, Functions - Data handling and visualization in MATLAB - Introduction to MATLAB toolboxes for AI - Simple AI programs using MATLAB		
Unit – II	**Problem Solving and Search Techniques**	**9 Periods**
Uninformed Search: BFS, DFS, Depth-Limited Search - Informed Search: A*, Best-First Search, Heuristic Functions - Constraint Satisfaction Problems - Implementation of search strategies in MATLAB - Case studies using AI search in MATLAB		
Unit – III	**Knowledge Representation and Reasoning**	**9 Periods**
Propositional and Predicate Logic - Rule-Based Systems and Inference Mechanisms - Forward and Backward Chaining - Uncertainty and Probabilistic Reasoning - MATLAB implementation of logical reasoning systems		
Unit – IV	**Machine Learning with MATLAB**	**9 Periods**
Supervised Learning: Regression, Classification - Unsupervised Learning: Clustering Techniques - Dimensionality Reduction and Data Preprocessing - Introduction to MATLAB Machine Learning Toolbox - Case studies: Fault detection, Image classification		
Unit – V	**Neural Networks and Fuzzy Logic Systems**	**9 Periods**
Basics of Artificial Neural Networks (ANNs) - Designing and Training Neural Networks in MATLAB - Introduction to Fuzzy Logic and Fuzzy Inference Systems - Building Fuzzy systems using MATLAB Fuzzy Logic Toolbox - Applications in control systems, prediction, and decision-making.		

Total: 45 Periods

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Text Books:	1. Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach, 4th US edition", Pearson Education, 2022. 2. Phil Kim, MATLAB Deep Learning: With Machine Learning, Neural Networks and Artificial Intelligence: A practical guide for AI and deep learning with MATLAB, Apress, 2017.
MOOC/Web Platforms:	https://www.mathworks.com/products/artificial-intelligence.html https://www.mathworks.com/learn/tutorials/matlab-onramp.html https://www.mathworks.com/matlabcentral/fileexchange/ https://www.coursera.org/learn/ai-for-everyone https://www.mathworks.com/services/training.html

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand and explain key concepts of Artificial Intelligence and their applications.	Understand (K2)
CO2	Implement AI techniques including search algorithms and knowledge-based systems using MATLAB.	Apply (K3)
CO3	Apply machine learning models in MATLAB for classification, clustering, and regression tasks.	Apply (K3)
CO4	Develop intelligent systems using neural networks and fuzzy logic in MATLAB.	Apply (K3)
CO5	Simulate and analyze AI-driven solutions for practical engineering problems.	Apply (K3)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	1	-	-	-	-	1	-	-	1	1
CO2	3	3	3	2	1	-	-	-	-	1	-	-	1	1
CO3	3	3	3	2	1	-	-	-	-	1	-	-	1	1
CO4	3	3	2	2	2	-	-	-	-	1	-	-	1	1
CO5	3	3	2	2	2	-	-	-	-	1	-	-	1	1

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23OEE02 APPLIED SOFT COMPUTING

Prerequisite	Programme Name	Semester	Category	L	T	P	C
NIL	All programmes except B.E - EEE	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1	To introduce the basic principles and scope of soft computing techniques such as fuzzy logic, neural networks, and genetic algorithms.
2	To impart knowledge on fuzzy set theory and fuzzy logic controllers, including their application in electrical engineering.
3	To explore the structure, learning methods, and practical applications of neural networks.
4	To understand the functioning of genetic algorithms and how they are applied to electrical engineering problems.
5	To train students in using MATLAB toolboxes for implementing fuzzy logic, neural networks, and genetic algorithms in real-world electrical problems.

III - Course Content

Unit – I	**INTRODUCTION**	**9 Periods**
Introduction to soft computing - Fuzzy logic, Neural Network and Genetic algorithm		
Unit – II	**FUZZY LOGIC**	**9 Periods**
Fuzzy sets, logic operations, and relations; Fuzzy decision-making; fuzzy inference systems; design steps in fuzzy logic controller; application of fuzzy logic controller in Electrical engineering		
Unit – III	**NEURAL NETWORKS**	**9 Periods**
Basic concepts and major classes of neural networks, supervised and unsupervised learning, Single-layer perceptron, multi-layer perceptron, Back Propagation Neural network, RBF networks. Application of neural network modelling / control problems in Electrical engineering		
Unit – IV	**GENETIC ALGORITHMS**	**9 Periods**
Introduction - genetic algorithm steps-Selection, Crossover and Mutation; Application of GA to Electrical engineering problems.		
Unit – V	**APPLICATION**	**9 Periods**
Use of MATLAB Fuzzy logic, Neural network and GA toolboxes to solve electrical engineering problems		

Total: 45 Periods

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Text Books:	1. S.N. Sivanandam & S.N. Deepa, Principles of Soft Computing, Wiley India Pvt. Ltd., 2nd Edition, 2011. 2. Timothy J. Ross,Fuzzy Logic with Engineering Applications, Wiley, 4th Edition, 2020.
Reference Books:	1. Simon Haykin,Neural Networks and Learning Machines,Pearson Education, 3rd Edition, 2008. 2. David E. Goldberg,Genetic Algorithms in Search, Optimization, and Machine Learning,Pearson Education, 1989. 3. Satish Kumar,Neural Networks: A Classroom Approach,McGraw-Hill Education, 2nd Edition, 2017. 4. J.S.R. Jang, C.T. Sun, and E. Mizutani, Neuro-Fuzzy and Soft Computing: A Computational Approach to Learning and Machine Intelligence,Pearson Education, 2004.
MOOC/Web Platforms:	https://onlinecourses.nptel.ac.in/noc22_cs54/preview

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Explain the fundamental concepts and components of soft computing.	Understand (K2)
CO2	Design and apply fuzzy logic systems in electrical engineering contexts.	Apply (K3)
CO3	Construct and use neural network models for analysis and control tasks in electrical systems.	Analyze (K4)
CO4	Implement genetic algorithm procedures for solving electrical engineering optimization problems.	Apply (K3)
CO5	Apply MATLAB tools to model and solve real-time electrical engineering problems using soft computing techniques.	Apply (K3)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	1	-	-	-	-	1	-	-	-	1	-
CO2	3	3	3	2	1	-	-	-	-	1	-	-	-	1	-
CO3	3	3	3	2	1	-	-	-	-	1	-	-	-	1	-
CO4	3	3	2	2	2	-	-	-	-	1	-	-	-	1	-
CO5	3	3	2	2	2	-	-	-	-	1	-	-	-	1	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23OEE03 ELECTRIC VEHICLE TECHNOLOGY

Prerequisite	Programme Name	Semester	Category	L	T	P	C
NIL	All programmes except B.E - EEE	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1	To understand the principles of electromechanical energy conversion and the characteristics of various electrical machines used in electric and hybrid electric vehicles.
2	To analyze the operation and characteristics of different types of power electronic converters and their applications in motor drive systems.
3	To study the control strategies for DC and AC motor drives including advanced techniques used in electric vehicle propulsion systems.
4	To explore the architecture, powertrain components, and energy storage systems used in hybrid and electric vehicles.
5	To apply the fundamentals of vehicle mechanics for analyzing drive cycles, powertrain sizing, and implementing control and energy management strategies in hybrid electric vehicles.

III - Course Content

Unit – I	**ROTATING POWER CONVERTERS**	**9 Periods**
Magnetic Circuits and Electromechanical Energy Conversion- DC Machines- AC Machines- Special Electrical Machines (BLDC, PMSM & SRM)- Power Electronic Converters for Motor Drives- Applications in Electric Vehicles and Renewable Energy Systems		
Unit – II	**STATIC POWER CONVERTERS**	**9 Periods**
Working and Characteristics of Power Diodes, MOSFET and IGBT. Working of uncontrolled rectifiers, controlled rectifiers (Single phase and three phase), DC choppers, single and three phase inverters, Multilevel inverters, and Matrix Converters.		
Unit – III	**CONTROL OF DC AND AC MOTOR DRIVES**	**9 Periods**
Fundamentals of Electric Drive Dynamics-DC Motor Drive Control (Chopper, four quadrant) - Induction Motor Drives (v/f, Inverter - fed) - Vector Control of AC Motors (IM, PMSM)-BLDC -SRM - Advanced Control and Implementation Techniques		
Unit – IV	**HYBRID ELECTRIC VEHICLE ARCHITECTURE AND POWER TRAIN COMPONENTS**	**9 Periods**
Evolution and Classification of Electrified Vehicles – Comparison – Powertrain Components and Energy Storage – Mechanical Subsystems of Powertrain - Advanced Technologies and Trends		
Unit – V	**MECHANICS OF HYBRID ELECTRIC VEHICLES AND CONTROL OF VEHICLES**	**9 Periods**
Fundamentals of Vehicle Mechanics - Drive Cycle Analysis and Powertrain Sizing - Hybrid Electric Vehicle Architectures – supervisory Control and Energy Management – Advanced Control Strategies - Intelligent Vehicle Control and Integration		

Total: 45 Periods

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Text Books:	1. Stephen D. Umans, "Fitzgerald & Kingsley's Electric Machinery", Tata McGraw Hill, 7th Edition, 2020. 2. Bogdan M. Wilamowski, J. David Irwin, The Industrial Electronics Handbook, Second Edition, Power Electronics and Motor Drives, CRC Press, 2011
Reference Books:	1. Paul C. Krause, Oleg Wasynczuk, Scott D. Sudhoff, Steven D. Pekarek "Analysis of Electric Machinery and Drive Systems", 3rd Edition, Wiley-IEEE Press, 2013. 2. Rashid M.H., "Power Electronics Circuits, Devices and Applications ", Pearson, fourth Edition, 10th Impression 2021. 3. Iqbal Husain, 'Electric and Hybrid Electric Vehicles', CRC Press, 2021. 4. Wei Liu, 'Hybrid Electric Vehicle System Modeling and Control', Second Edition, WILEY, 2017 5. James Larminie and John Lowry, 'Electric Vehicle Technology Explained', Second Edition, Wiley, 2012

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the operating principles and characteristics special machines used in electric mobility	Understand (K2)
CO2	Analyze the structure and functionality of power semiconductor devices in electric vehicle applications	Analyze (K4)
CO3	Analyze the control strategies for DC and AC electric drives.	Analyze (K4)
CO4	Clarify the architecture of electric and hybrid electric vehicles and inverters.	Analyze (K4)
CO5	Apply the fundamentals of vehicle mechanics to evaluate energy requirements and hybrid electric vehicles.	Apply (K3)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	3	3	-	-	-	-	-	1	-	-
CO2	3	3	-	-	-	3	3	-	-	-	-	-	1	-	-
CO3	3	3	-	2	-	3	3	-	-	-	-	-	1	-	-
CO4	3	3	2	2	-	3	3	-	-	-	-	-	1	-	-
CO5	3	2	-	-	-	3	3	-	-	-	-	-	1	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23OEE04 ELECTRICAL SAFTEY

Prerequisite	Programme Name	Semester	Category	L	T	P	C
NIL	All programmes except B.E - EEE	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1	To introduce the fundamental concepts of electrical safety, including the nature of electrical shocks and preventive measures.
2	To familiarize students with national and international electrical safety standards, codes, and statutory requirements.
3	To provide knowledge on electrical protection methods, maintenance procedures, and first aid techniques for electrical hazards.
4	To equip students with the skills to conduct energy audits for various electrical systems and recommend energy-saving techniques.
5	To develop an understanding of safety management practices, policies, and motivation strategies to foster a safety-oriented workplace.

III - Course Content

Unit – I	INTRODUCTION TO ELECTRICAL SAFETY, SHOCKS AND THEIR PREVENTION	9 Periods
Review of Electrical concept, Electrostatic – Electro magnetism – Electrical Hazards – Energy leakage – Clearance and insulation – Current surges – Electrical causes of fire and explosion – Human interface with electricity – Human resistance to electricity		
Unit – II	**STANDARDS AND REQUIREMENTS**	**9 Periods**
National electrical Safety code - Standards and statutory requirements – Indian electricity acts and rules – statutory requirements from Electrical inspectorate. Hazardous area classification and Classification of electrical equipment for hazardous areas (IS, NFPA, API and OSHA standards).		
Unit – III	**ELECTRICAL PROTECTION AND MAINTENANCE**	**9 Periods**
Selection of Environment, Protection and Interlock – Discharge rods and earthing device – Safety in the use of portable tools - Preventive maintenance. First aid-Cardio Pulmonary Resuscitation (CPR).		
Unit – IV	**ENERGY AUDIT OF ELECTRICAL SYSTEMS**	**9 Periods**
Instruments for energy audit - energy audit of heating, ventilation and air conditioning systems - energy audit of compressed air systems - energy audit of buildings - energy audit of electric drive utilities-energy efficient electrical systems- types and tips for improvement in industry.		
Unit – V	**SAFETY MANAGEMENT OF ELECTRICAL SYSTEMS**	**9 Periods**
Principles of Safety Management, Management Safety Policy, Safety organization, safety auditing, Motivation to managers, supervisors, employees towards safety.		

Total: 45 Periods

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Text Books:	1. John Codick, "Electrical safety handbook", 4th Edition, McGraw Hill Professional, 2012, New Delhi. 2. C.S. Raju, "A Practical Book on domestic safety", Sri Sai Publisher, Chennai - 2003. 3. Power Engg. Hand book, TNEB Engineers officers, Chennai-2002.
Reference Books:	1. Rao - R.C, Khanna, "Electrical safety, Fire safety engineering and safety management", 2nd Edition, Khanna Publisher, 2012, New Delhi. 2. Trivedi P.R., Jolka B.R., "Energy Management", Common Wealth Publishers, New Delhi, 1997. 3. Barney L. Capehart, Wayne C. Turner, and William J. Kennedy, Guide to Energy Management, Fifth Edition, The Fairmont Press, Inc., 2006

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Identify various electrical hazards and explain methods for preventing electrical shocks and fire incidents.	Understand (K2)
CO2	Interpret and apply national and international electrical safety standards and statutory requirements in real-world scenarios.	Apply (K3)
CO3	Demonstrate appropriate electrical protection techniques and perform basic preventive maintenance and emergency first aid (CPR).	Apply (K3)
CO4	Conduct energy audits in electrical systems and recommend measures for improving energy efficiency in industrial and building applications.	Analyze (K4)
CO5	Implement principles of electrical safety management and develop safety policies, audit strategies, and motivation techniques in organizations.	Apply (K3)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	3	3	-	-	-	-	-	1	-	-
CO2	3	3	-	-	-	3	3	-	-	-	-	-	1	-	-
CO3	3	3	-	2	-	3	3	-	-	-	-	-	1	-	-
CO4	3	3	2	2	-	3	3	-	-	-	-	-	1	-	-
CO5	3	2	-	-	-	3	3	-	-	-	-	-	1	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

Chairperson-Board of Studies,
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(Autonomous),
Natham, Dindigul - 624401

I - Course Name: 23OEE05 E-WASTE MANAGEMENT

Prerequisite	Programme Name	Semester	Category	L	T	P	C
NIL	All programmes except B.E - EEE	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1	Gaining knowledge about the current state of e-waste generation, collection, and disposal, both globally and in specific regions.
2	Learning about the potential risks associated with e-waste, including the release of hazardous materials and their impact on ecosystems and human health.
3	Studying national and international laws and regulations governing e-waste management, such as the E-Waste (Management) Rules.
4	Learning about the emerging technologies and green chemistry
5	Exploring various methods for reducing, reusing, recycling, and responsibly disposing of e-waste, including techniques for material recovery and waste minimization.

III - Course Content

Unit – I	**GENERAL CONCEPTS TO E WASTE AND E-WASTE MANAGEMENT**	**9 Periods**
Introduction and general concepts to e-waste and e-waste management; Principle and standards for the disposal; Life cycle and Performance assessment and understanding		
Unit – II	**HEALTH EFFECTS OF E-WASTE POLLUTION**	**9 Periods**
Health Effects of E-waste Pollution; Global Trends of E-waste Pollution and Its Impact on Environment		
Unit – III	**MATERIAL RECYCLING AND PROCESSING TECHNIQUES**	**9 Periods**
E-waste: Global Scenario, Constituents, and Biological Strategies for Remediation Materials Recycling Considerations Processing Techniques		
Unit – IV	**GREEN CHEMISTRY**	**9 Periods**
Emerging Technologies Bioremediation Approaches e-factor concept in green chemistry Case studies: implementation of e-waste recycling		
Unit – V	**RECYCLING PROCESS**	**9 Periods**
Recycling Processes and Plastic in e-waste is an emerging problem for India: Implications for Future Prospect		

Total: 45 Periods

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Text Books:	1. Hugo Marcelo Veit and Andréa Moura Bernardes, "Electronic Waste: Recycling Techniques" Springer 2015. 2. Johri R., E-waste: implications, regulations, and management in India and current global best practices, TERI Press, New Delhi
Reference Books:	1. Hester R.E., and Harrison R.M, Electronic Waste Management. Science, 2009 2. Muammer Kaya, "Electronic Waste and Printed Circuit Board Recycling Technologies", Sringer 2019. 3. Muhammad Zaffar Hashmi and Ajit Varma, "Electronic Waste Pollution: Environmental Ocrrence and Treatment Technologies", Springer 2019. 4. Lifeng Zhang andGregory K. Krumdick, "Recycling of Electronic Waste II", iley 2011. 5. Fowler B, Electronic Waste – 1 st Edition (Toxicology and Public Health Issues), 2017Elsevier
MOOC/Web Platforms:	https://news.mit.edu/2013/ewaste-mit

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the environmental impacts of e-waste.	Understand (K2)
CO2	Apply concepts of e-waste management hierarchy.	Apply (K3)
CO3	Distinguish the role of various national and internal act and laws applicable for e-waste management and handling.	Analyze (K4)
CO4	Analyze the e – waste management measures proposed under national ar global legislations.	Analyze (K4)
CO5	To assess the overall sustainability of e-waste, considering the three pillars: environmental, economic, and energy.	Understand (K2)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	3	3	-	-	-	1	-	-	-	-
CO2	3	3	-	-	-	3	3	-	-	-	1	-	-	-	-
CO3	3	3	-	2	-	3	3	-	-	-	1	-	-	-	-
CO4	3	3	2	2	-	3	3	-	-	-	1	-	-	-	-
CO5	3	2	-	-	-	3	3	-	-	-	1	-	-	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23OEE06 INDUSTRIAL AUTOMATION

Prerequisite	Programme Name	Semester	Category	L	T	P	C
NIL	All programmes except B.E - EEE	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1	To introduce the fundamentals of industrial automation systems, including their architecture and essential communication protocols such as Modbus and Profibus.
2	To familiarize students with key automation components like sensors, actuators, process control valves, and power electronic devices used in industrial systems.
3	To impart knowledge on computer-aided measurement and control systems, including data acquisition, process interfaces, and industrial communication systems.
4	To develop the ability to program, configure, and implement Programmable Logic Controllers (PLCs) in industrial process control and automation applications.
5	To understand the structure and operation of Distributed Control Systems (DCS), including software configurations, communication protocols, and integration with other automation systems.

III - Course Content

Unit – I	INTRODUCTION	9 Periods
Basics of industrial automation, Requirement of automation systems, Architecture of Industrial Automation system, Introduction of PLC and supervisory control and data acquisition (SCADA)- Flexible manufacturing system (FMS) - Industrial bus systems: Modbus & Profibus		
Unit – II	**AUTOMATION COMPONENTS**	**9 Periods**
Measurement Systems Characteristics - Sensors for temperature, pressure, force, displacement, speed, flow, level, humidity and pH measurement. Actuators, process control valves, power electronics devices DIAC, TRIAC, power MOSFET and IGBT. Introduction of DC and AC servo drives for motion control.		
Unit – III	**COMPUTER AIDED MEASUREMENT AND CONTROL SYSTEMS**	**9 Periods**
Role of computers in measurement and control, Elements of computer aided measurement and control, man- machine interface, computer aided process control hardware, process related interfaces, Communication and networking, Industrial communication systems, Data transfer techniques, Computer aided process control software, Computer based data acquisition system, Advanced automation functions, Levels of automations, Automated flow lines and transfer mechanisms - Analysis of transfer lines without storage, Automated flow lines with storage buffers		
Unit – IV	**PROGRAMMABLE LOGIC CONTROLLERS**	**9 Periods**
Programmable controllers, Programmable logic controllers, Analog digital input and output modules, PLC programming, Ladder diagram, Sequential flow chart, PLC Communication and networking, PLC selection, PLC Installation, Advantage of using PLC for Industrial automation, Application of PLC to process control Industries		
Unit – V	**DISTRIBUTED CONTROL SYSTEM**	**9 Periods**
Introductions to computer based industrial automation – Direct Digital Control (DDC) – DCS software configuration, DCS communication, DCS Supervisory Computer Tasks, DCS integration with PLC and Computers, Features of DCS, Advantages of DCS – Transport Automation		

Total: 45 Periods

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Text Books:	1. S.K.Singh, "Industrial Instrumentation", Tata Mcgraw Hill, 2nd edition companies,2003. 2. C D Johnson, "Process Control Instrumentation Technology", Prentice Hall India,8th Edition, 2006.
Reference Books:	1. E.A.Parr, Newnes ,NewDelhi,"Industrial Control Handbook",3rd Edition, 2000.

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the signal conditioning circuits for a variety of industrial and automation applications	Understand (K2)
CO2	Establish an in-depth understanding of data acquisition systems, interfacing techniques, and Distributed Control Systems (DCS).	Apply (K3)
CO3	Clarify the fundamentals and significance of communication buses used in applied automation engineering	Analyze (K4)
CO4	Understand the ladder logic and function block programs for PLCs using timers, counters, arithmetic, and logic instructions.	Analyze (K4)
CO5	Analyze the advanced PLC logic solutions for real- world industrial automation problems	Analyze (K4)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	-	3	3	-	-	-	-	-	1	-
CO2	3	3	-	-	-	3	3	-	-	-	-	-	1	-
CO3	3	3	-	2	-	3	3	-	-	-	-	-	1	-
CO4	3	3	2	2	-	3	3	-	-	-	-	-	1	-
CO5	3	2	-	-	-	3	3	-	-	-	-	-	1	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23OEE07 POWER PLANT INSTRUMENTATION

Prerequisite	Programme Name	Semester	Category	L	T	P	C
NIL	All programmes except B.E - EEE	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1	Understand the methods and instruments used for measuring metal temperature in boilers.
2	Understand different types of draught plants (natural, forced, induced, balanced) and their power requirements. Learn about fan drives, airflow control, and combustion control techniques.
3	Understand automation concepts specific to thermal power plants. Learn about boiler automation systems including diagnostic functions and protection mechanisms.
4	Understand the piping and instrumentation diagrams of different types of nuclear power plants.
5	Gain an introduction to Industrial Internet of Things (IIoT) applications in power plants. Understand smart grid technologies and their impact on power plant instrumentation.

III - Course Content

Unit – I	MEASUREMENT IN BOILER AND TURBINE	9 Periods
Metal temperature measurement in boilers, impulse-piping system for pressure measuring devices, flame monitoring. Introduction to turbine supervising system, pedestal vibration, shaft vibration, eccentricity measurement. Installation of non-contracting transducers for speed measurement, rotor and casing movement and expansion measurement.		
Unit – II	**CONTROLS IN BOILER**	**9 Periods**
Problems associated with control of multiple pulverizes. Draught plant: Introduction, natural draught, forced draught, induced draught, balanced draught, power requirements for draught systems. Fan drives and control, control of airflow. Combustion control: Fuel/Air ratio, oxygen, CO and CO2 trimming, combustion efficiency, excess air, parallel and cross limited combustion control, control of large systems.		
Unit – III	**AUTOMATION**	**9 Periods**
Automation: Thermal power plant, Boiler Automation – Diagnostic Functions and Protection – Digital Electro – Hydraulic Governor, Man-Machine Interface – Graphic Display of Automated Power plant.		
Unit – IV	**NUCLEAR POWER PLANT INSTRUMENTATION**	**9 Periods**
Piping and instrumentation diagram of different types of nuclear power plant, nuclear reactor control loops, reactor dynamics, excess reactivity, pulse channel and logarithmic instrumentation, control and safety instrumentation, reliability aspects.		
Unit – V	**EMERGING TRENDS AND APPLICATIONS**	**9 Periods**
Introduction to the Industrial Internet of Things (IIoT) in power plants. Smart grid technologies and their impact on instrumentation. Simulation and modeling of power plant system.		

Total: 45 Periods

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Text Books:	1. Philip Kiameh, Power Plant Instrumentation and Control Handbook 2. B. D. Taylor, 'Instrumentation for Engineers and Technicians 3. Modern Power Station Practice – British Electricity International
Reference Books:	1. Bela G. Liptak, Instrumentation in Industry 2. P.K. Nag, "Power Plant Engineering" 3. K.K. Ramalingam, "Power Plant Instrumentation"
MOOC/Web Platforms:	NPTEL (National Programme on Technology Enhanced Learning) Coursera (e.g., Energy Production, Distribution & Safety) edX (e.g., Smart Grids, Control Systems)

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Explain basic thermal power plant processes and layout	Understand (K2)
CO2	Identify and describe the operation of instrumentation devices in power plants	Apply (K3)
CO3	Analyze control strategies used in boiler and turbine operations	Analyze (K4)
CO4	Select appropriate control systems for different power plant functions	Analyze (K4)
CO5	Discuss advancements in combined cycle power generation	Understand (K2)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	3	2	-	-	-	-	-	-	-	-	-	-	-
CO5	2	2	-	-	3	-	-	-	-	-	-	-	-	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

Chairperson-Board of Studies,
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I - Course Name: 23OEE08 PRINCIPLES OF ROBOTICS

Prerequisite	Programme Name	Semester	Category	L	T	P	C
NIL	All programmes except B.E - EEE	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1	To introduce the fundamental components and mechanical structure of robotic systems.
2	To impart knowledge on spatial descriptions, coordinate transformations, and kinematic modeling using D-H parameters.
3	To analyze and design actuator and sensor systems for robotic control.
4	To develop trajectory planning techniques and implement control strategies.
5	To explore the integration of Artificial Intelligence and expert systems in robotics with real-world case studies.

III - Course Content

Preamble: This course provides a comprehensive understanding of robotic systems, focusing on their mechanical structure, kinematics, control, and programming. It emphasizes spatial transformations, actuator-sensor integration, and trajectory planning for manipulators. The course also explores the role of Artificial Intelligence in enhancing robotic capabilities through intelligent decision-making

Unit – I	FUNDAMENTALS OF ROBOT	9 Periods

Introduction: Fundamentals and robot - components, joints, degrees of freedom, coordinates. The mechanics & control of mechanical manipulators. Spatial Descriptions and Transformations: Descriptions – Positions, Orientations, and Frames, Mappings, Operators – Translations, Rotations, and Transformations, Transformation arithmetic and transform equations, transformation of free vectors, Representation & Orientation

Unit – II	REPRESENTATION AND KINEMATICS OF ROBOTIC STRUCTURES	9 Periods

Representation and Transformation of joints, links Mechanical Structure notations, Coordinate frames, Description of objects in space, Transformation and fundamental rotation matrices, Position and orientation of a rigid body, Homogeneous transformations, Representation of joints, link representation using D-H parameters, Kinematics: Forward kinematics of multi DOF manipulator - Inverse kinematics of 2DOF manipulator. Homogeneous transformation matrices, translation and rotation matrices

Unit – III	ELEMENTS OF ROBOTS	9 Periods

Position and orientation of a rigid body, Homogeneous transformations, Representation of joints, link representation using D-H parameters, Examples of D-H parameters and link transforms, different kinds of actuators – stepper, DC servo and brushless motors, model of a DC servo motor, Types of transmissions, Purpose of sensors, internal and external sensors, common sensors – encoders, tachometers, strain gauge based force-torque sensors, proximity and distance measuring sensors, and vision.

Unit – IV	TRAJECTORY PLANNING AND ROBOT PROGRAMMING	9 Periods

Trajectory planning, joint space techniques, cartesian space formulation. Control of manipulator, PID control scheme, computed torque control, force control of robotic manipulators. Robot Programming Robot Programming: Manual programming – Teach Pendant, Offline Programming - Welding, Online programming – Deburring, Palletizing and Inspection.

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Unit – V	AI AND ROBOTICS	9 Periods
Artificial Intelligence in Robotics Expert systems, Artificial Intelligence- Knowledge Representation, AI in Robotics, Case studies		

Total: 45 Periods

Text Books:	**1. John J. Craig,** *Introduction to Robotics: Mechanics and Control*, 4th Edition, Pearson Education, Boston, Massachusetts, 2022. ISBN: 978-0-13-784874-4. **2. Mark W. Spong, Seth Hutchinson, and M. Vidyasagar**, *Robot Modeling and Control*, 2nd Edition, Wiley, Hoboken, New Jersey, 2020. ISBN: 978-1-119-52404-5.
Reference Books:	1. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, 4th Edition, Pearson, Hoboken, New Jersey, 2020. ISBN: 978-0-13-461099-3. 2. Robert J. Schilling, Fundamentals of Robotics: Analysis and Control, 1st Edition, Pearson Education, Upper Saddle River, New Jersey, 1990. 3. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, 4th Edition, Pearson, Hoboken, New Jersey, 2020.
MOOC/Web Platforms:	https://archive.nptel.ac.in/courses/112/104/112104298/

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Identify and describe the fundamental components, joint types, and degrees of freedom in robotic systems.	Understand (K2)
CO2	Apply spatial transformation techniques to represent positions and orientations of robotic links and end-effectors.	Apply (K3)
CO3	Model robotic joints and links using Denavit-Hartenberg (D-H) parameters and solve forward and inverse kinematics problems.	Apply (K3)
CO4	Analyze and select appropriate actuators and sensors for robotic applications based on functionality and requirements.	Analyze (K4)
CO5	Design and implement trajectory planning and control schemes for robotic manipulators in both joint and Cartesian spaces.	Analyze (K4)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	-	-	-	-	-	1	-	-
CO2	3	3	2	2	-	-	-	-	1	-	1	-	1	-	-
CO3	3	3	3	2	1	-	-	-	1	-	1	-	1	-	-
CO4	3	2	3	2	-	-	-	-	1	-	1	-	1	-	-
CO5	3	2	2	3	2	-	-	-	2	-	2	-	1	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

Chairperson-Board of Studies,
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I - Course Name: 23OEC09 SENSORS AND TRANSDUCERS

Prerequisite	Programme Name	Semester	Category	L	T	P	C
NIL	All programmes except B.E - EEE	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1	To understand the concepts of measurement technology.
2	To learn the various sensors used to measure various physical parameters.
3	To learn the fundamentals of signal conditioning, data acquisition and communication systems used in mechatronics system development.

III - Course Content

Preamble: This course introduces the fundamental principles and types of sensors and actuators used in automotive and industrial applications. It covers sensor design, measurement techniques, and actuator control strategies including temperature and force control.

Unit – I	INTRODUCTION TO MEASUREMENTS AND SENSORS	9 Periods

Basics of Measurements – Classification of errors – Error analysis – Static and dynamic characteristics of transducers – Classification of sensors – Sensor calibration techniques – Sensor Output Signal Types- Performance measures of sensors.

Unit – II	VARIABLE RESISTANCE AND INDUTANCE SENSORS	9 Periods

Motion Proximity Sensors – Potentiometers, Resolver, Encoders – Optical, Magnetic, Inductive, Capacitive, Linear Varaiable transducer (LVDT) – Rotary Varaiable transducer RVDT – Synchro – Microsyn, Accelerometer.,– GPS, Bluetooth, Range Sensors – RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR)

Unit – III	VARIABLE AND OTHER SPECIAL SENSORS	9 Periods

Types of Strain Guage, Load Cell, Magnetic Sensors –principle, requirement and advantages: Magneto resistive – Hall Effect – Current sensor Heading Sensors – Compass, Gyroscope, Inclinometers.

Unit – IV	AUTOMOTIVE ACTUATORS	9 Periods

Photo resistive, Photo conductive cell, photo voltaic, LDR – Fiber optic sensors – Pressure – Diaphragm, Bellows, Piezoelectric – Tactile sensors, Temperature – IC, Thermistor, RTD, Thermocouple. Acoustic Sensors – flow and level measurement, Radiation Sensors - Smart Sensors - Film sensor, MEMS & Nano Sensors, LASER sensors.

Unit – V	AUTOMATIC TEMPERATURE CONTROL ACTUATORS	9 Periods

Sample and Hold circuits – Data Acquisition: Single channel and multi-channel data acquisition – Data logging - applications - Automobile, Aerospace, Home appliances, Manufacturing, Environmental monitoring

Total: 45 Periods

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Text Books:	1. Ernest O Doebelin, "Measurement Systems – Applications and Design", Tata McGraw-Hill, 2009. 2. Sawney A K and Puneet Sawney, "A Course in Mechanical Measurements and Instrumentation and Control", 12th edition, Dhanpat Rai & Co, New Delhi, 2013.
Reference Books:	1. Patranabis D, "Sensors and Transducers", 2nd Edition, PHI, New Delhi, 2010. 2. John Turner and Martyn Hill, "Instrumentation for Engineers and Scientists", Oxford Science Publications, 1999. 3. Richard Zurawski, "Industrial Communication Technology Handbook" 2nd edition, CRC Press, 2015.

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Expertise in various calibration techniques and signal types for sensors.	Understand (K2)
CO2	Apply the various sensors in the Automotive and Mechatronics applications.	Apply (K3)
CO3	Study the basic principles of various smart sensors.	Understand (K2)
CO4	Implement the DAQ systems with different sensors for real time applications.	Analyze (K4)
CO5	Analyze applications of advanced sensor technologies in smart systems.	Analyze (K4)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	1	-	-	-	-	-	-	-	-	-	1	-
CO2	2	2	3	-	-	-	-	-	-	-	-	-	1	-
CO3	1	-	2	-	-	-	-	-	-	-	-	-	1	-
CO4	2	2	3	2	1	-	-	-	-	-	-	-	1	-
CO5	2	2	2	3	2	-	-	-	-	-	-	-	1	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23OEE10 SOLAR AND WIND ENERGY RESOURCES

Prerequisite	Programme Name	Semester	Category	L	T	P	C
NIL	All programmes except B.E - EEE	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1	To introduce the fundamentals of solar energy, its availability, and its role in the renewable energy landscape.
2	To explain the working principles and performance characteristics of solar cells and photovoltaic technologies.
3	To enable students to understand the design, components, and operation of photovoltaic (PV) systems.
4	To provide foundational knowledge on wind energy, including wind resource assessment and conversion principles.
5	To familiarize students with different types of wind turbines and their performance characteristics in energy generation.

III - Course Content

Preamble: This course provides a comprehensive understanding of solar and wind energy as sustainable and renewable energy sources. It covers the fundamental principles, resource assessment, system components, and technologies for harnessing solar and wind power, preparing students to design and analyze efficient renewable energy systems for real-world applications.

Unit – I	INTRODUCTION TO SOLAR ENERGY	9 Periods

Basic characteristics of sunlight – solar spectrum – insolation specifics– irradiance and irradiation- pyranometer – Solar PV cell- Simplest equivalent circuit for a photovoltaic cell – Solar cells to modules, Solar cells to arrays I-V characteristics – P-V characteristics – fill factor.

Unit – II	PERFORMANCE OF SOLAR CELLS	9 Periods

Parameters of solar cells, solar cell technologies – Factors affecting electricity generated by a solar cell, Solar PV module, Standard PV module parameters, IV and PV characteristics of SPV module, Solar PV modules arrays – connection of modules in series and parallel

Unit – III	PHOTOVOLTAIC SYSTEMS	9 Periods

Introduction to Simplified grid connected PV systems, Current voltage curves for loads – DC motor IV curves - Battery IV curves – maximum power point trackers – hourly IV curves, grid connected systems

Unit – IV	INTRODUCTION TO WIND ENERGY	9 Periods

Nature of the wind – Types of wind turbines, power in the wind – factors influencing wind – wind energy potential and installation in India- wind speed monitoring - wind resource assessment -wind power laws - velocity and power duration curves - Betz limit - site selection.

Unit – V	WIND ENERGY CONVERSION TECHNIQUES	9 Periods

Wind energy conversion devices - classification, characteristics- Wind Turbine Generators Asynchronous (Induction) generator- Squirrel cage Induction generator, Wound rotor Induction generator- Optislip Induction generator- Doubly-fed Induction generator. Synchronous generator- Wound rotor generator- Permanent magnet generator, Indian standards

Total: 45 Periods

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Text Books:	1. Rai. G.D. "Non-Conventional Sources of Energy", Khanna Publishers, New Delhi, 2002. 2. Chetan Singh Solanki, 'Solar Photovoltaics: Fundamentals, Technologies, Applications' PHI Learning Publications, 2nd Edition, 2011.
Reference Books:	1. Solanki, C.S. "Solar Photovoltaic Technology and Systems", PHI learning Pvt. Ltd., New Delhi, 2013. 2. Rai. G.D. "Non-Conventional Sources of Energy", Khanna Publishers, New Delhi, 2002. 3. S N Bhadra, S Banerjee and D Kastha, 'Wind Electrical Systems', Oxford University Press, 1st Edition, 2005. 4. S. Sumathi,L. Ashok Kumar,P.Surekha ,'Solar PV and Wind Energy Conversion Systems', Springer 2015

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the fundamental concepts and significance of solar energy.	Understand (K2)
CO2	Analyze the performance characteristics of solar cells under various conditions.	Analyze (K4)
CO3	Design and evaluate photovoltaic systems for practical applications.	Evaluate (K5)
CO4	Describe the basic principles and potential of wind energy as a renewable source.	Understand (K2)
CO5	Compare and assess different wind energy conversion devices.	Understand (K2)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	1	-	-	-	-	1	-	1	-	-
CO2	3	3	3	2	1	-	-	-	-	1	-	1	-	-
CO3	3	3	3	2	1	-	-	-	-	1	-	1	-	-
CO4	3	3	2	2	2	-	-	-	-	1	-	1	-	-
CO5	3	3	2	2	2	-	-	-	-	1	-	1	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23OME01 ENERGY CONSERVATION AND MANAGEMENT

Prerequisite	Programme Name	Sem	Category	L	T	P	C
NIL	All Programmes except B.E- Mechanical Engineering	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1	To understand and analyse the Energy Data of Industries
2	To carryout energy accounting and balancing
3	To conduct energy audit and suggest methodologies for energy savings
4	To utilise the available resources in optimal ways
5	To understand the energy economics

III - Course Content

Unit – I	INTRODUCTION	9 Periods
Energy - Power – Past & Present scenario of World; National Energy consumption Data Environmental aspects associated with energy utilization – Energy Auditing: Need, Types, Methodology and Barriers. Role of Energy Managers. Instruments for energy auditing.		
Unit – II	**ELECTRICAL SYSTEMS**	**9 Periods**
Components of EB billing – HT and LT supply, Transformers, Cable Sizing, Concept of Capacitors, Power Factor Improvement, Harmonics, Electric Motors - Motor Efficiency Computation, Energy Efficient Motors, Illumination – Lux, Lumens, Types of lighting, Efficacy, LED Lighting and scope of Encon in Illumination.		
Unit – III	**THERMAL SYSTEMS**	**9 Periods**
Stoichiometry, Boilers, Furnaces and Thermic Fluid Heaters – Efficiency computation and encon measures. Steam: Distribution &U sage: Steam Traps, Condensate Recovery, Flash Steam Utilization, Insulators & Refractories		
Unit – IV	**ENERGY CONSERVATION IN MAJOR UTILITIES**	**9 Periods**
Pumps, Fans, Blowers, Compressed Air Systems, Refrigeration and Air Conditioning Systems –Cooling Towers – D.G. sets		
Unit – V	**ECONOMICS**	**9 Periods**
Energy Economics – Discount Rate, Payback Period, Internal Rate of Return, Net Present Value, Life Cycle Costing –ESCO concept		

Total: 45 Periods

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Text Books:	1. Energy Manager Training Manual (4 Volumes) available at www.energymanagertraining.com. a website administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India, 2004.
Reference Books:	1. Witte. L.C., P.S. Schmidt, D.R. Brown, "Industrial Energy Management and Utilisation" Hemisphere Publ, Washington, 1988. 2. Callaghn, P.W. "Design and Management for Energy Conservation", Pergamon Press, Oxford, 1981. 3. Dryden. I.G.C., "The Efficient Use of Energy" Butterworths, London, 1982 4. Turner. W.C., "Energy Management Hand book", Wiley, New York, 1982. 5. Murphy. W.R. and G. Mc KAY, "Energy Management", Butterworths, London 1987
MOOC/Web Platforms:	https://www.npcindia.gov.in/NPC/Homes1/e-learning/course?category=MTc= https://www.tpctraining.com/collections/energy-conservation-training

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Remember the knowledge for Basic combustion and furnace design and selection of thermal and mechanical energy equipment.	Understand (K2)
CO2	Study the Importance of Stoichiometry relations, Theoretical air required for complete combustion.	Understand (K2)
CO3	Apply calculation and design tube still heaters.	Apply (K3)
CO4	Study the different heat treatment furnace, Practical and theoretical knowledge burner design.	Apply (K3)
CO5	Apply economic evaluation technique.	Understand (K3)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	1	-	1	-	1	-	1	1	-	1	-	-
CO2	3	-	1	-	1	-	1	-	1	1	-	1	-	-
CO3	3	-	1	-	1	-	1	-	1	1	-	1	-	-
CO4	3	-	2	-	1	-	1	-	1	1	-	1	-	-
CO5	3	-	3	-	3	-	1	-	1	1	-	1	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23OME02 ENERGY TECHNOLOGY

Prerequisite	Programme Name	Sem	Category	L	T	P	C
NIL	All Programmes except B.E- Mechanical Engineering	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1	To Understand energy resources and energy consumption
2	To Understand Conventional energy resources
3	To study Solar energy, Wind energy
4	To Learn Biomass energy resources
5	To Learn Energy conservation in chemical process plants

III - Course Content

Unit – I	INTRODUCTION	9 Periods
Units of energy, conversion factors, general classification of energy, world energy resources and energy consumption, Indian energy resources and energy consumption, energy crisis, energy alternatives, Renewable and non-renewable energy sources and their availability. Prospects of Renewable energy sources.		
Unit – II	**CONVENTIONAL ENERGY**	**9 Periods**
Conventional energy resources, Thermal, hydel and nuclear reactors, thermal, hydel and nuclear power plants, efficiency, merits and demerits of the above power plants, combustion processes, fluidized bed combustion.		
Unit – III	**NON-CONVENTIONAL ENERGY**	**9 Periods**
Solar energy, solar thermal systems, flat plate collectors, focusing collectors, solar water heating, solar cooling, solar distillation, solar refrigeration, solar dryers, solar pond, solar thermal power generation, solar energy application in India, energy plantations. Wind energy, types of windmills, types of wind rotors, Darrieus rotor and Gravian rotor, wind electric power generation, wind power in India, economics of wind farm, ocean wave energy conversion, ocean thermal energy conversion, tidal energy conversion, geothermal energy.		
Unit – IV	**BIOMASS ENERGY**	**9 Periods**
Biomass energy resources, thermo-chemical and biochemical methods of biomass conversion, combustion, gasification, pyrolysis, biogas production, ethanol, fuel cells, alkaline fuel cell, phosphoric acid fuel cell, molten carbonate fuel cell, solid oxide fuel cell, solid polymer electrolyte fuel cell, magneto hydrodynamic power generation, energy storage routes like thermal energy storage, chemical, mechanical storage and electrical storage.		
Unit – V	**ENERGY CONSERVATION**	**9 Periods**
Energy conservation in chemical process plants, energy audit, energy saving in heat exchangers, distillation columns, dryers, ovens and furnaces and boilers, steam economy in chemical plants, energy conservation.		

Total: 45 Periods

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Text Books:	1. Rao, S. and Parulekar, B.B., Energy Technology, Khanna Publishers, 2005. 2. Rai, G.D., Non-conventional Energy Sources, Khanna Publishers, New Delhi, 1984. 3. Bansal, N.K., Kleeman, M. and Meliss, M., Renewable Energy Sources and Conversion Technology, Tata McGraw Hill, 1990. 4. Nagpal, G.R., Power Plant Engineering, Khanna Publishers, 2008.
Reference Books:	1. Nejat Vezirog, Alternate Energy Sources, IT, McGraw Hill, New York. 2. El. Wakil, Power Plant Technology, Tata McGraw Hill, New York, 2002. 3. Sukhatme. S.P., Solar Enery - Thermal Collection and Storage, Tata McGraw hill, New Delhi, 1981.
MOOC/Web Platforms:	https://www.coursera.org/courses?query=renewable%20energy https://onlinecourses.nptel.ac.in/noc25_ge53/preview https://www.renewableinstitute.org/training-courses/

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Students will be able to describe the fundamentals and main characteristics of renewable energy sources and their differences compared to fossil fuels.	Understand (K2)
CO2	Students will excel as professionals in the various fields of energy engineering	Understand (K2)
CO3	Compare different renewable energy technologies and choose the most appropriate based on local conditions.	Apply (K3)
CO4	Explain the technological basis for harnessing renewable energy sources.	Apply (K3)
CO5	Identify and critically evaluate current developments and emerging trends within the field of renewable energy technologies and to develop in-depth technical understanding of energy problems at an advanced	Understand (K2)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	1	-	1	-	1	-	1	1	-	1	-	-
CO2	3	-	1	-	1	-	1	-	1	1	-	1	-	-
CO3	3	-	1	-	1	-	1	-	1	1	-	1	-	-
CO4	3	-	2	-	1	-	1	-	1	1	-	1	-	-
CO5	3	-	3	-	3	-	1	-	1	1	-	1	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23OME03 ENGINEERING GRAPHICS DESIGN

Prerequisite	Programme Name	Sem	Category	L	T	P	C
NIL	All Programmes except B.E- Mechanical Engineering	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1	Drawing engineering curves.
2	Drawing freehand sketch of simple objects.
3	Drawing orthographic projection of solids and section of solids.
4	Drawing development of solids
5	Drawing isometric and perspective projections of simple solids

III - Course Content

Unit-I	Plane Curves	9 Periods
Basic Geometrical constructions, Curves used in engineering practices: Conics — Construction of ellipse, parabola and hyperbola by eccentricity method — Construction of cycloid — construction of involutes of square and circle — Drawing of tangents and normal to the above curves.		
Unit-II	**Projection of Points, Lines and Plane Surface**	**9 Periods**
Orthographic projection- principles-Principal planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces. Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.		
Unit-III	**Projection of Solids and Freehand Sketching**	**9 Periods**
Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes and parallel to the other by rotating object method. Visualization concepts and Free Hand sketching: Visualization principles —Representation of Three Dimensional objects — Layout of views- Freehand sketching of multiple views from pictorial views of objects.		
Unit-IV	**Projection of Sectioned Solids and Development of Surfaces**	**9 Periods**
Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other — obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids — Prisms, pyramids cylinders and cones.		
UNIT-V	**Isometric and Perspective Projections**	**9 Periods**
Principles of isometric projection — isometric scale - Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions - Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method. Practicing		

Total: 45 Periods

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Text Books:	1. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 53rd Edition, 2019
Reference Books:	1. Natrajan K.V., "A Text Book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2018. 2. Parthasarathy, N. S. and Vela Murali, "Engineering Drawing", Oxford University Press, 2015 3. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2008.
MOOC/Web Platforms:	https://onlinecourses.nptel.ac.in/noc21_me128/preview https://www.mygreatlearning.com/academy/learn-for-free/courses/engineering-graphics-drawing

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Use BIS conventions and specifications for engineering drawing.	Understand (K2)
CO2	Construct the conic curves, involutes and cycloid.	Understand (K2)
CO3	Solve practical problems involving projection of lines.	Apply (K3)
CO4	Draw the orthographic, isometric and perspective projections of simple solids.	Apply (K3)
CO5	Draw the development of simple solids.	Apply (K3)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	2	-	2	-	-	-	-	3	-	2	-	1
CO2	3	1	2	-	2	-	-	-	-	3	-	2	-	1
CO3	3	1	2	-	2	-	-	-	-	3	-	2	-	1
CO4	3	1	2	-	2	-	-	-	-	3	-	2	-	1
CO5	3	1	2	-	2	-	-	-	-	3	-	2	-	1

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23OME04 FOUNDATION OF ROBOTICS

Prerequisite	Programme Name	Sem	Category	L	T	P	C
NIL	All Programmes except B.E- Mechanical Engineering	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1	To study the kinematics, drive systems and programming of robots.
2	To study the basics of robot laws and transmission systems.
3	To familiarize students with the concepts and techniques of robot manipulator, its kinematics.
4	To familiarize students with the various Programming and Machine Vision application in robots.
5	To build confidence among students to evaluate, choose and incorporate robots in engineering systems.

III - Course Content

Unit – I	FUNDAMENTALS OF ROBOT	9 Periods
Robot – Definition – Robot Anatomy – Co-ordinate systems, Work Envelope, types and classification – specifications – Pitch, yaw, Roll, Joint Notations, Speed of Motion, Pay Load – Robot Parts and their functions – Need for Robots – Different Applications.- Industrial Robot Types and Their Applications in Automotive Manufacturing.		
Unit – II	**ROBOT KINEMATICS**	**9 Periods**
Forward kinematics, inverse kinematics and the difference: forward kinematics and inverse .Kinematics of Manipulators with two, three degrees of freedom (in 2 dimensional), four degrees of freedom (in 3 dimensional) – derivations and problems. Homogeneous transformation matrices, translation and rotation matrices. Industrial Implementation of Multi-DOF Robots in Precision Machining.		
Unit – III	**ROBOT DRIVE SYSTEMS AND END EFFECTORS**	**9 Periods**
Pneumatic Drives – Hydraulic Drives – Mechanical Drives – Electrical Drives – D.C. Servo Motors, Stepper Motor, A.C. Servo Motors – Salient Features, Applications and Comparison of All These Drives. End Effectors – Grippers – Mechanical Grippers, Pneumatic and Hydraulic Grippers, Magnetic grippers, vacuum grippers, internal grippers and external grippers, selection and design considerations of a gripper- Selection Criteria for End Effectors in Automated Packaging Systems.		
Unit – IV	**SENSORS IN ROBOTICS**	**9 Periods**
Force sensors, touch and tactile sensors, proximity sensors, non-contact sensors, safety considerations in robotic cell, proximity sensors, fail safe hazard sensor systems, and compliance mechanism. Machine vision system - camera, frame grabber, sensing and digitizing image data – signal conversion, image storage, lighting techniques, image processing and analysis – data reduction, segmentation, feature extraction, object recognition, other algorithms, applications –Inspection, identification, visual serving and navigation. Proximity Sensors in Automated Guided Vehicles (AGVs) for Warehousing		
Unit – V	**PROGRAMMING AND APPLICATIONS OF ROBOT**	**9 Periods**
Teach pendant programming, lead through programming, robot programming languages – VAL programming		

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– Motion Commands, Sensors commands, End-Effector Commands, and simple programs - Role of robots in inspection, assembly, material handling, underwater, space and medical fields. Application of Robots in Inspection and Quality Assurance in Electronics Manufacturing.

Total: 45 Periods

Text Books:	1. Ganesh.S.Hedge,"A textbook of Industrial Robotics", Lakshmi Publications, 2006. 2. Mikell.P.Groover , "Industrial Robotics – Technology, Programming and applications" McGraw Hill 2ND edition 2012.
Reference Books:	1. Fu K.S. Gonalz R.C. and ice C.S.G."Robotics Control, Sensing, Vision and Intelligence", McGraw Hill book co. 2007. 2. YoramKoren, "Robotics for Engineers", McGraw Hill Book, Co., 2002. 3. Janakiraman P.A., "Robotics and Image Processing", Tata McGraw Hill 2005. 4. John. J.Craig, "Introduction to Robotics: Mechanics and Control" 2nd Edition, 2002. 5. Jazar, "Theory of Applied Robotics: Kinematics, Dynamics and Control", Springer India reprint, 2010.
MOOC/Web Platforms:	https://onlinecourses.nptel.ac.in/noc20_me92/preview https://nptel.ac.in/courses/107106090

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Interpret the features of robots and technology involved in the control.	Understand (K2)
CO2	Apply the basic engineering knowledge and laws for the design of robotics.	Apply (K3)
CO3	Explain the basic concepts like various configurations, classification and parts of end effectors compare various end effectors and grippers and tools and sensors used in robots.	Understand (K2)
CO4	Explain the concept of kinematics, degeneracy, dexterity and trajectory planning.	Understand (K2)
CO5	Demonstrate the image processing and image analysis techniques by machine vision	Apply (K3)

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V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	-	-	-	-	1	-	-
CO2	3	2	1	1	-	-	-	-	-	-	-	1	-	-
CO3	3	2	1	1	-	-	-	-	-	-	-	1	-	-
CO4	3	2	1	1	-	-	-	-	-	-	-	1	-	-
CO5	3	2	1	1	-	-	-	-	-	-	-	1	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23OME05 INDUSTRIAL DESIGN & RAPID PROTOTYPING TECHNIQUES

Prerequisite	Programme Name	Sem	Category	L	T	P	C
NIL	All Programmes except B.E- Mechanical Engineering	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1	Understand the fundamentals of user interface (UI) and user experience (UX) design principles.
2	Gain foundational knowledge of mobile and web application architecture.
3	Use tools like CAD software to create digital mockups of industrial designs.
4	Learn various mechanical fabrication methods including 3D printing, laser cutting, and CNC machining.
5	Learn the fundamentals of electronic prototyping and embedded systems.

III - Course Content

Unit – I	UI/UX	9 Periods
Fundamental concepts in UI & UX - Tools - Fundamentals of design principles - Psychology and Human Factors for User Interface Design - Layout and composition for Web, Mobile and Devices - Typography - Information architecture - Color theory - Design process flow, wireframes, best practices in the industry - User engagement ethics - Design alternatives		
Unit – II	**APP DEVELOPMENT**	**9 Periods**
SDLC - Introduction to App Development - Types of Apps - web Development - understanding Stack - Frontend - backend - Working with Databases - Introduction to API - Introduction to Cloud services - Cloud environment Setup- Reading and writing data to cloud - Embedding ML models to Apps - Deploying application.		
Unit – III	**INDUSTRIAL DESIGN**	**9 Periods**
Introduction to Industrial Design - Points, lines, and planes - Sketching and concept generation - Sketch to CAD - Introduction to CAD tools - Types of 3D modeling - Basic 3D Modeling Tools - Part creation – Assembly - Product design and rendering basics - Dimensioning & Tolerancing		
Unit – IV	**MECHANICAL RAPID PROTOTYPING**	**9 Periods**
Need for prototyping - Domains in prototyping - Difference between actual manufacturing and prototyping - Rapid prototyping methods - Tools used in different domains - Mechanical Prototyping; 3D Printing and classification - Laser Cutting and engraving - RD Works - Additive manufacturing		
Unit – V	**ELECTRONIC RAPID PROTOTYPING**	**9 Periods**
Basics of electronic circuit design - lumped circuits - Electronic Prototyping - Working with simulation tool - simple PCB design with EDA		

Total: 45 Periods

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Text Books:	1. Peter Fiell, Charlotte Fiell, Industrial Design A-Z, TASCHEN America Llc(2003) 2. Samar Malik, Autodesk Fusion 360 - The Master Guide. 3. Steve Krug, Don't Make Me Think, Revisited: A Common Sense Approach to Web Usability, Pearson,3rd edition(2014)
Reference Books:	1. Rapid Product Development- Synergic integration of time-compression technologies K. P. Karunakaran, V. P. Bapat, Sreenath Babu Akula P. D. Solanki Gaurav Gupta, V.R. Prasanth, Saket Anand, Arnab Sarkar and S. Venkatkrishnan 2. Manufacturing Processes for Engineering Materials -Serope Kalpakjion and Steven R. SchmidPearson Education
MOOC/Web Platforms:	https:// nptel/courses/video/112105126/L01.html

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Create quick UI/UX prototypes for customer needs	Understand (K2)
CO2	Develop web application to test product traction / product feature	Apply (K3)
CO3	Develop 3D models for prototyping various product ideas	Apply (K3)
CO4	Built prototypes using Tools and Techniques in a quick iterative methodology	Apply (K3)
CO5	To develop the electronic prototyping with simulation	Apply (K3)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	-	-	2	1	1	1	-	1	1	-	-
CO2	3	1	1	-	-	2	1	1	1	-	1	1	-	-
CO3	3	1	1	-	-	2	1	1	1	-	1	1	-	-
CO4	3	1	1	-	-	2	1	1	1	-	1	1	-	-
CO5	3	1	1	-	-	2	1	1	1	-	1	1	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23OME06 INDUSTRIAL MANAGEMENT

Prerequisite	Programme Name	Sem	Category	L	T	P	C
NIL	All Programmes except B.E- Mechanical Engineering	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1	To introduce fundamental concepts of industrial management.
2	To understand the approaches to the study of Management.
3	To learn about Decision Making, Organizing and leadership.
4	To analyze the Managerial Role and functions.
5	To know about the Supply Chain Management.

III - Course Content

UNIT-I	INTRODUCTION	9 Periods
Technology Management - Definition - Functions - Evolution of Modern Management - Scientific Management Development of Management Thought. Approaches to the study of Management, Forms of Organization -Individual Ownership - Partnership - Joint Stock Companies - Co-operative Enterprises - Public Sector Undertakings, Corporate Frame Work- Share Holders - Board of Directors - Committees - Chief Executive Line and Functional Managers,-Financial-Legal-Trade Union.		
Unit – II	**AUTOMATION COMPONENTS**	**9 Periods**
Planning - Nature and Purpose - Objectives - Strategies – Policies and Planning Premises - Decision Making - Organizing - Nature and Process - Premises - Departmentalization - Line and staff - Decentralization - Organizational culture, Staffing - selection and training .Placement - Performance appraisal - Career Strategy – Organizational Development. Leading - Managing human factor - Leadership .Communication, Controlling - Process of Controlling - Controlling techniques, productivity and operations management - Preventive control, Industrial Safety.		
UNIT-III	**ORGANIZATIONAL BEHAVIOUR**	**9 Periods**
Definition - Organization - Managerial Role and functions -Organizational approaches, Individual behaviour - causes - Environmental Effect - Behaviour and Performance, Perception - Organizational Implications. Personality - Contributing factors - Dimension – Need Theories - Process Theories - Job Satisfaction, Learning and Behaviour-Learning Curves, Work Design and approaches.		
UNIT-IV	**GROUP DYNAMICS**	**9 Periods**
Group Behaviour - Groups - Contributing factors - Group Norms, Communication - Process - Barriers to communication - Effective communication, leadership - formal and informal characteristics – Managerial Grid - Leadership styles - Group Decision Making - Leadership Role in Group Decision, Group Conflicts - Types -Causes - Conflict Resolution -Inter group relations and conflict, Organization centralization and decentralization - Formal and informal - Organizational Structures Organizational Change and Development -Change Process – Resistance to Change - Culture and Ethics.		
UNIT-V	**MODERN CONCEPTS**	**9 Periods**
Management by Objectives (MBO) - Management by Exception (MBE),Strategic Management - Planning for Future direction - SWOT Analysis -Evolving development strategies, information technology in		

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management Decisions support system-Management Games Business Process Reengineering(BPR) – Enterprises Resource Planning (ERP) - Supply Chain Management (SCM) - Activity Based Management (AM) - Global Perspective - Principles and Steps Advantages and disadvantage

Total: 45 Periods

Text Books:	Maynard H.B, "Industrial Engineering Hand book", McGraw-Hill, sixth 2008
Reference Books:	S.Chandran, "Organizational Behaviours", Vikas Publishing House Pvt. Ltd., 1994
MOOC/Web Platforms:	https://www.udemy.com/course/industrial-management/ https://onlinecourses.nptel.ac.in/noc22_me04/preview

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Explain basic concepts of management; approaches to management; contributors to management studies; various forms of business organization and trade unions function in professional organizations.	Understand (K2)
CO2	Discuss the planning; organizing and staffing functions of management in professional organization.	Understand (K2)
CO3	Apply the leading; controlling and decision making functions of management in professional organization.	Apply (K3)
CO4	Discuss the organizational theory in professional organization.	Understand (K2)
CO5	Apply principles of productivity and modern concepts in management in professional organization.	Apply (K3)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	3	2	3	-	-	-	-	-	-	-	-	-	-
CO3	2	3	2	3	-	-	-	-	-	-	-	-	-	-
CO4	2	2	3	3	-	-	-	-	-	-	-	-	-	-
CO5	2	2	-	-	-	-	-	-	-	-	-	-	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23OME07 INDUSTRIAL SAFETY AND HAZARD MANAGEMENT

Prerequisite	Programme Name	Sem	Category	L	T	P	C
NIL	All Programmes except B.E- Mechanical Engineering	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1	To Understand the Introduction and basic Terminologies safety.
2	To enable the students to learn about the Important Statutory Regulations and standards.
3	To enable students to Conduct and participate the various Safety activities in the industry.
4	To have knowledge about Workplace Exposures and Hazards.
5	To assess the various Hazards and consequences through various Risk Assessment Techniques.

III - Course Content

Unit – I	Safety Terminologies	9 Periods
Hazard-Types of Hazard- Risk-Hierarchy of Hazards Control Measures-Lead indicators- lag Indicators-Flammability- Toxicity Time-weighted Average (TWA) - Threshold Limit Value (TLV) - Short Term Exposure Limit (STEL)- Immediately dangerous to life or health (IDLH)- acute and chronic Effects- Routes of Chemical Entry-Personnel Protective Equipment- Health and Safety Policy-Material Safety Data Sheet-MSDS.		
Unit – II	**Standards and Regulations**	**9 Periods**
Indian Factories Act-1948- Health- Safety- Hazardous materials and Welfare- ISO 45001:2018 occupational health and safety (OH&S) - Occupational Safety and Health Audit IS14489:1998- Hazard Identification and Risk Analysis- code of practice IS 15656:2006.		
Unit – III	**Safety Activities**	**9 Periods**
Toolbox Talk- Role of safety Committee- Responsibilities of Safety Officers and Safety Representatives-Safety Training and Safety Incentives- Mock Drills- On-site Emergency Action Plan- Off-site Emergency Action Plan- Safety poster and Display- Human Error Assessment.		
Unit – IV	**Workplace Health and Safety**	**9 Periods**
Noise hazard- Particulate matter- musculoskeletal disorder improper sitting poster and lifting Ergonomics RULE & REBA- Unsafe act & Unsafe Condition- Electrical Hazards- Crane Safety - Toxic gas Release.		
Unit – V	**Hazard Identification Techniques**	**9 Periods**
Job Safety Analysis-Preliminary Hazard Analysis-Failure mode and Effects Analysis- Hazard and Operability-Fault Tree Analysis- Event Tree Analysis Qualitative and Quantitative Risk Assessment - Checklist Analysis-Root cause analysis- What-If Analysis- and Hazard Identification and Risk Assessment.		

Total: 45 Periods

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Text Books:	1. R.K. Jain and Prof. Sunil S. Rao Industrial Safety, Health and Environment Management Systems KHANNA PUBLISHER 2. L. M. Deshmukh Industrial Safety Management: Hazard Identification and Risk Control McGraw-Hill Education.
Reference Books:	1. Frank Lees (2012) 'Lees' Loss Prevention in Process Industries. Butterworth-Heinemann publications, UK, 4th Edition. 2. John Ridley & John Channing (2008) Safety at Work: Routledge, 7th Edition. 3. Dan Petersen (2003) Techniques of Safety Management: A System Approach. 4. Alan Waring (1996) Safety management system: Chapman &Hall, England 5. Society of Safety Engineers, USA.
MOOC/Web Platforms:	ISO 45001:2018 occupational health and safety (OH&S) International Organization for Standardization https://www.iso.org/standard/63787.html Indian Standard code of practice on occupational safety and health audit https://law.resource.org/pub/in/bis/S02/is.14489.1998.pdf Indian Standard code of practice on Hazard Identification and Risk Analysis IS 15656:2006 https://law.resource.org/pub/in/bis/S02/is.15656.2006.pdf

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the basic concept of safety.	Understand (K2)
CO2	Obtain knowledge of Statutory Regulations and standards.	Apply (K3)
CO3	Know about the safety Activities of the working place.	Apply (K3)
CO4	Analyze on the impact of Occupational Exposures and their Remedies.	Analyze (K4)
CO5	Obtain knowledge of Risk Assessment Techniques.	Apply (K3)

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V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	1	1	3	2	2	3	3	1	3	-	-
CO2	2	3	2	2	1	3	2	3	3	2	1	3	-	-
CO3	2	2	2	2	1	2	2	2	3	2	1	2	-	-
CO4	3	3	3	2	2	3	2	2	3	2	2	3	-	-
CO5	3	2	3	2	2	3	2	2	3	2	2	3	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I–Course Name: 23OME08 INTRODUCTION TO INDUSTRIAL AUTOMATION SYSTEMS

Prerequisites	Program Name	Sem	Category	L	T	P	C
NIL	All programs except Mechanical Engineering	V / VI / VII	OEC	3	0	0	3

II - Course Objectives

1	To educate on design of signal conditioning circuits for various applications.
2	To Introduce signal transmission techniques and their design.
3	Study of components used in data acquisition systems interface techniques
4	To educate on the components used in distributed control systems
5	To introduce the communication buses used in automation industries.

III - Course Content

Unit – I	Introduction	9 Periods
Automation overview, Requirement of automation systems, Architecture of Industrial Automation system, Introduction of PLC and supervisory control and data acquisition (SCADA). Industrial bus systems : Modbus & Profibus		
Unit – II	**Automation Components**	**9 Periods**
Sensors for temperature, pressure, force, displacement, speed, flow, level, humidity and pH measurement. Actuators, process control valves, power electronics devices DIAC, TRIAC, power MOSFET and IGBT. Introduction of DC and AC servo drives for motion control- Industrial Internet of Things (IIoT) Enabled Sensors and Actuators		
Unit – III	**Computer Aided Measurement and Control Systems**	**9 Periods**
Role of computers in measurement and control, Elements of computer aided measurement and control, man machine interface, computer aided process control hardware, process related interfaces, Communication and networking, Industrial communication systems, Data transfer techniques, Computer aided process control software, Computer based data acquisition system, Internet of things (IoT) for plant automation- Digital Twin Technology for Real-Time Process Monitoring		
Unit – IV	**Programmable Logic Controllers**	**9 Periods**
Programmable controllers, Programmable logic controllers, Analog digital input and output modules, PLC programming, Ladder diagram, Sequential flow chart, PLC Communication and networking, PLC selection, PLC Installation, Advantage of using PLC for Industrial automation, Application of PLC to process control industries- Networked PLC Systems for Industry 4.0		
Unit – V	**Distributed Control System**	**9 Periods**
Overview of nanomaterials properties and their applications, nano painting, nano coating, nanomaterials for renewable energy, Molecular Electronics and Nanoelectronics – Nanobots- Biological Applications. Emerging technologies for environmental applications- Practice of nanoparticles for environmental remediation and water treatment-Nanotechnology in Environmental Remediation- Cybersecurity in Distributed Control Systems		

TOTAL: 45 Periods

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Text Books:	1.S.K.Singh, "Industrial Instrumentation", Tata Mcgraw Hill, 2nd edition companies,2003. 2. C D Johnson, "Process Control Instrumentation Technology", Prentice Hall India,8th Edition, 2006. 3. E.A.Parr, Newnes ,NewDelhi,"Industrial Control Handbook",3rd Edition, 2000.
Reference Books:	1.John W. Webb and Ronald A. Reis, "Programmable Logic Controllers: Principles and Applications", 5th Edition, Prentice Hall Inc., New Jersey, 2003. 2. Frank D. Petruzella, "Programmable Logic Controllers", 5th Edition, McGraw- Hill, New York, 2016. 3. Krishna Kant, "Computer - Based Industrial Control", 2nd Edition, Prentice Hall, New Delhi, 2011. 4. Gary Dunning, Thomson Delmar,"Programmable Logic Controller", CeneageLearning, 3 rd Edition,2005.
MOOC/Web Platforms:	nptel.ac.in/courses/108105062

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Design a signal conditioning circuits for various application.	Understand (K2)
CO2	Acquire a detail knowledge on data acquisition system interface and DCS system.	Apply (K3)
CO3	Understand the basics and Importance of communication buses in applied automation engineering.	Understand (K2)
CO4	Ability to design PLC Programmes by Applying Timer/Counter and Arithmetic and Logic Instructions Studied for Ladder Logic and Function Block.	Apply (K3)
CO5	Able to develop a PLC logic for a specific application on real world problem.	Apply (K3)

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V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2	3	3	-	-	1	1	3	1	1	-	-
CO2	2	3	1	-	-	2	1	1	1	-	1	1	-	-
CO3	2	2	1	-	-	2	1	1	1	-	1	1	-	-
CO4	2	2	1	-	-	2	1	1	1	-	1	1	-	-
CO5	2	2	1	-	-	2	1	1	1	-	1	1	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23OME09 Introduction to Non- Destructive Testing

Prerequisites	Program Name	Sem	Category	L	T	P	C
NIL	All programs except Mechanical Engineering	V / VI / VII	OEC	3	0	0	3

II - Course Objectives

1	Understanding the basic importance of NDT in quality assurance.
2	Imbibing the basic principles of various NDT techniques, its applications, limitations, codes and standards.
3	Equipping themselves to locate a flaw in various materials, products.
4	Applying apply the testing methods for inspecting materials in accordance with industry specifications and standards.
5	Acquiring the knowledge on the selection of the suitable NDT technique for a given application.

III - Course Content

Unit – I	Introduction To NDT & Visual Testing	9 Periods
Concepts of Non-destructive testing-relative merits and limitations-NDT Versus mechanical testing, Fundamentals of Visual Testing – vision, lighting, material attributes, environmental factors, visual perception, direct and indirect methods – mirrors, magnifiers, boroscopes and fibroscopes – light sources and special lighting-Real Case Studies: Examples from aerospace or petrochemical industries where visual testing prevented major failures.		
Unit – II	**Liquid Penetrant & Magnetic Particle Testing**	**9 Periods**
Liquid Penetrant Inspection: principle, applications, advantages and limitations, dyes, developers and cleaners, Methods & Interpretation. Magnetic Particle Inspection: Principles, applications, magnetization methods, magnetic particles, Testing Procedure, demagnetization, advantages and limitations, – Interpretation and evaluation of test indications-In-Process Inspection: Use of LPI/MPI in high-volume manufacturing – case from railways and aerospace sectors.		
Unit – III	**Eddy Current Testing & Thermography**	**9 Periods**
Eddy Current Testing: Generation of eddy currents– properties– eddy current sensing elements, probes, Instrumentation, Types of arrangement, applications, advantages, limitations – Factors affecting sensing elements and coil impedance, calibration, Interpretation/Evaluation. Thermography- Principle, Contact & Non-Contact inspection methods, Active & Passive methods, Liquid Crystal – Concept, example, advantages & limitations. Electromagnetic spectrum, infrared thermography- approaches, IR detectors, Instrumentation and methods, applications- Industry Use Cases: Case study of IR thermography in solar panel inspection and mechanical bearing faults.		
Unit – IV	**Ultrasonic Testing & AET**	**9 Periods**
Ultrasonic Testing: Types of ultrasonic waves, characteristics, attenuation, couplants, probes, EMAT. Inspection methods-pulse echo, transmission and phased array techniques, types of scanning and displays, angle beam inspection of welds, time of flight diffraction (TOFD) technique, Thickness determination by ultrasonic method, Study of A, B and C scan presentations, calibration. Acoustic Emission Technique –		

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Introduction, Types of AE signal, AE wave propagation, Source location, Kaiser effect, AE transducers, Principle, AE parameters, AE instrumentation, Advantages & Limitations, Interpretation of Results, AET Applications: Real-time monitoring in power plants, pressure vessels, and structural health monitoring.		
Unit – V	**Radiography Testing**	**9 Periods**
Sources-X-rays and Gamma rays and their characteristics-absorption, scattering. Filters and screens, Imaging modalities-film radiography and digital radiography (Computed, Direct, Real Time, CT scan). Problems in shadow formation, exposure factors, inverse square law, exposure charts, Penetrameters, safety in radiography- Real-Time RT: Applications in automotive and pipeline inspections with automated image analysis.		

Total: 45 Periods

Text Books:	1. Baldev Raj, T. Jayakumar and M. Thavasimuthu, Practical Non Destructive Testing, Alpha Science International Limited, 3rd edition, 2002. 2. J. Prasad and C. G. K. Nair, Non-Destructive Test and Evaluation of Materials, Tata McGraw- Hill Education, 2nd edition, 2011. 3. Ravi Prakash, "Non-Destructive Testing Techniques", 1st revised edition, New Age International Publishers, 2010.
Reference Books:	1. ASM Metals Handbook, V-17, "Nondestructive Evaluation and Quality Control", American Society of Metals, USA, 2001. 2. Barry Hull and Vernon John,"Nondestructive Testing", Macmillan, 1989. 3. Chuck Hellier, "Handbook of Nondestructive Evaluation", Mc Graw Hill, 2012. 4. Louis Cartz, "Nondestructive Testing", ASM International, USA, 1995.
MOOC/Web Platforms:	https://nptel.ac.in/courses/113106070 https://onlinecourses.nptel.ac.in/noc25_mm29/preview

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Realize the importance of NDT in various engineering fields.	Understand (K2)
CO2	Have a basic knowledge of surface NDE techniques which enables to carry out various inspection in accordance with the established procedures.	Understand (K2)
CO3	Calibrate the instrument and inspect for in-service damage in the components by means of Eddy current testing as well as Thermography testing.	Apply (K3)
CO4	Differentiate various techniques of UT and AET and select appropriate NDT methods for better evaluation.	Understand (K2)
CO5	Interpret the results of Radiography testing and also have the ability to analyse the influence of various parameters on the testing.	Apply (K3)

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V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	3	-	-	2	2	-	-	-	2	-	-	-
CO2	3	1	2	2	-	-	2	2	-	-	-	2	-	-	-
CO3	3	2	1	2	-	-	2	2	-	-	-	2	-	-	-
CO4	3	1	2	2	-	-	2	2	-	-	-	2	-	-	-
CO5	3	2	2	2	-	-	2	2	-	-	-	2	-	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23OME10 MECHATRONICS

Prerequisites	Program Name	Sem	Category	L	T	P	C
NIL	All programs except Mechanical Engineering	V / VI / VII	OEC	3	0	0	3

II - Course Objectives

1	To understand Mechatronics principles and sensor technologies.
2	To study the architecture and programming of 8085 microprocessor.
3	To interface peripherals using 8255 and implement basic control systems.
4	To develop PLC-based automation with timers, counters, and I/O handling.
5	To explore actuators and apply Mechatronics design methodology through real-world systems.

III - Course Content

Unit – I	INTRODUCTION AND SENSORS	9 Periods
Introduction to Mechatronics – Systems – Need for Mechatronics – Emerging areas of Mechatronics – Classification of Mechatronics. Sensors and Transducers: Static and Dynamic Characteristics of Sensor, Potentiometers – LVDT – Capacitance Sensors – Strain Gauges – Eddy Current Sensor – Hall Effect Sensor – Temperature Sensors – Light Sensors.		
Unit – II	**8085 MICROPROCESSOR**	**9 Periods**
Introduction – Pin Configuration - Architecture of 8085 – Addressing Modes – Instruction set, Timing diagram of 8085.		
Unit – III	**PROGRAMMABLE PERIPHERAL INTERFACE**	**9 Periods**
Introduction – Architecture of 8255, Keyboard Interfacing, LED display – Interfacing, ADC and DAC Interface, Temperature Control – Stepper Motor Control – Traffic Control Interface.		
Unit – IV	**PROGRAMMABLE LOGIC CONTROLLER**	**9 Periods**
Introduction – Architecture – Input / Output Processing – Programming with Timers, Counters and Internal relays – Data Handling – Selection of PLC		
Unit – V	**ACTUATORS AND MECHATRONICS SYSTEM DESIGN**	**9 Periods**
Types of Stepper and Servo motors – Construction – Working Principle – Characteristics, Stages of Mechatronics Design Process – Comparison of Traditional and Mechatronics Design Concepts with Examples – Case studies of Mechatronics Systems – Pick and Place Robot – Engine Management system – Automatic Car Park Barrier. Automatic Washing Machine, Auto focus camera, exposure control.		

Total: 45 Periods

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Text Books:	1. Bolton W., "Mechatronics", Pearson Education, 6th Edition, 2015. 2. Ramesh S Gaonkar, "Microprocessor Architecture, Programming, and Applications with the 8085", Penram International Publishing Private Limited, 6th Edition, 2013.
Reference Books:	1. Davis G. Alciatore and Michael B. Histand, "Introduction to Mechatronics and Measurement systems", McGraw Hill Education, 2011.
MOOC/Web Platforms:	nptel.ac.in/courses/112107298

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Explain the role of Mechatronics and classify sensors based on applications.	Understand (K2)
CO2	Analyze the structure and functioning of the 8085 microprocessor.	Analyze (K4)
CO3	Design and interface microprocessor systems using PPI (8255).	Apply (K3)
CO4	Develop basic PLC programs for industrial automation.	Apply (K3)
CO5	Apply Mechatronics design processes using actuators and practical case studies.	Apply (K3)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	-	-	1	-	-	-	-	2	-	-
CO2	3	3	2	1	-	-	1	-	-	-	-	2	-	-
CO3	3	3	2	1	-	-	1	-	-	-	-	2	-	-
CO4	3	3	2	1	-	-	1	-	-	-	-	2	-	-
CO5	3	3	2	1	-	-	1	-	-	-	-	2	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23OME11 NANOMATERIALS AND APPLICATIONS

Prerequisites	Program Name	Sem	Category	L	T	P	C
NIL	All programs except Mechanical Engineering	V / VI / VII	OEC	3	0	0	3

II - Course Objectives

1	Understanding the evolution of nanomaterials in the scientific era and make them to understand different types of nanomaterials for the future engineering applications
2	Gaining knowledge on dimensionality effects on different properties of nanomaterials
3	Getting acquainted with the different processing techniques employed for fabricating nanomaterials
4	Having knowledge on the different characterisation techniques employed to characterise the nanomaterials
5	Acquiring knowledge on different applications of nanomaterials in different disciplines of engineering.

III - Course Content

Unit – I	NANOMATERIALS	9 Periods
Introduction, Classification: 0D, 1D, 2D, 3D nanomaterials and nano-composites, their mechanical, electrical, optical, magnetic properties; Nanomaterials versus bulk materials.		
Unit – II	**THERMODYNAMICS & KINETICS OF NANOSTRUCTURED MATERIALS**	**9 Periods**
Size and interface/interphase effects, interfacial thermodynamics, phase diagrams, diffusivity, grain growth, and thermal stability of nanomaterials.		
Unit – III	**PROCESSING**	**9 Periods**
Bottom-up and top-down approaches for the synthesis of nanomaterials, mechanical alloying, chemical routes, severe plastic deformation, and electrical wire explosion technique.		
Unit – IV	**STRUCTURAL CHARACTERISTICS**	**9 Periods**
Principles of emerging nanoscale X-ray techniques such as small angle X-ray scattering and X-ray absorption fine structure (XAFS), electron and neutron diffraction techniques and their application to nanomaterials; SPM, Nanoindentation, Grain size, phase formation, texture, stress analysis		
Unit – V	**APPLICATIONS**	**9 Periods**
Applications of nanoparticles, quantum dots, nanotubes, nanowires, nanocoatings; applications in electronic, electrical and medical industries		

Total: 45 Periods

Text Books:	1. Bhusan, Bharat (Ed), "Springer Handbook of Nanotechnology", 2nd edition, 2007. 2. Carl C. Koch (ed.), NANOSTRUCTURED MATERIALS, Processing, Properties and Potential Applications, NOYES PUBLICATIONS, Norwich, New York, U.S.A.

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Reference Books:	1. Poole C.P, and Owens F.J., Introduction to Nanotechnology, John Wiley 2003 2. Nalwa H.S., Encyclopedia of Nanoscience and Nanotechnology, American Scientific Publishers 2004 3. Zehetbauer M.J. and Zhu Y.T., Bulk Nanostructured Materials, Wiley 2008 4. Wang Z.L., Characterization of Nanophase Materials, Wiley 2000 5. Gutkin Y., Ovid'ko I.A. and Gutkin M., Plastic Deformation in Nanocrystalline Materials, Springer 2004
MOOC/Web Platforms:	https://www.tutorialsduniya.com/

V - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Evaluate nanomaterials and understand the different types of nanomaterials	Understand (K2)
CO2	Recognise the effects of dimensionality of materials on the properties	Apply (K3)
CO3	Process different nanomaterials and use them in engineering applications	Apply (K3)
CO4	Use appropriate techniques for characterising nanomaterials	Apply (K3)
CO5	Identify and use different nanomaterials for applications in different engineering fields	Apply (K3)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2	3	3	-	-	1	1	3	1	1	-	-
CO2	2	3	1	-	-	2	1	1	1	-	1	1	-	-
CO3	2	2	1	-	-	2	1	1	1	-	1	1	-	-
CO4	2	2	1	-	-	2	1	1	1	-	1	1	-	-
CO5	2	2	1	-	-	2	1	1	1	-	1	1	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23OME12 NANO TECHNOLOGY

Prerequisites	Program Name	Sem	Category	L	T	P	C
NIL	All programs except Mechanical Engineering	V / VI / VII	OEC	3	0	0	3

II - Course Objectives

1	To understand the basic concepts and principles of nanoscience and nanotechnology.
2	To study the synthesis methods and characterization techniques of nanomaterials.
3	To explore the mechanical, electrical, magnetic, and optical properties of nanomaterials.
4	To familiarize students with the applications of nanomaterials in engineering, medicine, and electronics.
5	To develop awareness of the environmental, health, and safety aspects of nanotechnology.

III - Course Content

Unit – I	INTRODUCTION	9 Periods
General definition and size effects–important nano structured materials and nano particles- importance of nano materials- Size effect on thermal, electrical, electronic, mechanical, optical and magnetic properties of nanomaterials- surface area - band gap energy and applications. Photochemistry and Electrochemistry of nanomaterials –Ionic properties of nanomaterials- Nano catalysis.		
Unit – II	**SYNTHESIS OF NANOMATERIALS**	**9 Periods**
Bottom up and Top-down approach for obtaining nano materials - Precipitation methods – sol gel technique – high energy ball milling, CVD and PVD methods, gas phase condensation, magnetron sputtering and laser deposition methods – laser ablation, sputtering- Laser-Assisted Synthesis of Nanomaterials-Magnetron Sputtering for Thin Film Nanocoatings		
Unit – III	**NANO COMPOSITES**	**9 Periods**
Definition- importance of nanocomposites- nano composite materials-classification of composites- metal/metal oxides, metal-polymer- thermoplastic based, thermoset based and elastomer based- influence of size, shape and role of interface in composites applications- Graphene-Based Polymer Nanocomposites-		
Unit – IV	**NANO STRUCTURES AND CHARACTERIZATION TECHNIQUES**	**9 Periods**
Classifications of nanomaterials - Zero dimensional, one-dimensional and two-dimensional nanostructures- Kinetics in nanostructured materials- multilayer thin films and superlattice- clusters of metals, semiconductors and nanocomposites. Spectroscopic techniques, Diffraction methods, thermal analysis method, BET analysis method.- X-ray Photoelectron Spectroscopy		
Unit – V	**APPLICATIONS OF NANO MATERIALS**	**9 Periods**
Overview of nanomaterials properties and their applications, nano painting, nano coating, nanomaterials for renewable energy, Molecular Electronics and Nanoelectronics – Nanobots- Biological Applications. Emerging technologies for environmental applications- Practice of nanoparticles for environmental remediation and water treatment-Nanotechnology in Environmental Remediation		

Total: 45 Periods

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Text Books:	1.Mick Wilson, Kamali Kannangara,Geoff Smith, Michelle Simmom, Burkhard Raguse, " Nano Technology: Basic Science & Engineering Technology", 2005, Overseas Press 2. G. Cao, "Nanostructures & Nanomaterials: Synthesis, Properties &Applications" Imperial College Press, 2004 3. William A Goddard "Handbook of Nanoscience, Engineering and Technology", 3rd Edition, CRC Taylor and Francis group 2012.
Reference Books:	1.R.H.J.Hannink & A.J.Hill, Nanostructure Control, Wood Head Publishing Ltd.,Cambridge, 2006. 2. C.N.R.Rao, A.Muller, A.K.Cheetham, The Chemistry of Nanomaterials: Synthesis, Properties and Applications Vol. I & II, 2nd edition, 2005, Wiley VCH Verlag Gibtl & Co 3. Ivor Brodie and Julius J.Muray,'The physics of Micro/Nano – Fabrication',Springer International Edition,2010
MOOC/Web Platforms:	nptel.ac.in/courses/113106093

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the basic properties such as structural, physical, chemical properties of nanomaterials and their applications.	Understand (K2)
CO2	Able to acquire knowledge about the different types of nano material	Apply (K3)
CO3	Describes about the shape, size,structure of composite nano materials and their interference	Understand (K2)
CO4	Understand the different characterization techniques for nanomaterials	Understand (K2)
CO5	Develop a deeper knowledge in the application of nanomaterials in different fields.	Apply (K3)

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V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2	3	3	-	-	1	1	3	1	1	-	-
CO2	2	3	1	-	-	2	1	1	1	-	1	1	-	-
CO3	2	2	1	-	-	2	1	1	1	-	1	1	-	-
CO4	2	2	1	-	-	2	1	1	1	-	1	1	-	-
CO5	2	2	1	-	-	2	1	1	1	-	1	1	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23OME13 OPERATION MANAGEMENT

Prerequisites	Program Name	Sem	Category	L	T	P	C
NIL	All programs except Mechanical Engineering	V / VI / VII	OEC	3	0	0	3

II - Course Objectives

1	Recognize and appreciate the concept of Production and Operations Management in creating and enhancing a firm's competitive advantages.
2	Describe the concept and contribution of various constituents of Production and Operations Management (both manufacturing and service).
3	Relate the interdependence of the operations function with the other key functional areas of a firm.
4	Teach analytical skills and problem-solving tools to the analysis of the operations problems.
5	Apply scheduling and Lean Concepts for improving System Performance.

III - Course Content

Unit – I	INTRODUCTION TO OPERATIONS MANAGEMENT	9 Periods
Operations Management – Nature, Importance, historical development, transformation processes, differences between services and goods, a system perspective, functions, challenges, current priorities, recent trends; Operations Strategy - Strategic fit , framework; Supply Chain Management		
Unit – II	**FORECASTING, CAPACITY AND FACILITY DESIGN**	**9 Periods**
Demand Forecasting - Need, Types, and steps. Overview of Qualitative and Quantitative methods. Capacity Planning - Long range, Types, Developing capacity alternatives. Overview of sales and operations planning. Overview of MRP, MRP II and ERP. Facility Location – Theories, Steps in Selection, Location Models. Facility Layout – Principles, Types, Planning tools and techniques.		
Unit – III	**DESIGN OF PRODUCT, PROCESS AND WORK SYSTEMS**	**9 Periods**
Product Design – Influencing factors, Approaches, Legal, Ethical and Environmental issues. Process – Planning, Selection, Strategy, Major Decisions. Work Study, Procedure. Method Study and Motion Study. Work Measurement and Productivity – Measuring Productivity and Methods to improve productivity.		
Unit – IV	**MATERIALS MANAGEMENT**	**9 Periods**
Materials Management – Planning, Budgeting and Control. Purchasing, Functions, Policies, Vendor rating and Value Analysis. Stores Management – Nature, Layout, Classification and Coding. Inventory, Costs and control techniques. Overview of JIT.		
Unit – V	**SCHEDULING AND PROJECT MANAGEMENT**	**9 Periods**
Project Management – Scheduling Techniques, PERT, CPM; Scheduling - work centers – nature, importance; Priority rules and techniques, shopfloor control; Flow shop scheduling – Johnson"s Algorithm – Gantt charts; personnel scheduling in services.		

Total: 45 Periods

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Text Books:	1.Richard B. Chase, Ravi Shankar, F. Robert Jacobs, Nicholas J. Aquilano, Operations and Supply Management, Tata McGraw Hill, 12th Edition, 2010. 2. Norman Gaither and Gregory Frazier, Operations Management, South Western Cengage Learning, 2002.
Reference Books:	1. William J Stevenson, Operations Management, Tata McGraw Hill, 9th Edition, 2009. 2. Russel and Taylor, Operations Management, Wiley, Fifth Edition, 2006. 3. Kanishka Bedi, Production and Operations Management, Oxford University Press, 2004. 4. Chary S. N, Production and Operations Management, Tata McGraw Hill, Third Edition, 2008. 5. Aswathappa K and Shridhara Bhat K, Production and Operations Management, Himalaya Publishing House, Revised Second Edition, 2008. 6. Mahadevan B, Operations Management Theory and practice, Pearson Education, 2007. 7. Pannerselvam R, Production and Operations Management, Prentice Hall India, Second Edition, 2008.
MOOC/Web Platforms:	nptel.ac.in/courses/108102191

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Appreciate the role of Production and Operations management in enabling and enhancing a firm's competitive advantages in the dynamic business environment.	Understand (K2)
CO2	Obtain sufficient knowledge and skills to forecast demand for Production and Service Systems.	Understand (K2)
CO3	Formulate and Assess Aggregate Planning strategies and Material Requirement Plan.	Understand (K2)
CO4	Develop analytical skills to calculate capacity requirements and developing capacity alternatives.	Apply (K3)
CO5	Apply scheduling and Lean Concepts for improving System Performance	Apply (K3)

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V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	-	-	1	-	-	-	-	3	-	-
CO2	3	3	2	1	-	-	1	-	-	-	-	3	-	-
CO3	3	3	2	1	-	-	1	-	-	-	-	3	-	-
CO4	3	3	2	1	-	-	1	-	-	-	-	3	-	-
CO5	3	3	2	1	-	-	1	-	-	--	-	3	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

Chairperson-Board of Studies,
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I - Course Name: 23OME14 PRODUCTION PLANNING AND CONTROL

Prerequisites	Program Name	Sem	Category	L	T	P	C
NIL	All programs except Mechanical Engineering	V / VI / VII	OEC	3	0	0	3

II - Course Objectives

1	To understand the concept of production planning and control act work study.
2	To apply the concept of product planning
3	To analyze the production scheduling,
4	To apply the Inventory Control concepts.
5	To prepare the manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).

III - Course Content

Unit – I	OVERVIEW OF PRODUCTION PLANNING CONTROL	9 Periods
Objectives and benefits of planning and control-Functions of production control-Types of production job-batch and continuous-Product development and design-Marketing aspect - Functional aspects Operational aspect-Durability and dependability aspect aesthetic aspect. Profit consideration Standardization, Simplification & specialization- Break even analysis-Economics of a new design. FORECASTING: Importance - Forecasting Techniques- qualitative methods: Jury/Expert Method, Survey method, Sales force composite method, Delphi method and quantitative methods: Simple average, moving average, smoothing coefficient, Least Square method		
Unit – II	**WORK STUDY**	**9 Periods**
Method study, basic procedure-Selection-Recording of process - Critical analysis, Development - Implementation - Micro motion and memo motion study – work measurement - Techniques of work measurement - Time study - Production study - Work sampling - Synthesis from standard data - Predetermined motion time standards.		
Unit – III	**PRODUCT PLANNING AND PROCESS PLANNING**	**9 Periods**
Product planning-Extending the original product information-Value analysis-Problems in lack of product planning-Process planning and routing-Pre requisite information needed for process planning- Steps in process planning-Quantity determination in batch production-Machine capacity, balancing- Analysis of process capabilities in a multi product system.		
Unit – IV	**PRODUCTION SCHEDULING**	**9 Periods**
Production Control Systems-Loading and scheduling-Master Scheduling- Scheduling Policies-Scheduling rules-Gantt charts-Perpetual loading-Basic scheduling problems - Line of balance – Flow production scheduling. Batch production scheduling-Product sequencing – Production Control systems- Periodic batch control. Material requirement planning kanban – Dispatching-Progress reporting and expediting-Manufacturing lead time-Techniques for aligning completion times and due dates.		

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Unit – V	INVENTORY CONTROL AND RECENT TRENDS IN PPC	9 Periods
Inventory control-Purpose of holding stock-Effect of demand on inventories-Ordering procedures. Two bin system - Ordering cycle system-Determination of Economic order quantity and economic lot size. ABC analysis - Recorder procedure-Introduction to computer integrated production planning systems elements of JUST IN TIME SYSTEMS-Fundamentals of MRP II and ERP.		

Total: 45 Periods

Text Books:	1. Chary. S.N., "Theory and Problems in Production & Operations Management", Tata McGraw Hill, 1995. 2. Elwood S.Buffa, and Rakesh K.Sarin, "Modern Production / Operations Management", 8th Edition John Wiley and Sons, 2000 3. Jain. K.C. & Aggarwal. L.N., "Production Planning Control and Industrial Management", Khanna Publishers, 1990 4. Kanishka Bedi, "Production and Operations management", 2nd Edition, Oxford university press, 2007. 5. Melynk, Denzler, " Operations management – A value driven approach" Irwin Mcgraw hill. 6. Norman Gaither, G. Frazier, "Operations Management" 9th Edition, Thomson learning IE, 2007 7. Samson Eilon, "Elements of Production Planning and Control", Universal Book Corpn.1984 8. Upendra Kachru, " Production and Operations Management – Text and cases" 1st Edition, Excel books 2007
Reference Books:	1. Jain, Jain, "Production planning and control", Khanna Publications, 1stEdition, 2012.. 2. Power Plant Engineering Author: P.K. Nag Edition: 4th Edition Publisher: McGraw Hill Education Year: 2014 3. A Textbook of Power Plant Engineering Author: R.K. Rajput Edition: Latest Edition Publisher: Laxmi Publications Year: 2007
MOOC/Web Platforms:	https:// nptel/courses/video/112105126/L01.html

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand production planning and control act work study.	Understand (K2)
CO2	Apply product planning.	Apply(K3)
CO3	Apply production scheduling.	Apply(K3)
CO4	Use Inventory Control.	Apply(K3)
CO5	Plan Manufacturing Requirement Planning (MRP II) and Enterprise Resource Planning (ERP).	Apply(K3)

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V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	-	-	2	1	1	1	-	1	1	-	-
CO2	3	1	1	-	-	2	1	1	1	-	1	1	-	-
CO3	3	1	1	-	-	2	1	1	1	-	1	1	-	-
CO4	3	1	1	-	-	2	1	1	1	-	1	1	-	-
CO5	3	1	1	-	-	2	1	1	1	-	1	1	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23OME15 QUALITY ENGINEERING

Prerequisites	Program Name	Sem	Category	L	T	P	C
NIL	All programs except Mechanical Engineering	V / VI / VII	OEC	3	0	0	3

II - Course Objectives

1	To introduce fundamental concepts, dimensions, and economics of quality engineering.
2	To impart knowledge on statistical process control using control charts for variables and attributes.
3	To develop analytical skills in advanced control tools and factorial experimental design.
4	To evaluate process stability, process capability, and measurement system capability.
5	To apply acceptance sampling methods, Taguchi techniques, and robust quality design for industrial applications.

III - Course Content

Unit – I	INTRODUCTION	9 Periods
Quality Dimensions–Quality definitions–Inspection-Quality control–Quality Assurance–Quality Planning-Quality costs–Economics of quality– Quality loss function.		
Unit – II	**CONTROL CHARTS**	**9 Periods**
Chance and assignable causes of process variation, statistical basis of the control chart, control charts for variables- X, R and S charts, attribute control charts - p, np, c and u- Construction and application		
Unit – III	**SPECIAL CONTROL**	**9 Periods**
Warning and modified control limits, control chart for individual measurements, multi-vari chart, chart for moving averages and ranges, cumulative-sum and exponentially weighted moving average control charts. Design and analysis of 2^k factorial experiments		
Unit – IV	**STATISTICAL PROCESSCONTROL**	**9 Periods**
Process stability, process capability analysis using a Histogram or probability plots and control chart. Gauge capability studies, setting specification limits. Analysis of variance (ANOVA): One-way and Two-way		
Unit – V	**ACCEPTANCE SAMPLING**	**9 Periods**
The acceptance sampling fundamental, OC curve, sampling plans for attributes, simple, double, multiple and sequential, sampling plans for variables, MIL-STD- 05DandMIL-STD-414E&IS2500 standards. Taguchi loss function, orthogonal arrays, and signal-to-noise ratio analysis for robust quality design		

Total: 45 Periods

Text Books:	1. D.C. Montgomery, Design and Analysis of Experiments, John Wiley & Sons , Eighth Edition 2. M.S.Phadke, Quality Engineering Using Robust Design, Prentice Hall , First Edition

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Reference Books:	1. S S. Singh, Total Quality Control Essentials, McGraw Hill , First Edition 2. L.S. Srinath, Reliability Engineering, EWP , First Edition
MOOC/Web Platforms:	https://www.mooc-list.com/course/quality-engineering-management-edx/ https://onlinecourses.nptel.ac.in/noc21_mg24

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Control the quality of processes using control charts for variables in manufacturing industries	Understand (K2)
CO2	Control the occurrence of defective product and the defects in manufacturing companies	Apply (K3)
CO3	Control the occurrence of defects in services.	Apply (K3)
CO4	Analysing and understanding the process capability study	Analyze (K4)
CO5	Developing the acceptance sampling procedures for incoming raw material	Apply (K3)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	1	-	2	-	1	-	-
CO2	3	3	2	2	-	-	-	-	2	-	-	1	-	-
CO3	2	3	2	2	2	2	-	-	3	2	1	2	-	-
CO4	2	3	2	2	2	3	-	-	2	1	2	2	-	-
CO5	2	3	3	2	3	2	2	-	2	1	3	2	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23OME16 SUSTAINABLE MANUFACTURING

Prerequisites	Program Name	Sem	Category	L	T	P	C
NIL	All programs except Mechanical Engineering	V / VI / VII	OEC	3	0	0	3

II - Course Objectives

1	Explain the principles of sustainability and their relevance to modern manufacturing.
2	Evaluate manufacturing processes for energy efficiency, material usage, and waste generation.
3	Integrate recycling, reuse, and remanufacturing principles into production systems.
4	Incorporate concepts such as lean manufacturing, circular economy, and green supply chain management.
5	Assess emerging technologies such as Industry 4.0, renewable energy integration, and digital twins for sustainability

III - Course Content

Unit – I	ECONOMIC SUSTAINABILITY	9 Periods
Industrial Revolution-Economic sustainability: globalization and international issues Sustainability status - Emerging issues- Innovative products- Reconfiguration manufacturing enterprises - Competitive manufacturing strategies - Performance evaluation- Management for sustainability - Assessments of economic sustainability		
Unit – II	**SOCIAL AND ENVIRONMENTAL SUSTAINABILITY**	**9 Periods**
Social sustainability – Introduction-Work management -Human rights - Societal commitment -Customers - Business practices -Modelling and assessing social sustainability. Environmental issues. pertaining to the manufacturing sector: Pollution - Use of resources -Pressure to reduce costs -Environmental management: Processes that minimize negative environmental impacts -environmental legislation and energy costs - need to reduce the carbon footprint of manufacturing Operations-Modelling and assessing environmental sustainability		
Unit – III	**SUSTAINABILITY PRACTICES**	**9 Periods**
Sustainability awareness - Measuring Industry Awareness-Drivers and barriers -Availability of sustainability indicators -Analysis of sustainability practicing -Modeling and assessment of sustainable practicing - Sustainability awareness -Sustainability drivers and barriers - Availability of sustainability indicators- Designing questionnaires- Optimizing Sustainability Indexes-Elements – Cost and time model.		
Unit – IV	**TRENDS IN SUSTAINABLE OPERATIONS**	**9 Periods**
Concepts of competitive strategy and manufacturing strategies and development of a strategic improvement programme - Manufacturing strategy in business success strategy formation and formulation - Structured strategy formulation - Sustainable manufacturing system design options - Approaches to strategy formulation - Realization of new strategies/system designs.		
Unit – V	**TRENDS IN SUSTAINABLE OPERATIONS**	**9 Periods**
Principles of sustainable operations - Life cycle assessment manufacturing and service activities - influence of product design on operations - Process analysis – Capacity management - Quality management - Inventory management - Just-In-Time systems - Resource efficient design - Consumerism and sustainable well-being.		

Total: 45 Periods

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Text Books:	1.Ibrahim Garbie, "Sustainability in Manufacturing Enterprises Concepts, Analyses and Assessments for Industry 4.0", Springer International Publishing., United States, 2016, ISBN-13: 978-3319293042. 2. Davim J.P., "Sustainable Manufacturing", John Wiley & Sons., United States, 2010, ISBN: 978-1-848-21212-1.
Reference Books:	1.Anil Markandya, Climate Change and Sustainable Development: Prospects for Developing Countries, Routledge, 2002 2.Systems Analysis for Sustainable Engineering: Theory and Applications, Ni bin Chang, McGraw Hill, Chicago, 2011. 3. S.S Purohit, Green Technology-An approach for sustainable Environment, Agrobio publication, India, 2008. 4.Meadows, D. Randers, J., Meadows. D. (2004) Limits to growths. The 30-year update. Chelsea Green Publishing. • Meadows, D. (2008) Thinking in systems. Chelsea Green Publishing.
MOOC/Web Platforms:	https:// nptel/courses/video/112105126/L01.html

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Discuss the importance of economic sustainability.	Understand (K2)
CO2	The importance of sustainable practices.	Apply (K3)
CO3	Identify drivers and barriers for the given conditions.	Apply (K3)
CO4	Formulate strategy in sustainable manufacturing.	Apply (K3)
CO5	Plan for sustainable operation of industry with environmental, cost consciousness.	Apply (K3)

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V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	-	-	2	1	1	1	-	1	1	-	-
CO2	3	1	1	-	-	2	1	1	1	-	1	1	-	-
CO3	3	1	1	-	-	2	1	1	1	-	1	1	-	-
CO4	3	1	1	-	-	2	1	1	1	-	1	1	-	-
CO5	3	1	1	-	-	2	1	1	1	-	1	1	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23OMA01 ALGEBRA AND NUMBER THEORY

Prerequisite	Programme Name	Sem	Category	L	T	P	C
NIL	All B.E/B.Tech Programmes	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1	To introduce the basic notions of groups, rings, fields which will then be used to solve related problems.
2	To examine the key questions in the Theory of Numbers.
3	To give an integrated approach to number theory and abstract algebra, and provide a firm basis for further reading and study in the subject.
4	To introduce the basic notions of congruences.
5	To apply the concepts in the real time problems by using theorems.

III - Course Content

UNIT I	**GROUPS AND RINGS**	**12 Periods**
Groups: Definition - Properties (Statements only) - Homomorphism - Isomorphism - Cyclic groups (Statements only) - Cosets - Lagrange's theorem. Rings: Definition - Sub rings - Ring homomorphism - Integral domain - Field - Integer modulo n.		
UNIT II	**FINITE FIELDS AND POLYNOMIALS**	**12 Periods**
Rings - Polynomial rings - Irreducible polynomials over finite fields - Factorization of polynomials over finite fields.		
UNIT III	**DIVISIBILITY THEORY AND CANONICAL DECOMPOSITIONS**	**12 Periods**
Division algorithm- Base-b representations – Number patterns – Prime and composite numbers – GCD – Euclidean algorithm – Fundamental theorem of arithmetic – LCM.		
UNIT IV	**DIOPHANTINE EQUATIONS AND CONGRUENCES**	**12 Periods**
Linear Diophantine equations – Congruence's – Linear Congruence's - Applications: Divisibility tests - Modular exponentiation - Chinese remainder theorem – 2x2 linear systems.		
UNIT V	**CLASSICAL THEOREMS AND MULTIPLICATIVE FUNCTIONS**	**12 Periods**
Linear Diophantine equations – Congruence's – Linear Congruence's - Applications: Divisibility tests - Modular exponentiation - Chinese remainder theorem – 2x2 linear systems.		

Total: 45 Periods

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Text Books:	1. Grimaldi, R.P and Ramana, B.V., "Discrete and Combinatorial Mathematics", Pearson Education, 5th Edition, New Delhi, 2007. 2. Thomas Koshy, "Elementary Number Theory with Applications", Elsevier Publications, New Delhi, 2002.
Reference Books:	1. P. Sivaramakrishna das and C. Vijayalakshmi, "Algebra and Number Theory", Pearson Publications, 2019. 2. Niven. I, Zuckerman's., and Montgomery, H.L., "An Introduction to Theory of Numbers", John Wiley and Sons, Singapore, 2004. 3. Lidl.R., and Pitz. G, "Applied Abstract Algebra", Springer Verlag, New Delhi, 2nd Edition, 2006.
MOOC/Web Platforms:	http://kcl.digimat.in/nptel/courses/video/111108609/L01.html https://archive.nptel.ac.in/courses/111/106/111106137/ https://nptel.ac.in/courses/111108413 https://www.youtube.com/watch?v=B1AMosLhHGU https://www.slideshare.net/slideshow/number-theory-lesson-1-introduction-to-number-theory/232368762

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Explain the fundamental concepts of advanced algebra and their role in modern mathematics and applied contexts.	Apply (K3)
CO2	Demonstrate accurate and efficient use of advanced algebraic techniques.	Understand (K 2)
CO3	Demonstrate their mastery by solving non-trivial problems related to the concepts.	Understand (K2)
CO4	Understand the concepts of congruences and their applications.	Understand (K2)
CO5	Apply the classical Theorems to the real time problems.	Apply (K3)

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V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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CO2	2	2	2	2	-	-	-	-	2	-	-	2	-	-
CO3	3	2	2	2	-	-	-	-	2	-	-	2	-	-
CO4	2	2	2	2	-	-	-	-	2	-	-	2	-	-
CO5	2	2	2	2	-	-	-	-	2	-	-	2	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23OMA02 GRAPH THEORY

Prerequisite	Programme Name	Sem	Category	L	T	P	C
NIL	All B.E/B.Tech Programmes	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1	Impart mathematical modelling to describe and explore real-world phenomena and data.
2	Provide basic understanding on Linear, quadratic, power and polynomial, exponential, and multi variable models.
3	Summarize and apply the methodologies involved in framing the real world problems related to fundamental principles of polynomial equations.

III - Course Content

Unit – I	INTRODUCTION	12 Periods
Graphs – Introduction – Isomorphism – Sub graphs – Walks, Paths, Circuits –Connectedness – Components – Euler graphs – Hamiltonian paths and circuits – Trees – Properties of trees – Distance and centers in tree – Rooted and binary trees.		
Unit – II	**TREES, CONNECTIVITY & PLANARITY**	**12 Periods**
Spanning trees – Fundamental circuits – Spanning trees in a weighted graph – cut sets – Properties of cut set – All cut sets – Fundamental circuits and cut sets – Connectivity and separability – Network flows – 1-Isomorphism – 2-Isomorphism – Combinational and geometric graphs – Planer graphs – Different representation of a planer graph.		
Unit – III	**MATRICES, COLOURING AND DIRECTED GRAPH**	**12 Periods**
Chromatic number – Chromatic partitioning – Chromatic polynomial – Matching – Covering – Four color problem – Directed graphs – Types of directed graphs – Digraphs and binary relations – Directed paths and connectedness – Euler graphs.		
Unit – IV	**PERMUTATIONS & COMBINATIONS**	**12 Periods**
Fundamental principles of counting - Permutations and combinations - Binomial theorem - combinations with repetition - Combinatorial numbers - Principle of inclusion and exclusion - Derangements - Arrangements with forbidden positions.		
Unit – V	**GENERATING FUNCTIONS**	**12 Periods**
Generating functions - Partitions of integers - Exponential generating function – Summation operator - Recurrence relations - First order and second order – Non-homogeneous recurrence relations - Method of generating functions.		

Total: 45 Periods

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Reference Books:	1. Narsingh Deo, "Graph Theory: With Application to Engineering and Computer Science", Prentice Hall of India, 2003. 2. Grimaldi R.P. "Discrete and Combinatorial Mathematics: An Applied Introduction", Addison Wesley, 1994. 3. Clark. J and Holton D.A " A First look at Graph Theory". Allied Publishers, 1995 4. Rosen K.H. " Discrete Mathematics and Its Applications" , Mc. Graw Hill, 2007.
MOOC/Web Platforms:	https://www.youtube.com/watch?v=f1JTtMP6NGw https://www.youtube.com/watch?v=fZqfkJ-cb28 https://www.youtube.com/results?search_query=MATRICES%2C+COLOURING+AND+DIRECTED+GRAPH+NPTEL+ https://www.youtube.com/watch?v=Dsi7x-A89Mw https://www.youtube.com/watch?v=QylihXAzzD8

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Write precise and accurate mathematical definitions of objects in graph theory.	Understand (K2)
CO2	Use mathematical definitions to identify and construct examples and to distinguish examples from non-examples	Apply (K3)
CO3	Validate and critically assess a mathematical proof.	Apply (K3)
CO4	Use a combination of theoretical knowledge and independent mathematics thinking in creative investigation of questions in graph theory.	Apply (K3)
CO5	Reason from definitions to construct mathematical proofs.	Analyse (K4)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	-	-	-	-	-	-	-	-	3	-	-
CO2	3	3	3	-	-	-	-	-	-	-	-	3	-	-
CO3	3	3	3	-	-	-	-	-	-	-	-	3	-	-
CO4	3	3	3	-	-	-	-	-	-	-	-	3	-	-
CO5	3	3	3	-	-	-	-	-	-	-	-	3	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23OMA03 LINEAR ALGEBRA

Prerequisite	Programme Name	Sem	Category	L	T	P	C
NIL	All B.E/B.Tech Programmes	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1	To test the consistency and solve system of linear equations.
2	To find the basis and dimension of vector space.
3	To obtain the matrix of linear transformation and its eigenvalues and eigenvectors.
4	To find orthonormal basis of inner product space and find least square approximation.
5	To find eigenvalues of a matrix using numerical techniques and perform matrix decomposition

III - Course Content

Unit – I	MATRICES AND SYSTEM OF LINEAR EQUATIONS	9 Periods
Matrices - Row echelon form - Rank - System of linear equations - Consistency - Gauss elimination method - Gauss Jordan method.		
Unit – II	**VECTOR SPACES**	**9 Periods**
Vector spaces over Real and Complex fields - Subspace – Linear space – Linear independence and dependence - Basis and dimension.		
Unit – III	**LINEAR TRANSFORMATION**	**9 Periods**
Linear transformation - Rank space and null space - Rank and nullity - Dimension theorem – Matrix representation of linear transformation - Eigenvalues and eigenvectors of linear transformation Diagonalization.		
Unit – IV	**INNER PRODUCT SPACES**	**9 Periods**
Inner product and norms - Properties - Orthogonal, Orthonormal vectors - Gram Schmidt orthonormalization process - Least square approximation.		
Unit – V	**EIGEN VALUE PROBLEMS AND MATRIX DECOMPOSITION**	**9 Periods**
Eigen value Problems: Power method, Jacobi rotation method - Singular value decomposition – QR decomposition.		

Total: 45 Periods

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Text Books:	1. Faires J.D. and Burden R., Numerical Methods, Brooks/Cole (Thomson Publications), New Delhi, 2002. 2. Friedberg A.H, Insel A.J. and Spence L, Linear Algebra, Pearson Education, 5th Edition,2019.
Reference Books:	1. Bernard Kolman, David R. Hill, Introductory Linear Algebra, Pearson Educations, New Delhi, 8th Edition, 2009. 2. Gerald C.F. and Wheatley P.O, Applied Numerical Analysis, Pearson Educations, New Delhi, 7th Edition, 2007. 3. Kumaresan S, Linear Algebra - A geometric approach, Prentice Hall of India, New Delhi, Reprint, 2010. 4. Richard Branson, Matrix Operations, Schaum's outline series, 1989. 5. Strang G, Linear Algebra and its applications, Thomson (Brooks / Cole) New Delhi, 4th Edition, 2005. 6. Sundarapandian V, Numerical Linear Algebra, Prentice Hall of India, New Delhi, 2014.
MOOC/Web Platforms:	https://nptel.ac.in/courses/111106135 https://nptel.ac.in/courses/111102011 https://www.youtube.com/watch?v=ZLh4Ud_vjB8

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Test the consistency and solve system of linear equations.	Understand (K2)
CO2	Find the basis and dimension of vector space.	Apply (K3)
CO3	Obtain the matrix of linear transformation and its eigenvalues and eigenvectors.	Apply (K3)
CO4	Find orthonormal basis of inner product space and find least square approximation.	Apply (K3)
CO5	Find eigenvalues of a matrix using numerical techniques and perform matrix decomposition.	Apply (K3)

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V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2	2	2	1	1	1	1	3	-	-
CO2	3	3	3	3	3	2	2	1	1	1	1	3	-	-
CO3	3	3	3	3	3	2	2	1	1	1	1	3	-	-
CO4	3	3	3	3	3	2	2	1	1	1	1	3	-	-
CO5	3	3	3	3	3	2	2	1	1	1	1	3	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23OMA04 OPERATIONS RESEARCH

Prerequisite	Programme Name	Sem	Category	L	T	P	C
NIL	All B.E/B.Tech Programmes	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1	To provide the concept and an understanding of basic concepts in Operations Research techniques for Analysis and Modeling in Computer Applications.
2	To understand, develop and solve mathematical model of linear programming problems
3	To understand, develop and solve mathematical model of Transport and assignment problems
4	To Understand network modeling for planning and scheduling the project activities

III - Course Content

Unit – I	LINEAR PROGRAMMING MODELS	9 Periods
Formulation of LPP, Graphical solution of LPP. Simplex Method, Artificial variables: big-M -**Two Phase method**, degeneracy and unbound solutions.		
Unit – II	**TRANSPORTATION AND ASSIGNMENT MODELS**	**9 Periods**
Formulation - Methods for finding basic Feasible Solution - Optimality Test - MODI method - Degeneracy in Transportation Problem -Unbalanced Transportation Problem. Assignment Method: Mathematical formulation of assignment models – Hungarian Algorithm – Variants of the Assignment problem		
Unit – III	**SCHEDULING BY PERT AND CPM**	**9 Periods**
Introduction - Rules to frame a Network - Fulkerson's Rule to numbering of events - Activity, Times - Critical Path Computation - Slack and Float - PERT- Steps and computing variance, Merits and demerits of PERT, CPM-Time estimating & Limitations, Comparison between PERT & CPM.		
Unit – IV	**QUEUEING MODELS**	**9 Periods**
Characteristics of Queueing Models–Poisson Queues-(M /M/1): (FIFO/∞/∞), (M / M / 1): (FIFO / N / ∞), (M / M / C): (FIFO / ∞ / ∞), (M / M / C): (FIFO / N / ∞) models.		
Unit – V	**GAME THEORY**	**9 Periods**
Competitive game, rectangular game, saddle point, minimax (maximin) method of optimal strategies- value of the game. Solution of games with saddle points, dominance principle. Rectangular games without saddle point – mixed strategy for 2 X 2 games		

Total: 45 Periods

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Reference Books:	1. Taha H.A., "Operations Research: An Introduction", 10th Edition, Prentice Hall of India, New Delhi, 2017 2. Kanti Swarup, P.K. Gupta, Man Mohan, "Operations Research", 15th Revised Edition, S. Chand& Sons Education Publications, New Delhi, 2017 3. Ronald L Rardin, Optimization in Operations Research, 2nd Edition, Pearson Education, India, 2018 4. Jatinder Kumar, Optimization Techniques in Operations Research, LAP LAMBERT Academic Publishing, 2015 5. D.S. Hira and P.K. Gupta, Operations Research, 5th Edition, S. Chand & Sons, 2015.
MOOC/Web Platforms:	www.digimat.in/nptel/courses/video/111104027/L01.html https://www.youtube.com/watch?v=Q31jKiEXxdc www.digimat.in/nptel/courses/video/110104073/L21.html https://nptel.ac.in/courses/117103017 https://onlinecourses.nptel.ac.in/noc19_ge32/preview

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand and apply linear programming to solve operational problem with constraints	Apply(K3)
CO2	Apply transportation and assignment models to find optimal solution	Apply(K3)
CO3	To prepare project scheduling using PERT and CPM	Apply(K3)
CO4	Identify and analyze appropriate queuing model to reduce the waiting time in queue.	Apply(K3)
CO5	To choose the best strategy using decision making methods under game theory.	Analyse(K4)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	-	-	-	-	-	-	-	-	-	-
CO2	3	3	3	3	2	-	-	-	-	-	-	-	-	-
CO3	3	3	2	2	-	-	-	-	-	-	-	-	-	-
CO4	3	3	2	2	-	1	-	-	-	-	-	-	-	-
CO5	3	3	2	2	-	-	-	-	-	-	-	-	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23OMA05 QUEUEING AND RELIABILITY MODELLING

Prerequisite	Programme Name	Sem	Category	L	T	P	C
NIL	All B.E/B.Tech Programmes	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1	To provide necessary basic concepts in probability and random processes for applications such as random signals, linear systems in communication engineering.
2	To understand the concept of queueing models and apply in engineering.
3	To provide the required mathematical support in real life problems and develop probabilistic models which can be used in several areas of science and engineering.
4	To study the system reliability and hazard function for series and parallel systems.
5	To implement Markovian Techniques for availability and maintainability which opens up new avenues for research

III - Course Content

Unit – I	RANDOM PROCESSES	9 Periods
Classification – Stationary process – Markov process - Poisson process – Discrete parameter Markov chain – Chapman Kolmogorov equations – Limiting distributions.		
Unit – II	**MARKOVIAN QUEUEING MODELS**	**9 Periods**
Markovian queues – Birth and death processes – Single and multiple server queueing models – Little's formula - Queues with finite waiting rooms.		
Unit – III	**ADVANCED QUEUEING MODELS**	**9 Periods**
M/G/1 queue – Pollaczek Khinchin formula - M/D/1 and M/EK/1 as special cases – Series queues – Open Jackson networks.		
Unit – IV	**SYSTEM RELIABILITY**	**9 Periods**
Reliability and hazard functions- Exponential, Normal, Weibull and Gamma failure distribution – Time - dependent hazard models – Reliability of Series and Parallel Systems.		
Unit – V	**MAINTAINABILITY AND AVAILABILITY**	**9 Periods**
Maintainability and Availability functions – Frequency of failures – Two Unit parallel system with repair – k out of m systems.		

Total: 45 Periods

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Reference Books:	1. Medhi J,"Stochastic models of Queueing Theory", Academic Press, Elsevier, Amsterdam, 2003. 2. Taha, H.A., "Operations Research", 9th Edition, Pearson India Education Services, Delhi, 2016. 3. Trivedi, K.S., "Probability and Statistics with Reliability, Queueing and Computer Science Applications", 2nd Edition, John Wiley and Sons, 2002. 4. Govil A.K., "Reliability Engineering", Tata-McGraw Hill PublishingCompany Ltd., New Delhi,1983.
MOOC/Web Platforms:	https://www.classcentral.com/course/youtube-electronics-probability-random-variables-47668 https://onlinecourses.nptel.ac.in/noc21_ee93/preview https://onlinecourses.nptel.ac.in/noc21_ee93/preview https://onlinecourses.nptel.ac.in/noc21_ce58/preview https://onlinecourses.nptel.ac.in/noc21_ce58/preview

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Enable the students to apply the concept of random processes in engineering disciplines.	Apply(K3)
CO2	Students acquire skills in analyzing various queueing models.	Apply(K3)
CO3	Students can understand and characterize phenomenon which evolve with respect to time in a probabilistic manner.	Apply(K3)
CO4	Students can analyze reliability of the systems for various probability distributions.	Apply(K3)
CO5	Students can be able to formulate problems using the maintainability and availability analyses by using theoretical approach	Analyse(K4)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	2	-	-	2	-	-
CO2	3	3	2	-	-	-	-	-	2	-	-	2	-	-
CO3	3	3	-	2	-	-	-	-	2	-	-	2	-	-
CO4	3	3	2	-	-	-	-	-	2	-	-	2	-	-
CO5	3	3	3	2	-	-	-	-	2	-	-	2	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23OMA06 RESOURCE MANAGEMENT TECHNIQUES

Prerequisite	Programme Name	Sem	Category	L	T	P	C
NIL	All B.E/B.Tech Programmes	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1	To formulate linear programming problems and solve LPP using simple algorithm.
2	To solve networking problems.
3	To formulate and solve integer programming problems.
4	To solve Non-Linear programming problems.
5	To formulate linear programming problems and solve LPP using simple algorithm.

III - Course Content

Unit – I	LINEAR PROGRAMMING	9 Periods
Principal components of decision problem – Modeling phases – LP formulation and graphic solution – Resource allocation problems – simplex method – sensitivity analysis.		
Unit – II	**DUALITY AND NETWORKS**	**9 Periods**
Definition of dual problems – primal – Dual relationships – Dual simplex method –post optimality analysis – Transportation and assignment model – Shortest route problem		
Unit – III	**INTEGER PROGRAMMING**	**9 Periods**
Cutting plan algorithm – Branch and bound methods, Multistage (Dynamic) programming		
Unit – IV	**CLASSICAL OPTIMIZATION THEORY**	**9 Periods**
Unconstrained external problems, Newton – Raphson method – Equality constraints –Jacobean methods – Lagrangian method – Kuhn – Tucker conditions – Simple problems		
Unit – V	**OBJECT SCHEDULING**	**9 Periods**
Network diagram representation – Critical path method – Time charts and resource leveling – PERT.		

Total: 45 Periods

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Text Books:	1. H.A. Taha, "Operation Research", Prentice Hall of India, 2002.
Reference Books:	1.Paneer selvam, 'Operations Research' Prentice Hall of India, 2002. 2.Anderson 'Quantitative Methods for Business', 8th Edition, Thomson Learning, 2002. 3.Winston 'Operations Research for Business', Thomson Learning, 2003. 4.Vohra, 'Quantitative Techniques in Management', Tata Mc Graw Hill, 2002. 5.Anand sarma, 'Operation Research' Himalaya Publishing House, 2003.
MOOC/Web Platforms:	https://share.google/uasnB9X2KP7TbVhjU https://share.google/G2pLV43yVjJHiPWCQ https://share.google/0ddZC1NWcqQyv6bds

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand to formulate linear programming problems and solve LPP using simple algorithm.	Understand (K2)
CO2	Understand to solve networking problems.	Understand (K2)
CO3	Understand to formulate and solve integer programming problems.	Apply(K3)
CO4	Understand to solve Non-Linear programming problems.	Understand (K2)
CO5	Understand to solve project management problems.	Apply(K3)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	3	3	2	-	-	-	-	-	-	-	-	-	-
CO2	-	3	3	2	-	-	-	-	-	-	-	-	-	-
CO3	-	3	3	2	-	-	-	-	-	-	-	-	-	-
CO4	-	3	3	2	-	-	-	-	-	-	-	-	-	-
CO5	-	3	3	2	-	-	-	-	-	-	-	-	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23OHS01 ENGLISH FOR COMPETITIVE EXAMINATIONS

Prerequisite	Programme Name	Sem	Category	L	T	P	C
NIL	All B.E/B.Tech Programmes	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1	To train the students in the language components essential to face competitive examinations both at the national (UPSC, Banking, Railway, Defense) and the international level (GRE, TOEFL, IELTS).
2	To enhance an awareness of the specific patterns in language testing and the respective skills to tackle verbal reasoning and verbal ability tests.
3	To inculcate effective practices in language-learning in order to improve accuracy in usage of grammar and coherence in writing.

III - Course Content

Unit – I	Vocabulary and Verbal Ability	9 Periods
Orientation on different formats of competitive exams Vocabulary Verbal ability Verbal reasoning - Exploring the world of words - Essential words - Meaning and their usage - Synonyms-antonyms - Word substitution - Word analogy - Idioms and phrases Commonly confused words - Spellings - Word expansion - new words in use.		
Unit – II	**Grammar and Sentence Construction**	**9 Periods**
Grammar - Sentence Improvement-Sentence completion - Rearranging phrases into sentences. Error identification-Tenses - Prepositions - Adjectives - Adverbs - Subject-verb agreement - Voice - Reported speech - Articles - Clauses - Speech patterns.		
Unit – III	**Reading and Comprehension Skills**	**9 Periods**
Reading - Specific information and detail - Identifying main and supporting ideas - Speed reading techniques Improving global reading skills Linking ideas Summarizing -Under-standing argument - Identifying opinion/attitude and making inferences - Critical reading.		
Unit – IV	**Writing and Composition Skills**	**9 Periods**
Writing - Pre-writing techniques - Mind-map - Describing pictures and facts - Paragraph structure organizing points - Rhetoric writing Improving an answer Drafting, writing and developing an argument - Focus on cohesion - Using cohesive devices -Analytic writing - Structure and types of essay Mind maps Structure of drafts, letters, memos, emails Statements of Purpose Structure, Content and Style- Technical writing.		
Unit – V	**Listening and Speaking Skills**	**9 Periods**
Listening and Speaking Contextual listening - Listening to instructions - Listening for specific information Identifying detail, main ideas Following signpost words Stress, rhythm and intonation - Speaking to respond and elicit ideas - Guided speaking - Opening phrases - Interactive communication -Sentence stress - Speaking on a topic - Giving opinions - Giving an oral presentation Telling a story or a personal anecdote - Talking about oneself Utterance Speech acts- Brainstorming ideas - Group discussion.		

Total: 45 Periods

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Text Books:	1. R.P.Bhatnagar General English for Competitive Examinations. Macmillan India Limited, 2009.
Reference Books:	1. Educational Testing Service the Official Guide to the GRE Revised General Test, Tata McGraw Hill, 2010. 2. The Official Guide to the TOEFL Test, Tata McGraw Hill, 2010. 3. R Rajagopalan- General English for Competitive Examinations, McGraw Hill Education (India) Private Limited, 2008.
MOOC/Web Platforms:	http://www.examenglish.com0 http://www.ets.org/, http://www.bankxams.com/ http://civilservicesmentor.com http://www.educationobserver.com http://www.cambridgeenglish.org/in/ http://www.examenglish.com http://www.ets.org http://www.bankxams.com/ http://civilservicesmentor.com http://www.educationobserver.com http://www.cambridgeenglish.org/in/

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Expand their vocabulary and gain practical techniques to read and comprehend a wide range of texts with the emphasis required	Understand (K2)
CO2	Identify errors with precision and write with clarity and coherence	Analyze (K4)
CO3	Understand the importance of task fulfilment and the usage of task-appropriate vocabulary	Understand (K2)
CO4	Communicate effectively in group discussions, presentations and interviews	Apply (K3)
CO5	Write topic-based essays with precision and accuracy	Apply (K3)

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V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	2	3	-	2	-	-
CO2	-	-	-	-	-	-	-	-	2	3	-	2	-	-
CO3	-	-	-	-	-	-	-	-	2	3	-	2	-	-
CO4	-	-	-	-	-	-	-	-	2	3	-	2	-	-
CO5	-	-	-	-	-	-	-	-	2	3	-	2	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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I - Course Name: 23OHS02 PROJECT REPORT WRITING

Prerequisite	Programme Name	Sem	Category	L	T	P	C
NIL	All B.E/B.Tech Programmes	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1	Understand the essentials of project writing.
2	Perceive the difference between general writing and technical writing
3	Assimilate the fundamental features of report writing.
4	Understand the essential differences that exist between general and technical writing.
5	Learn the structure of a technical and project report

III - Course Content

Unit – I	Writing Skills	9 Periods
Essential Grammar and Vocabulary – Passive Voice, Reported Speech, Concord, Signpost words, Cohesive Devices – Paragraph writing - Technical Writing vs. General Writing.		
Unit – II	**Project Report**	**9 Periods**
Definition, Structure, Types of Reports, Purpose – Intended Audience – Plagiarism– Report Writing in STEM fields – Experiment – Statistical Analysis.		
Unit – III	**Structure of the Project Report: (Part 1)**	**9 Periods**
Framing a Title – Content – Acknowledgement – Funding Details -Abstract – Introduction – Aim of the Study – Background - Writing the research question - Need of the Study/Project Significance, Relevance – Determining the feasibility – Theoretical Framework.		
Unit – IV	**Structure of the Project Report: (Part 2)**	**9 Periods**
Literature Review, Research Design, Methods of Data Collection -Tools and Procedures - Data Analysis - Interpretation - Findings – Limitations - Recommendations – Conclusion – Bibliography		
Unit – V	**Proof reading a report**	**9 Periods**
Avoiding Typographical Errors – Bibliography in required Format – Font –Spacing – Checking Tables and Illustrations – Presenting a Report Orally – Techniques		

Total: 45 Periods

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Books for study & Reference:	1. Gerson and Gerson-Technical Communication: Process and Product, 7th Edition, Prentice Hall (2012) 2. Virendra K. Pamecha - Guide to Project Reports, Project Appraisals and Project Finance (2012) 3. Daniel Riordan - Technical Report Writing Today (1998) 4. Darla-Jean Weatherford - Technical Writing for Engineering Professionals (2016) Penwell Publishers
MOOC/Web Platforms:	https://devimpactinstitute.com/courses/project-management/training-on-report writing/ https://glomacs.com/training-course/advanced-report-writing-and-presentation-skills https://www.indepthresearch.org/course/effective-report-writing-skills-course

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Write effective project reports.	Analyze (K4)
CO2	Use statistical tools with confidence.	Apply (K3)
CO3	Explain the purpose and intension of the proposed project coherently and with clarity.	Understand (K2)
CO4	Create writing texts to suit achieve the intended purpose.	Evaluate (K5)
CO5	Master the art of writing winning proposals and project	Evaluate (K5)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	2	3	-	2	-	-
CO2	-	-	-	-	-	-	-	-	2	3	-	2	-	-
CO3	-	-	-	-	-	-	-	-	2	3	-	2	-	-
CO4	-	-	-	-	-	-	-	-	2	3	-	2	-	-
CO5	-	-	-	-	-	-	-	-	2	3	-	2	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

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