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.E. – CIVIL ENGINEERING
CURRICULUM AND SYLLABUS

CHOICE BASED CREDIT SYSTEM (CBCS)

REGULATION – 2023

Chairperson-Board of Studies,
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I - Department Vision

To inculcate students with ingenious technical knowledge and ethical skills to develop qualified Civil Engineers.

II - Department Mission

- To provide quality education with field training to create competent civil engineer.
- To develop innovative applications in the design and construction of structural works.

III - Program Name: B.E., CIVIL ENGINEERING

IV- Program Educational Objectives

Students who graduate from this Programme will be able

1. To become successful in the field of Civil Engineering that meets the needs of Indian and multi-national companies.
2. To develop the confidence and ability among students to synthesize data and technical concepts and thereby apply it in real world problems.
3. To utilize modern techniques, skill and mathematical engineering tools for solving problems in Civil Engineering.
4. To provide students with a sound foundation in mathematical, scientific and engineering fundamentals necessary to formulate, solve and analyze engineering problems and to prepare them for graduate studies.
5. To promote students to work collaboratively on multi-disciplinary projects and make them engage in life-long learning process throughout their professional life.

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 and design 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.

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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 engineering activities 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.
11. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to ones 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

- Identify, examine and solve problems in the domains of Civil Engineering that needs analytical and design requirements.
- Plan, analyze, design and prepare estimate for Civil Engineering projects with professional ethics

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VII - Mapping of PEOs, POs, and PSO

POs/ PEOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
I	S	S	S	S	S	M	M	L	S	S	S	S	S	S
II	S	S	S	S	L	L	M	L	L	L	S	S	S	S
III	S	S	S	S	M	M	M	M	S	S	S	S	S	S
IV	S	S	S	S	S	S	S	S	S	S	S	S	S	S
V	S	S	S	S	S	S	S	S	S	S	S	S	S	S

VIII - Program Scope

1. To provide strong fundamental foundation by concentrating on essential core of Scientific & Engineering basics in the Field of Civil Engineering.
2. To provide for Continuing education & Lifelong Learning.
3. To help the students to solve real time problems in the society.
4. To promote creativity, Critical Thinking, develop problem solving skill or preparing student for further education or Employment

IX - Program Specific Criteria

Curriculum:

- Apply knowledge of mathematics through differential equations, calculus-based physics, chemistry, and at least one additional area of science, consistent with the program educational objectives.
- Apply knowledge in Civil Engineering areas such as Structures, Construction techniques, Geotechnical, Geo - informatics, Transportation, Environment and Water resources and their problem identification, formulation, analysis, design and execution.
- Explain basic concepts in management, business, public policy, and leadership and explain the importance of professional licensure.

Faculty:

- The program must show that instructors of courses with a focus on design are competent to teach the subject matter either by professional licensing or field of expertise in Civil Engineering program.
- The program must show that it is not critically dependent on a single person.

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X– 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
2	23HS101	Professional English-I	HSMC	3	0	0	3	3
3	23MA101	Matrices & 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	தமிழர் மரபு / Heritage of Tamils	HSMC	1	0	0	1	1
LABORATORY								
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.	Course Code	Course Title	Curricular Category	Period Per Week			Total Contact Periods	Credits
				L	T	P		
1	23HS201	Professional English – II	HSMC	2	0	0	2	2
2	23MA201	Statistics and Numerical methods	BSC	3	1	0	4	4
3	23PH201	Physics for Civil Engineering	BSC	3	0	0	3	3
4	23BE202	Basic Electrical, Electronics and Instrumentation Engineering	ESC	3	0	0	3	3
5	23GE201	தமிழரும் தொழில்நுட்பமும் / Tamils and Technology	HSMC	1	0	0	1	1
6	23GE202	Engineering Graphics	ESC	2	0	4	6	4
7	23ME201	Engineering Mechanics	ESC	3	0	0	3	3
8		NCC Credit Course level – 1#	-	2	0	0	2	2#
LABORATORY								
9	23GE211	Engineering Practices Laboratory	ESC	0	0	3	3	1.5
10	23BE211	Basic Electrical, Electronics and Instrumentation Engineering Laboratory	ESC	0	0	3	3	1.5
11	23GE212	English Laboratory - II	EEC	0	0	2	2	1
Total				17	1	12	30	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		
1	23MA301	Transforms and Applications of Partial Differential Equations	BSC	3	1	0	4	4
2	23CE301	Mechanics of Materials	PCC	3	0	0	3	3
3	23CE302	Fluid Mechanics	PCC	3	0	0	3	3
4	23CE303	Surveying	PCC	3	0	0	3	3
5	23CE304	Construction Materials and Technology	PCC	3	0	0	3	3
LABORATORY								
6	23CE311	Surveying Laboratory	PCC	0	0	4	4	2
7	23CE312	Building Drawing Laboratory	PCC	0	0	4	4	2
8	23CE313	Material Testing Laboratory	PCC	0	0	4	4	2
9	23CEAO1	Value added course – I [$]	EEC	0	0	2	2	1[$]
Total				**15**	**1**	**14**	**30**	**22**

[$] **Value Added Course I - The grade earned by the students will be recorded in the mark sheet. It will not be considered for computation of CGPA**

Semester – IV

S. No.	Course Code	Course Title	Curricular Category	Period Per Week			Total Contact Periods	Credits
				L	T	P		
1	23CE401	Geotechnical Engineering - I	PCC	3	0	0	3	3
2	23CE402	Concrete Technology	PCC	3	0	0	3	3
3	23CE403	Hydraulic Engineering	PCC	3	0	0	3	3
4	23CE404	Water supply and Wastewater Engineering	PCC	4	0	0	4	4
5	23CE405	Highway and Railway Engineering	PCC	3	0	0	3	3
6	23GE901	Environmental Sciences and Sustainability	BSC	2	0	0	2	2
7		NCC Credit Course level –2[#]	-	3	0	0	3	3[#]
LABORATORY								
8	23CE411	Hydraulic Engineering Laboratory	PCC	0	0	4	4	2
9	23CE412	Water and Waste water Engineering Laboratory	PCC	0	0	4	4	2
10	23CE413	Geotechnical Laboratory	PCC	0	0	4	4	2
11	23CEAO2	Value added course – II[$]	EEC	0	0	2	2	1[$]
Total				**18**	**0**	**14**	**32**	**24**

[#] 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.

[$] Value Added course- II - The grade earned by the students will be recorded in the mark sheet. It will not be considered for computation

n 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		
1	23CE501	Design of RC structural elements	PCC	3	1	0	4	4
2	23CE502	Structural Analysis – I	PCC	3	0	0	3	3
3	23CE503	Geotechnical Engineering - II	PCC	3	0	0	3	3
4		Professional Elective - I	PEC	3	0	0	3	3
5		Professional Elective - II	PEC	3	0	0	3	3
6		Open Elective – I~	OEC	3	0	0	3	3~
7		Mandatory course*	MC	3	0	0	3	0*
LABORATORY								
8	23CE511	Concrete & Highway Engineering Laboratory	PCC	0	0	4	4	2
9	23CE512	Survey Camp (2 weeks)	EEC	0	0	0	0	1
10	23CE513	Industry Internship - I	EEC	0	0	0	0	1
Total				**21**	**1**	**4**	**26**	**23**

* Mandatory Course-I is a Non-credit Course (Student shall select one course from the list given under MC-I)

~ Open Elective – I shall be chosen from the emerging technologies

Semester – VI

S. No.	Course Code	Course Title	Curricular Category	Period Per Week			Total Contact Periods	Credits
				L	T	P		
1	23CE601	Design of steel structures	PCC	3	0	0	3	3
2	23CE602	Structural Analysis –II	PCC	3	0	0	3	3
3	23CE603	Estimation, Costing and Professional Practice	PCC	3	0	0	3	3
4		Professional Elective - III	PEC	3	0	0	3	3
5		Professional Elective - IV	PEC	3	0	0	3	3
6		Open Elective – II~	OEC	3	0	0	3	3~
LABORATORY								
7	23CE611	Computer Aided Design and Analysis Laboratory	PCC	0	0	4	4	2
8	23CE612	Creative and Innovative Project	EEC	0	0	4	4	2
Total				**18**	**0**	**10**	**28**	**22**

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Semester – VII

S. No.	Course Code	Course Title	Curricular Category	Period Per Week			Total Contact Periods	Credits
				L	T	P		
1	23CE701	Water Resources and Irrigation Engineering	PCC	3	0	0	3	3
2	23CE702	Construction Project Management	PCC	3	0	0	3	3
3		Management Elective[&]	HSMC	3	0	0	3	3[&]
4		Professional Elective - V	PEC	3	0	0	3	3
5		Professional Elective - VI	PEC	3	0	0	3	3
6		Open Elective – III~	OEC	3	0	0	3	3~
LABORATORY								
7	23CE711	Industry Internship - II	EEC	0	0	0	0	1
			Total	**18**	**0**	**0**	**18**	**19**

Semester –VIII

S. No.	Course Code	Course Title	Curricular Category	Period Per Week			Total Contact Periods	Credits
				L	T	P		
1	23CE811	Project Work	EEC	0	0	20	20	10
			Total	**0**	**0**	**20**	**20**	**10**

XI – Management Courses

S. No.	Course Code	Course Title	Curricular 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	Curricular Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
1	23MC901	English for Communication SWAYAM/BEC	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 Buildingand 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 (Structures)	VERTICAL II (Construction techniques and Practices)	VERTICAL III (Geotechnical)	VERTICAL IV (Geo-Informatics)	VERTICAL V (Transportation infrastructure)	VERTICAL VI (Environment)	VERTICAL VII (Water Resources)
Concrete Structures	Formwork Engineering	Geo-Environmental Engineering	Total Station and GPS Surveying	Airports and Harbours	Air and Noise Pollution Control Engineering	Participatory Water Resources Management
Prestressed concrete structures	Construction Equipment and Machinery	Ground Improvement Techniques	Remote Sensing Concepts	Traffic Engineering and Management	Environmental Impact Assessment	Groundwater Engineering
Prefabricated Structures	Sustainable Construction and Lean Construction	Soil Dynamics and Machine Foundations	Satellite Image Processing	Urban Planning and Development	Industrial Wastewater Management	Water Resources Systems Engineering
Repair and Rehabilitation of Structures	Construction Management and Safety	Earth and Earth Retaining Structures	Cartography And GIS	Smart cities	Solid and Hazardous Waste Management	Integrated Water Resources Management
Dynamics and Earthquake Resistant Structures	Advanced Construction Techniques	Pile Foundation	Photogrammetry	Intelligent Transport Systems	Environmental Policy and Legislations	Urban Water Infrastructure
Introduction to Finite Element Method	Energy Efficient Buildings	Tunneling Engineering	Airborne and Terrestrial laser mapping	Pavement Engineering	Environment, Health and Safety	Water Quality and Management

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Professional Elective Courses

Vertical - I: Concrete Structures

S. No.	Course Code	Course Title	Curricular Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
1	23PCE01	Concrete Structures	PEC	3	0	0	3	3
2	23PCE02	Prestressed Concrete Structures	PEC	3	0	0	3	3
3	23PCE03	Prefabricated Structures	PEC	3	0	0	3	3
4	23PCE04	Repair and Rehabilitation of Structures	PEC	3	0	0	3	3
5	23PCE05	Dynamics and Earthquake Resistant Structures	PEC	3	0	0	3	3
6	23PCE06	Introduction to Finite Element Method	PEC	3	0	0	3	3

Vertical 2: Construction Techniques and Practices

S. No.	Course Code	Course Title	Curricular Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
1	23PCE07	Formwork Engineering	PEC	3	0	0	3	3
2	23PCE08	Construction Equipment and Machinery	PEC	3	0	0	3	3
3	23PCE09	Sustainable Construction and Lean Construction	PEC	3	0	0	3	3
4	23PCE10	Construction Management and Safety	PEC	2	0	2	4	3
5	23PCE11	Advanced Construction Techniques	PEC	3	0	0	3	3
6	23PCE12	Energy Efficient Buildings	PEC	3	0	0	3	3

Vertical 3: Geotechnical

S. No.	Course Code	Course Title	Curricular Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
1	23PCE13	Geo-environmental Engineering	PEC	3	0	0	3	3
2	23PCE14	Ground Improvement Techniques	PEC	3	0	0	3	3
3	23PCE15	Soil Dynamics and Machine Foundations	PEC	3	0	0	3	3
4	23PCE16	Earth and Earth Retaining Structures	PEC	3	0	0	3	3
5	23PCE17	Pile Foundation	PEC	3	0	0	3	3
6	23PCE18	Tunneling Engineering	PEC	3	0	0	3	3

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Vertical 4: Geo-Informatics

S. No.	Course Code	Course Title	Curricular Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
1	23PCE19	Total Station and GPS Surveying	PEC	3	0	0	3	3
2	23PCE20	Remote Sensing Concepts	PEC	3	0	0	3	3
3	23PCE21	Satellite Image Processing	PEC	3	0	0	3	3
4	23PCE22	Cartography and GIS	PEC	3	0	0	3	3
5	23PCE23	Photogrammetry	PEC	3	0	0	3	3
6	23PCE24	Airborne and Terrestrial laser mapping	PEC	3	0	0	3	3

Vertical 5: Transportation Infrastructure

S. No.	Course Code	Course Title	Curricular Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
1	23PCE25	Airports and Harbours	PEC	3	0	0	3	3
2	23PCE26	Traffic Engineering and Management	PEC	3	0	0	3	3
3	23PCE27	Urban Planning and Development	PEC	3	0	0	3	3
4	23PCE28	Smart cities	PEC	3	0	0	3	3
5	23PCE29	Intelligent Transport Systems	PEC	3	0	0	3	3
6	23PCE30	Pavement Engineering	PEC	3	0	0	3	3

Vertical 6: Environment

S. No.	Course Code	Course Title	Curricular Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
1	23PCE31	Air and Noise Pollution Control Engineering	PEC	3	0	0	3	3
2	23PCE32	Environmental Impact Assessment	PEC	3	0	0	3	3
3	23PCE33	Industrial Wastewater Management	PEC	3	0	0	3	3
4	23PCE34	Solid and HazardousWaste Management	PEC	3	0	0	3	3
5	23PCE35	Environmental Policy and Legislations	PEC	3	0	0	3	3
6	23PCE36	Environment, Health and Safety	PEC	3	0	0	3	3

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Vertical 7: Water Resources

S. No.	Course Code	Course Title	Curricular Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
1	23PCE37	Participatory Water Resources Management	PEC	3	0	0	3	3
2	23PCE38	Ground Water Engineering	PEC	3	0	0	3	3
3	23PCE39	Water Resources Systems Engineering	PEC	3	0	0	3	3
4	23PCE40	Integrated Water Resources Management	PEC	3	0	0	3	3
5	23PCE41	Urban Water Infrastructure	PEC	3	0	0	3	3
6	23PCE42	Water Quality and Management	PEC	3	0	0	3	3

XIV - Open Electives

S. No.	Course Code	Course Title	Curricular Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
1	23OCS01	Artificial Intelligence and Machine Learning Fundamentals	OEC	3	0	0	3	3
2	23OCS02	Fundamentals of Augmented Reality /Virtual Reality	OEC	3	0	0	3	3
3	23OCS03	Data Science Fundamentals	OEC	3	0	0	3	3
4	23OCS04	Introduction to Data Structures using Python	OEC	3	0	0	3	3
5	23OCS05	IoT Concepts and Applications	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	Fundamentals of Wearable Devices	OEC	3	0	0	3	3

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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
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 System	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	Operation 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

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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

XV Summary of Curriculum Components with Credits

S. No.	Curricular Components	Semester wise								Total Credits	Credit Weightage
		I	II	III	IV	V	VI	VII	VIII		
1	HSMC	4	3					3		10	6.02
2	BSC	12	7	4	2					25	15.06
3	ESC	5	13							18	10.84
4	PCC			18	22	12	11	6		69	41.57
5	PEC					6	6	6		18	10.84
6	OEC					3	3	3		09	5.42
7	EEC	1	1			2	2	1	10	17	10.24
8	MC (NON – CREDIT)					✓				-	-
	TOTAL	22	24	22	24	23	22	19	10	166	100

HSMC – Humanities and Social Science including Management courses
BSC – Basic Science Courses
ESC – Engineering Science Courses
PCC – Professional Core Courses
PEC – Professional Elective Courses
OEC – Open Elective Courses
EEC – Employability Enhancement Courses
MC – Mandatory Courses

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SEMESTER – I

23IP100 INDUCTION PROGRAMME

This is a mandatory two week Programme to be conducted as soon as the students enter the institution. Normal classes start only after the induction program is over. The induction Programme has been introduced by AICTE with the following objective: "Engineering colleges were established to train graduates well in the branch/department of admission, have a holistic outlook, and have a desire to work for national needs and beyond. The graduating student must have knowledge and skills in the area of his/her study. However, he/she must also have broad understanding of society and relationships. Character needs to be nurtured as an essential quality by which he/she would understand and fulfill his/her responsibility as an engineer, a citizen and a human being. Besides the above, several meta-skills and underlying values are needed." "One will have to work closely with the newly joined students in making them feel comfortable, allow them to explore their academic interests and activities, reduce competition and make them work for excellence, promote bonding within them, build relations between teachers and students, give a broader view of life, and build character. " Hence, the purpose of this programme is to make the students feel comfortable in their new environment, open them up, set a healthy daily routine, create bonding in the batch as well as between faculty and students, develop awareness, sensitivity and understanding of the self, people around them, society at large, and nature. The following are the activities under the induction program in which the student would be fully engaged throughout the day for the entire duration of the program.

(i) Physical Activity

This would involve a daily routine of physical activity with games and sports, yoga, gardening, etc.

(ii) Creative Arts

Every student would choose one skill related to the arts whether visual arts or performing arts. Examples are painting, sculpture, pottery, music, dance etc. The student would pursue it every day for the duration of the program. These would allow for creative expression. It would develop a sense of aesthetics and also enhance creativity which would, hopefully, grow into engineering design later.

(iii) Universal Human Values

This is the anchoring activity of the Induction Programme. It gets the student to explore oneself and allows one to experience the joy of learning, stand up to peer pressure, take decisions with courage, be aware of relationships with colleagues and supporting stay in the hostel and department, be sensitive to others, etc. A module in Universal Human Values provides the base. Methodology of teaching this content is extremely important. It must not be through do's and dont's, but get students to explore and think by engaging them in a dialogue. It is best taught through group discussions and real life activities rather than lecturing. Discussions would be conducted in small groups of about 20 students with a faculty mentor each. It would be effective that the faculty mentor assigned is also the faculty advisor for the student for the full duration of the UG Programme.

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(iv) Literary Activity

Literary activity would encompass reading, writing and possibly, debating, enacting a play etc.

(v) Proficiency Modules

This would address some lacunas that students might have, for example, English, computer familiarity etc.

(vi) Lectures by Eminent People

Motivational lectures by eminent people from all walks of life should be arranged to give the students exposure to people who are socially active or in public life.

(vii) Visits to Local Area

A couple of visits to the landmarks of the city, or a hospital or orphanage could be organized. This would familiarize them with the area as well as expose them to the under privileged.

(viii) Familiarization to Dept./Branch & Innovations

They should be told about what getting into a branch or department means what role it plays in society, through its technology. They should also be shown the laboratories, workshops & other facilities.

(ix) Department Specific Activities

About a week can be spent in introducing activities (games, quizzes, social interactions, small experiments, design thinking etc.) that are relevant to the particular branch of Engineering/Technology/Architecture that can serve as a motivation and kindle interest in building things (become a maker) in that particular field. This can be conducted in the form of a workshop. For example, CSE and IT students may be introduced to activities that kindle computational thinking, and get them to build simple games. ECE students may be introduced to building simple circuits as an extension of their knowledge in Science, and so on. Students may be asked to build stuff using their knowledge of science.

Induction Programme is totally an activity based programme and therefore there shall be no tests / assessments during this programme.

References: Guide to Induction program from AICTE

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SEMESTER - I

I – Course Code & 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 & FUNDAMENTALS OF COMMUNICATION	9 Periods

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 introducing oneself. **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 – Words often confused.

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** – Compoun d Nouns, Homonyms; and Homophones, discourse markers (connectives & sequence words).

Unit – IV	CLASSIFICATION AND RECOMMENDATIONS	9 Periods

Writing – Note-making / Note-taking; 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.

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Unit – V	EXPRESSION	9 Periods
Reading – Reading editorials; and Opinion Blogs; **Writing** – Essay Writing (Descriptive or narrative). **Grammar**–Mixed Tenses - Punctuation; Simple, Compound & Complex Sentences. **Vocabulary** - Cause & Effect Expressions – Content vs Functionwords – British & American vocabulary (spelling and word changes)		

Total Periods: 45

Text Books:	1. English for Engineers & Technologists Orient Blackswan Private Ltd. Department of English, Anna University, (2020 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:	1. https://onlinecourses.nptel.ac.in/noc23_hs115/preview

IV - Course Outcomes

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 grammatical 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)

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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	-	2	-	-
CO2	-	-	-	-	-	-	-	-	3	3	-	2	-	-
CO3	-	-	-	-	-	-	-	-	3	3	-	2	-	-
CO4	-	-	-	-	-	-	-	-	3	3	-	2	-	-
CO5	-	-	-	-	-	-	-	-	3	3	-	2	-	-

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

VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
√	√					√	√		√	

I – Course Code & 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.

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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 - Irrigational 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.		
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.		

Total Periods: 60

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 Unit –s 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.

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	7. Thomas. G. B., Hass. J, and Weir. M.D, "Thomas Calculus", 14th Edition, Pearson India, 2018.
MOOC/Web Platforms:	1. https://nptel.ac.in/courses/122104018 2. https://archive.nptel.ac.in/courses/111/106/111106146/ 3. https://onlinecourses.nptel.ac.in/noc21_ma16/preview 4. https://digimat.in/nptel/courses/video/111105122/L01.html

IV - Course Outcomes

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)

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	1	1	-	-	-	-	2	-	2	3	-	-
CO2	3	3	1	1	-	-	-	-	2	-	2	3	-	-
CO3	3	3	1	1	-	-	-	-	2	-	2	3	-	-
CO4	3	3	1	1	-	-	-	-	2	-	2	3	-	-
CO5	3	3	-	-	-	-	-	-	2	-	-	2	-	-

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

VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
√	√						√	√	√	

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I – Course Code & Name: 23PH101 Engineering Physics

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 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:

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Bridgman method.

Total Periods: 45

Text & Reference Books	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:	1. https://onlinecourses.nptel.ac.in/noc20_mm13/preview 2. https://www.noaa.gov/jetstream/satellites/electromagnetic-waves 3. https://fractory.com/fibre-lasers-explained/ 4. https://www.livescience.com/33816-quantum-mechanics-explanation.html 5. https://archive.nptel.ac.in/courses/115/104/115104109/

IV - Course Outcomes

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)

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	3	-	-	2	-	-	-	-	3	-	-
CO2	3	2	3	2	-	-	2	-	-	-	-	3	-	-
CO3	3	3	3	3	-	-	-	-	-	-	-	3	-	-
CO4	3	3	3	2	-	-	3	-	-	-	-	2	-	-
CO5	3	2	3	3	-	-	-	-	-	-	-	1	-	-

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

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VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
√	√						√		√	

I – Course Code & 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 nanomaterial.
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: Definition and significance of-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

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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.

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 Periods: 45

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.

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	6. Gowariker V.R., Viswanathan N.V. and Jayadev Sreedhar, "Polymer Science", New Age International P (Ltd.,) Chennai, 4th Edition , 2021.
MOOC/Web Platforms:	1. https://nptel.ac.in/courses

IV - Course Outcomes

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)

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	-	-	-	3	-	-	-	-	2	-	-
CO2	2	1	1	-	-	-	3	-	-	-	-	2	-	-
CO3	2	1	1	-	-	-	3	-	-	-	-	2	-	-
CO4	2	1	1	-	-	-	1	-	-	-	-	2	-	-
CO5	3	2	2	-	-	-	3	-	-	-	-	3	-	-

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

VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
√	√						√		√	

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I – Course Code & 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 & Mechanical	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.

Unit – V	FILES, MODULES, PACKAGES	9 Periods

Files and exception: 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).

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	Total Periods: 45
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 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:	1. https://www.python.org/ 2. Introduction to C (w3schools.com)

IV - Course Outcomes

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)

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	3	3	2	2	-	-	-	-	-	2	3	-	-
CO3	3	3	3	2	2	-	-	-	-	-	2	3	-	-
CO4	3	2	2	-	-	-	-	-	-	-	2	-	-	-
CO5	3	3	3	2	3	-	-	-	-	-	2	3	-	-

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

VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
√	√	√					√		√	

I – Course Code & Name: 23GE103 தமிழர்மரபு /Heritage of Tamils

Prerequisite	Program Name	Sem	Category	L	T	P	C
Nil	B.E./B.TECH. – Common To All Branches	I	ESC	1	0	0	1

III - Course Content

Unit – I	**LANGUAGE AND LITERATURE**	**9 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**	**9 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**	**9 Periods**
Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leatherpuppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.		
Unit – IV	**THINAI CONCEPT OF TAMILS**	**9 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**	**9 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 Periods: 45

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Text Books & Reference Books:	1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே. கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம். 2. கணினித்தமிழ் – முனைவர் - இல. சுந்தரம். (விகடன் பிரசுரம்). 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. 7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies). 8. The Contributions of the Tamils to Indian Culture (Dr. M. Valarmathi) (Published by: International Institute of Tamil Studies.) 9. 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) 10. Studies in the History of India with Special Reference to Tamil Nadu (Dr. K. K. Pillay) (Published by: The Author) 11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu) 12. Journey of Civilization Indus to Vaigai (R. Balakrishnan) (Published by: RMRL) – Reference Book.

VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
√	√					√	√		√	

I – Course Code & 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 and Mechanical	I	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 worldproblems

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4.	To use Python data structures - lists, tuples, dictionaries
5.	To do input/output with files in Python.

III - Course Content

EXPERIMENTS	
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. **Total Periods - 60**	
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 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. Martin C. Brown, "Python: The Complete Reference", 4th Edition, Mc-Graw Hill, 2018.

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MOOC/Web Platforms:	1. https://www.python.org/

IV - Course Outcomes

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	Understand the concepts of compound data using Python lists, tuples, and dictionaries.	Understand (K2)
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)

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	-	-	2	-	3	2	2	-	-
CO2	3	3	3	2	2	-	-	2	-	3	2	3	-	-
CO3	3	2	1	2	-	-	-	2	-	3	2	3	-	-
CO4	3	2	2	2	2	-	-	-	2	-	2	3	-	-
CO5	3	3	3	2	2	-	-	-	2	-	2	3	-	-

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

VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
	√	√				√		√		

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I – Course Code & Name: 23BS111 Physics and Chemistry Laboratory

Prerequisite	Program Name	Sem	Category	L	T	P	C
Nil	B.E./B.Tech. – Common To All Branches	I	BSC	0	0	4	2

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.

Total Periods: 60

IV - Course Outcomes (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 (K2)
CO2	Apply the principles of operations of optical fibers, semiconductor using simple circuits and interaction of electromagnetic waves and crystalline solids.	Apply (K3)
CO3	Measure the elastic moduli and moment of inertia of given materials with the help of suggested procedures.	Apply (K3)
CO4	Experiment the relationship between the light and matter & properties of liquids.	Analyze (K4)

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CO5	Estimate the thermal properties and thermal behavior of the material.	Understand (K2)

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.

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 (8th edition, 2014).
MOOC/Web Platforms:	-

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IV - Course Outcomes

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)

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	3	2	-	-	-	-
CO2	3	1	-	-	-	-	-	1	2	1	-	-	-	-
CO3	3	3	-	-	-	-	-	2	2	1	-	-	-	-
CO4	3	2	-	-	-	-	-	1	3	2	-	-	-	-
CO5	3	2	-	-	-	-	-	2	1	2	-	-	-	-

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

VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
	√	√				√		√		

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I – Course Code & 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 and grammar 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. 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.

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.

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	Total Periods: 30
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:	1. https://www.digitalteacher.in/english-language-lab

IV - Course Outcomes

	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)

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

VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
√	√					√			√	

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SEMESTER – II

I – Course Code & Name: 23HS201 Professional English-II

Prerequisite	Program Name	Sem	Category	L	T	P	C
Nil	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; Writing – Agenda & Minutes of the meeting - Compare and Contrast Essay; Grammar – Parts of speech (Conversion of one form into another form) – Kinds of sentences		
Unit – II	**EXPRESSING CAUSAL RELATIONS IN SPEAKING AND WRITING**	**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 - Active & Passive Voice - Infinitive and Gerunds.		
Unit – III	**PROBLEM SOLVING**	**6 Periods**
Reading - Case Studies, excerpts from literary texts, news reports etc. Writing – Letter to the Editor, Checklists, Circular drafting -Problem solution essay / Argumentative Essay. Grammar – Error correction; If conditional sentences.		
Unit – IV	**REPORTING OF EVENTS AND RESEARCH**	**6 Periods**
Reading –Newspaper articles; Writing – Accident Report with Recommendations, Survey Report; Grammar – Reported Speech, Modals – Conjunctions- Sentence pattern		
Unit – V	**THE ABILITY TO PUT IDEAS OR INFORMATION COGENTLY**	**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.		
		Total Periods: 45

Text Books:	1. English for Engineers & Technologists (2020 edition) Orient Blackswan Private Ltd.Department of English, Anna University.

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	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:	1. https://onlinecourses.nptel.ac.in/noc23_hs115/preview

IV - Course Outcomes

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.	Understand (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)

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

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VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
√	√						√		√	

I – Course Code & Name: 23MA201 Statistics and Numerical Methods

Prerequisite	Program Name	Sem	Category	L	T	P	C
Nil	Common to B. E (CIVIL, EEE, MECHANICAL) & B. Tech (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		

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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.		
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.		
		Total Periods: 60
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, 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 Outcomes

	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	Apply 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)

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CO5	Solve the ordinary differential equations with initial conditions by using certain techniques with engineering applications.	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	3	3	1	1	1	-	-	-	2	-	2	3	-	-
CO2	3	3	1	1	1	-	-	-	2	-	2	3	-	-
CO3	3	3	1	1	1	-	-	-	2	-	2	3	-	-
CO4	2	3	1	1	1	-	-	-	2	-	2	3	-	-
CO5	3	3	1	1	1	-	-	-	2	-	2	3	-	-

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

VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
√	√						√	√	√	

I – Course Code & Name: 23PH201 Physics for Civil Engineering

Program Name	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Civil Engineering	II	BSC	3	0	0	3

II - Course Objectives

1.	To provide an introduction to the fundamentals of heat transmission through various materials, building thermal performance, and diverse thermal applications.
2.	To dissemination of information on building ventilation and air conditioning.
3.	To introduce the ideas of soundproofing and lighting layouts..
4.	To describe the properties and uses of dielectric, and superconducting materials.
5.	To create knowledge of safety precautions and natural disasters

III - Course Content

Preamble:
The purpose of this course is to provide information to students about thermal applications, ventilation, sound absorption materials, ceramics, and natural disasters. In the civil engineering Programme, it also comprehends the ideas described above.

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Unit – I	THERMAL APPLICATIONS	9 Periods
Principles of heat transfer, steady state of heat flow, conduction through compound media - series and parallel - conductivity of rubber tube and powder materials - heat transfer through fenestrations, thermal insulation and its benefits - heat gain and heat loss estimation - factors affecting the thermal performance of buildings, thermal comfort, shading devices - central heating.		
Unit – II	**VENTILATION AND REFRIGERATION**	**9 Periods**
Requirements, principles of natural ventilation - ventilation measurements, design for natural ventilation - window types and packaged air conditioners - chilled water plant - fan coil systems - water piping - cooling load - air conditioning systems for different types of buildings - protection against fire to be caused by A.C.Systems..		
Unit – III	**ACOUSTICS AND LIGHTING DESIGNS**	**9 Periods**
Methods of sound absorptions - absorbing materials - noise and its measurements, sound insulation and its measurements. visual field glare, colour - day light calculations - daylight design of windows, measurement of day-light and use of models and artificial skies, principles of artificial lighting, supplementary artificial lighting.		
Unit – IV	**NEW ENGINEERING MATERIALS**	**9 Periods**
Composites - fibre reinforced plastics (FRP) and fiber reinforced metals (FRM) - metallic glasses - shape memory alloys - ceramics - bonded ceramics - slip casting - isostatic pressing - gas pressure bonding - properties of ceramic fibres - ferroelectric and ferromagnetic ceramics - high aluminium ceramics..		
Unit – V	**NATURAL DISASTERS**	**9 Periods**
Seismology and seismic waves - earth quake ground motion - basic concepts and estimation techniques - site effects - probabilistic and deterministic seismic hazard analysis - cyclone and flood hazards - fire hazards and fire protection, fire-proofing of materials, fire safety regulations and firefighting equipment - prevention and safety measures.		
		Total Periods: 45

Text & Reference Books:	1. Marko Pinteric, Building Physics, Springer 2017. 2. Peter A. Claisse, Civil Engineering Materials, Elsevier, 2016. 3. Hugo Hens, Building Physics: Heat, Air and Moisture, Wiley, 2017 4. W.R.Stevens. Building Physics: Lighting. Pergamon Press, 2013. 5. K.G.Budinski and M.K.Budinski. Engineering Materials: Properties and 6. Selection. Pearson Education, 2016.
MOOC/Web Platforms:	1. https://onlinecourses.nptel.ac.in/noc23_me31/preview 2. https://beeindia.gov.in/sites/default/files/3Ch4.pdf 3. https://www.slideshare.net/nikitaloknathan/light-acoustics 4. https://www.slideshare.net/tparikh25/new-engineering-materials 5. https://archive.nptel.ac.in/courses/105/104/105104183/

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IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	To learn about thermal performance of buildings, insulation, and heat transfer through various materials..	Understand (K2)
CO2	To know about building air conditioning and ventilation systems..	Understand (K2)
CO3	To comprehend the ideas behind lighting schemes, noise insulation, and sound absorption..	Apply (K3)
CO4	To appreciate how composites, metallic glasses, shape memory alloys, and ceramics are processed and used.	Understand (K2)
CO5	To Explore about safety precautions and natural disasters including earthquakes, cyclones, and fires.	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	-	3
CO2	3	2	1	1	-	-	2	-	-	-	-	3	-	3
CO3	3	3	-	3	2	-	-	-	-	-	-	3	-	3
CO4	3	3	-	3	1	-	-	-	-	-	-	1	-	-
CO5	3	2	3	3	3	-	-	-	-	-	-	1	-	-

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

VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
√	√						√		√	

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I – Course Code & Name: 23BE202 Basic Electrical, Electronics and Instrumentation Engineering

Prerequisite	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Civil Engineering	II	ESC	3	0	0	3

II - Course Objectives

1.	To introduce the basics of electric circuits analysis and various electrical equipment installations
2.	To introduce working, operating principle of various electrical machines, analog devices and their characteristics and the function of various sensors

III - Course Content

Preamble:
It is an introductory course which emphasize 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'sLaws – 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	MAGNETIC CIRCUITS AND ELECTRICAL INSTALLATIONS	9 Periods

Magnetic circuits-definitions-MMF, flux, reluctance, magnetic field intensity, flux density (Qualitative Analysis) . Domestic wiring , types of wires and cables, earthing, protective devices-switch fuse Unit –- Miniature circuit breaker-moulded case circuit breaker- earth leakage circuit breaker, safety precautions and First Aid

Unit – III	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 – IV	ANALOG ELECTRONICS (Qualitative Analysis)	9 Periods

Semiconductor Materials: Silicon & ; Germanium – PN Junction Diodes, Zener Diode – Characteristics Applications – Bipolar Junction Transistor Working -CB Characteristics, JFET, SCR, MOSFET – Types, I- V Characteristics and Applications, Rectifiers

Unit – V	SENSORS FOR BULDING MANAGEMENT	9 Periods

Sensors, solenoids, pneumatic controls with electrical actuator, types of valves and its applications, electro-pneumatic systems, proximity sensors, piezoelectric, hall effect, Air quality sensor, Smoke sensor,Co2 sensor, Water leakage detection sensor, Smart sensors, Thermal Imagers.

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	Total Periods: 45
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:	1. https://www.classcentral.com/course/swayam-fundamentals-of-electrical-engineering-14074

IV - Course Outcomes

On completion of the course, the students will be able to		**Bloom's Level Mapped**
CO1	Compute the electric circuit parameters for simple problems	Apply (K3)
CO2	Acquire the knowledge of different types of electrical installation	Understand (K2)
CO3	Explain the working principle and applications of electrical machines	Understand (K2)
CO4	Illustrates the characteristics of analog electronic devices	Analyze (K4)
CO5	Explain the working principle and applications of electrical machines	K 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	2	2	1	-	-	-	1	-	-	-	2	2	-	-
CO2	2	2	1	-	-	-	1	-	-	-	2	2	-	-
CO3	2	1	1	-	-	-	1	-	-	-	2	2	-	-
CO4	2	2	1	-	-	-	1	-	-	-	2	2	-	-
CO5	2	2	1	-	-	-	-	-	-	-	-	-	-	-

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

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VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
√	√						√		√	

I – Course Code & Name: 23ME201 Engineering Mechanics

Prerequisite	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical & Civil Engineering	II	ESC	3	0	0	3

II - Course Objectives

1.	To expose various laws of forces for the equilibrium of rigid bodies.
2.	To introduce the concept of properties of surfaces and solids.
3.	To impart knowledge on the fundamental of dynamics of particles and rigid bodies.

III - Course Content

Preamble:
The engineering Mechanics course is designed to provide a comprehensive understanding of the fundamental principles that govern the behavior of bodies under the influence of forces and moments. Through this course, students will gain insights into the mechanics of how structures and machines interact with their environments and how these principles form the basis of engineering analysis and design.

Unit – I	EQUILIBRIUM OF FORCES	9 Periods

Types of force system- Coplanar concurrent force – Resultant - Moment of force and its applications – couples and resultant of a force system equation of equilibrium of coplanar concurrent and non-concurrent force system Lami's theorem- Resolution of a force in to a force and a couple-polygon law of forces for resultant.

Unit – II	EQUILIBRIUM OF RIGID BODIES	9 Periods

Free body diagram – Types of supports –Support reaction – Moments and Couples – Moment of a force about a point and about an axis – Scalar components of a moment – Varignon's theorem – Single equivalent force -Equilibrium of Rigid bodies in two dimensions.

Unit – III	PROPERTIES OF SURFACES AND SOLIDS	9 Periods

Centroids and centre of mass – Centroids of lines and areas - Rectangular, circular, triangular areas by integration – T section, I section, - Angle section, Hollow section by using standard formula – Theorems of Pappus - Area moments of inertia of plane areas – Rectangular, circular, triangular areas by integration – T section, I section, by using standard formula – Parallel axis theorem and perpendicular axis theorem – Principal moments of inertia of plane areas – Principal axes of inertia-Mass moment of inertia –mass moment of inertia for prismatic and cylindrical

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solids.		
Unit – IV	**DYNAMICS OF PARTICLES**	**9 Periods**
Displacements, Velocity and acceleration, their relationship – Relative motion – Curvilinear motion - Newton's laws of motion – Work Energy Equation– Impulse and Momentum – Impact of elastic bodies.		
Unit – V	**FRICTION AND RIGID BODY DYNAMICS**	**9 Periods**
Friction force – Laws of sliding friction – equilibrium analysis of simple systems with sliding friction – wedge friction- Rolling resistance - Translation and Rotation of Rigid Bodies – Velocity and acceleration – General Plane motion of simple rigid bodies such as cylinder, disc/wheel and sphere.		
Total Periods: 45		
Text Books:	1. Vela Murali, "Engineering Mechanics", Oxford University Press (2018) 2. Bhavikatti, S.S, "Engineering Mechanics", MULTI COLOUR EDITION, New Age International (P) Limited Publishers, 2021.	
Reference Books:	1. Beer, F.P and Johnston Jr. E.R., "Vector Mechanics for Engineers (In SI Unit –s): Statics and Dynamics", 9th Edition, Tata McGraw-Hill Publishing company, New Delhi (2009). 2. S. Timoshenko, D.H young, J.V. Rao, Sukumar pati, "Engineering Mechanics" 4th edition TMH Education 2016. 3. Sanjay Bansal R. K. Bansal A Text book of Engineering Mechanics 8th edition Lakshmi Publication 2011.	
MOOC/Web Platforms:	-	

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Identify various force system in a plane.	Understand (K2)
CO2	Solve equilibrium of rigid bodies in two dimensions.	Apply (K3)
CO3	Calculate the centroid, areas and mass moment of inertia for surface and solids.	Apply (K3)
CO4	Apply the concept of dynamics for particle motions.	Apply (K3)
CO5	Determine the friction of elements and dynamics of rigid bodies.	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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1	-	-	-	-	-	-	-	2	3	-
CO2	3	3	2	1	-	-	-	-	-	-	-	2	3	-
CO3	3	3	2	1	-	-	-	-	-	-	-	2	3	-
CO4	3	3	2	1	-	-	-	-	-	-	-	2	3	-
CO5	3	3	2	1	-	-	-	-	-	-	-	2	3	-

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

VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
√	√					√	√	√	√	

I – Course Code & Name: 23GE202 Engineering Graphics

Prerequisite	Program Name	Sem	Category	L	T	P	C
Nil	B.E./B.Tech. – Common to Civil, Mechanical & EEE	II	ESC	2	0	4	4

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

Preamble:
Engineering graphics serves as a foundation for your journey into the world of engineering design and visualization. Through this course, you will acquire essential skills and knowledge that are crucial for effective communication and representation of engineering concepts. This course bridges the gap between ideas and reality by transforming abstract concepts into visual representations.

Unit – I	PLANE CURVES	18 Periods
Basic Geometrical constructions, Curves used in engineering practices: Conics — Construction of ellipse, parabola and hyperbola by eccentricity method — Construction of cycloid — construction		

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of involutes of square and circle — Drawing of tangents and normal to the above curves.		
Unit – II	**PROJECTION OF POINTS, LINES AND PLANE SURFACE**	**18 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**	**18 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. Practicing three-dimensional modeling of simple objects by CAD Software (Not for examination).		
Unit – IV	**SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES**	**18 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. Practicing three-dimensional modeling of simple objects by CAD Software (Not for examination).		
Unit – V	**ISOMETRIC AND PERSPECTIVE PROJECTIONS**	**18 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 three-dimensional modeling of isometric projection of simple objects by CAD Software (Not for examination).		
		Total Periods: 90

Text Books:	1. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 53rd Edition, 2019. 2. Natrajan K.V., "A Text Book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2018.
Reference Books:	1. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2008. 2. Parthasarathy N. S. and Vela Murali, "Engineering Graphics", Oxford University, Press, New Delhi, 2015. 3. T.Jeyapoovan, "Engineering Graphics Using AutoCAD", 7th Edition, Vikas Publishing Houses Pvt Ltd, 2015. 4. Basant Agarwal and Agarwal C.M., "Engineering Drawing", McGraw Hill, 2nd Edition, 2019. 5. Shah M.B., and Rana B.C., "Engineering Drawing", Pearson Education India, 2nd Edition, 2009.
MOOC/Web Platforms:	1. https://nptel.ac.in/courses/112103019 2. https://archive.nptel.ac.in/courses/112/102/112102304/

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IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Construct the conic curves, involutes and cycloid.	Apply (K3)
CO2	Solve practical problems involving projection of lines, points and plane surfaces	Apply (K3)
CO3	Draw orthographic projection of solids and freehand sketch of simple objects.	Apply (K3)
CO4	Draw the sectioning and development of simple solids.	Apply (K3)
CO5	Draw isometric and perspective projections 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	1	-	-	-	-	-	-	-	3	-	2	-
CO2	3	3	1	-	-	-	-	-	-	-	3	-	2	-
CO3	3	1	1	-	-	-	-	-	-	-	3	-	2	-
CO4	3	1	1	-	-	-	-	-	-	-	3	-	2	-
CO5	3	1	1	-	-	-	-	-	-	-	3	-	2	-

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

VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
√	√					√	√		√	

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I – Course Code & 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

III - Course Content

Unit – 1	WEAVING AND CERAMIC TECHNOLOGY	3 Periods
Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.		
Unit – 2	**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 – 3	**MANUFACTURING TECHNOLOGY**	**3 Periods**
Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting, steel -Copper and gold-Coins 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 – 4	**AGRICULTURE AND IRRIGATION TECHNOLOGY**	**3 Periods**
Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu 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 – 5	**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 Periods: 15

Text Books & Reference Books:

1. தமிழக வரலாறு மக்களும் பண்பாடும் = கே. கே. பிள்ளை (வெளியீடு தமிழ்நாடு பாடநூல் மற்றும் கல்வியல் பணிகள் கழகம்
2. கணினித்தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
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.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).

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	8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.) 9. 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) 10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author) 11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu) 12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
√	√					√	√		√	

I – Course Code & Name: 23GE211 Engineering Practices Laboratory

Prerequisite	Program Name	Sem	Category	L	T	P	C
Nil	B.E./B.TECH. – Common to, CSE, CIVIL, IT, MECHANICAL & EEE	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; planning; 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

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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.

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 air conditioner.

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)

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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		

IV - Course Outcomes

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.	Apply (K3)
CO2	Wire various electrical joints in common household electrical wire work.	Apply (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 equipment's; Make a tray out of metal sheet using sheet metal work.	Apply (K3)
CO4	Solder and test simple electronic circuits; Assemble and test simple electronic components on PCB.	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	3	2	-	-	1	1	1	-	-	-	-	2	1	1
CO2	3	2	-	-	1	1	1	-	-	-	-	2	1	1
CO3	3	2	-	-	1	1	1	-	-	-	-	2	1	1
CO4	3	2	-	-	1	1	1	-	-	-	-	2	1	1

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

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VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
	√	√				√		√		

I – Course Code & Name: 23BE211 Basic Electrical, Electronics and Instrumentation Engineering Laboratory

Prerequisite	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Civil Engineering	II	ESC	0	0	3	1.5

II - Course Objectives

1.	To train the students in conducting load tests on electrical machines
2.	To gain practical experience in characterizing electronic devices
3.	To train the students to measure three phase power

III - Course Content

List of Experiments
1. Verification of ohms and Kirchhoff's Laws.
2. Load test on DC Shunt Motor.
3. Load test on Self Excited DC Generator
4. Load test on Single phase Transformer
5. Load Test on single phase Induction Motor
6. Characteristics of PN and Zener Diodes
7. Characteristics of BJT and SCR
8. Characteristics of MOSFET
9. Design and analysis of Half wave rectifiers
10. Design and analysis of Full Wave rectifiers

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Use experimental methods to verify the Ohm's law and Kirchhoff's Law	Apply (K3)
CO2	Analyze experimentally the load characteristics of electrical machines	Analyze (K4)
CO3	Analyze the characteristics of basic electronic devices	Analyze (K4)
CO4	Use experimental methods measure three phase power	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	2	1	1	-	-	1	2	-	-	-	-	-
CO2	3	3	2	1	1	-	-	1	2	-	-	-	-	-
CO3	3	3	2	1	1	-	-	1	2	-	-	-	-	-
CO4	3	3	2	1	1	-	-	1	2	-	-	-	-	-

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

VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
	√	√				√		√		

I – Course Code & Name: 23GE212 English Laboratory - II

Prerequisite	Program Name	Sem	Category	L	T	P	C
Nil	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 discussions in a professional context.
2.	To analyze concepts and problems and make effective presentations explaining them clearly and 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- discussing		

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past 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 – individual presentation practice–– 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- activities to improve GD skills.		
Unit – V	**INTERVIEW**	**6 Periods**
Interview etiquette – dress code – body language – attending job interviews– telephone/skype interview -one to one interview & panel interview – FAQs related to job interviews.		
		Total Periods: 30
Text Books:	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:	1. https://www.digitalteacher.in/english-language-lab	

IV - Course Outcomes

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)

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CO4	Attend job interviews and be successful in them.	Create (K6)
CO5	Develop adequate Soft Skills required for the workplace.	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

VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
√	√					√			√	

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SEMESTER – III

I – Course Code & Name: 23MA301 Transforms and Applications of Partial Differential Equations.

Prerequisite	Program Name	Sem	Category	L	T	P	C
Nil	B.E. - Civil and Mechanical Engineering	III	BSC	3	1	0	4

II - Course Objectives

1.	To introduce the Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems.
2.	To Study the application of transform techniques using Fourier Transforms.
3.	To provide the basic concepts of Z-Transform techniques for discrete time systems.
4.	To introduce the basic concepts of PDE for solving standard Partial Differential Equations.
5.	To familiarize the student with Fourier series techniques in solving heat flow problems used in various situations.

III - Course Content

Preamble:
Fourier analysis allows modeling periodic phenomena which appears frequently in engineering, alternating electric currents or the motion of planets. The idea of Fourier analysis is to represent complicated functions in terms of simple periodic functions, namely cosines and sines.

Unit – I	**FOURIER SERIES**	**12 Periods**

Dirichlet's conditions – General Fourier series –Half range sine and cosine series – Parseval's identity – Harmonic analysis.

Unit – II	**FOURIER TRANSFORMS**	**12 Periods**

Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem (excluding proof) – Parseval's identity.

Unit – III	**Z - TRANSFORMS AND DIFFERENCE EQUATIONS**	**12 Periods**

Z-transforms- Elementary properties–Inverse Z-transform (using partial fraction and residues) - Convolution theorem - Formation of difference equations – Solution of difference equations using Z -transform.

Unit – IV	**PARTIAL DIFFERENTIAL EQUATIONS**	**12 Periods**

Formation of partial differential equations - Elimination of arbitrary constants and functions – Solutions of five standard types of first order partial differential equations - Lagrange's linear equation - Homogenous type of Second order Linear differential equations with constant coefficients.

Unit – V	**APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS**	**12 Periods**

Classification of PDE –Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction (excluding insulated edges).

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	Total Periods: 60
Text Books:	[1] Grewal B.S.,"Higher Engineering Mathematics" 44thEdition, Khanna Publishers,New Delhi, 2018. [2] Kreyszig E, "Advanced Engineering Mathematics ", 10th Edition, John Wiley, New Delhi, India, 2016.
Reference Books:	[1] Bali. N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 10th Edition, Laxmi Publications Pvt. Ltd, 2021. [2] James. G., "Advanced Modern Engineering Mathematics", 4thEdition, Pearson Education, New Delhi, 2016. [3] Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2018. [4] Wylie. R.C. and Barrett. L.C., "Advanced Engineering Mathematics "Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.
MOOC/Web Platforms:	https://archive.nptel.ac.in/courses/111/103/111103021/ https://archive.nptel.ac.in/courses/111/106/111106139/

IV - Course Outcomes

On completion of the course, the students will be able to		**Bloom's Level Mapped**
CO1	Design general periodic functions and apply in problems of Fourier series, which are sums of sines and cosines.	Apply (K3)
CO2	Use the Fourier transform as the tool to connect the time domain and frequency domain in signal processing.	Apply (K3)
CO3	Use the effective mathematical tools for the solutions of partial differential equations by using Z - Transform techniques for discrete time systems.	Apply (K3)
CO4	Understand how to solve the given standard PDEs.	Understand (K2)
CO5	Describe real time engineering problems using PDE in 1-D wave vibrating membrane and heat passing through rod, two-dimensional heat conduction problems.	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	1	1	-	-	-	-	2	-	-	3	-	-
CO2	3	3	1	1	-	-	-	-	2	-	-	3	-	-
CO3	3	3	1	1	-	-	-	-	2	-	-	3	-	-
CO4	3	3	1	1	-	-	-	-	2	-	-	3	-	-
CO5	3	3	1	1	-	-	-	-	2	-	-	3	-	-

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

VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
√	√						√	√	√	

I – Course Code & Name: 23CE301 Mechanics of Materials

Prerequisite	Program Name	Semester	Category	L	T	P	C
Engineering Mechanics	B.E. -Civil Engineering	III	PCC	3	0	0	3

II - Course Objectives

1.	To learn the fundamental concepts of Stress in simple and complex states
2.	To know the mechanism of load transfer in beams and the induced stresses due to simple bending
3.	To understand the effect of torsion on shafts and springs.
4.	To estimate the load carrying capacity of columns and Stresses in cylinders.
5.	To determine Unsymmetrical bending and deformation in determinate beams

III - Course Content

Preamble:
This course aims to impart knowledge to the students on the different loading conditions of structures and their behavior under loads.

Unit – I	STRESS-STRAIN AND DEFORMATION OF SOLIDS	9 Periods

Rigid bodies and deformable solids – stability, strength, stiffness – tension, compression and shear stresses – strain, elasticity, Hooke's law, limit of proportionately, modulus of elasticity, stress-strain curve, lateral strain - temperature stresses – deformation of simple and compound bars – shear modulus, bulk modulus, relationship between elastic constants.

Unit – II	SHEAR AND BENDING IN BEAMS	9 Periods

Types of beams and transverse loadings– Shear force and bending moment for Simply supported, cantilever and over-hanging beams - Fixed Beams – Fixed end moments reactions- Continuous beams – support reactions and moments – Theorem of three moments- Theory of simple

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bending.		
Unit – III	**TORSION AND SPRINGS**	**9 Periods**
Torsion of Circular and Hollow Shafts – Stresses and Deflection in Circular Solid and Hollow Shafts – combined bending moment and torsion of shafts– Power transmitted to shaft – Shaft in series and parallel – Closed and Open Coiled helical springs – Springs in series and parallel.		
Unit – IV	**COLUMNS AND CYLINDERS**	**9 Periods**
Euler's theory of long columns – critical loads for prismatic columns with different end conditions; Rankine-Gordon formula for eccentrically loaded columns – Eccentrically loaded short columns – Thick cylinders – Compound cylinders.		
Unit – V	**ADVANCED TOPICS**	**9 Periods**
Unsymmetrical bending of beams - Curved beams -Theories of failure – Principal stress, principal strain, shear stress, strain energy and distortion energy theories.		
		Total Periods: 45
Text Books:	1. Rajput R.K. "Strength of Materials (Mechanics of Solids)", S.Chand & company Ltd., New Delhi, 2018. 2. Rattan.S.S., "Strength of Materials", Tata McGraw Hill Education Pvt. Ltd., New Delhi,2017	
Reference Books:	1. Bansal. R.K. "Strength of Materials", Laxmi Publications Pvt. Ltd., New Delhi, 2010 2. Basavarajiah and Mahadevapa, Strength of Materials, University press, Hyderabad, 2016 3. Gambhir. M.L., "Fundamentals of Solid Mechanics", PHI Learning Private Limited., New Delhi, 2009. 4. Singh. D.K.,"Strength of Materials", Ane Books Pvt. Ltd., New Delhi, 2021	
MOOC/Web Platforms:	1. Mechanics Of Materials - Course (nptel.ac.in) 2. Mechanics of Materials I: Fundamentals of Stress & Strain and Axial Loading | My Mooc (my-mooc.com)	

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Comprehend the fundamental principles of stress and strain, along with the concepts of principal stresses and principal planes.	Apply (K3)
CO2	Analyze shear force and bending moment in beams and grasp the theory of simple bending.	Analyze (K4)
CO3	Calculate the stresses, deflections, and power transmission in circular and hollow shafts as well as the load-deflection behavior of helical springs.	Apply (K3)
CO4	Apply Euler's theory for long columns, Rankine-Gordon formula for eccentrically loaded columns, and evaluating the behavior and stresses in thick and compound cylinders.	Apply (K3)

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CO5	Evaluate stresses resulting from unsymmetrical bending of beams, identify the shear center, and explore various failure theories.	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	3	-	2	-	-	-	-	-	3	3	2
CO2	3	3	3	3	-	2	-	-	-	-	-	3	3	2
CO3	3	3	3	3	-	2	-	-	-	-	-	3	3	2
CO4	3	3	3	3	-	2	-	-	-	-	-	3	3	2
CO5	3	3	3	3	-	2	-	-	-	-	-	3	3	2

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

VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓							✓		✓	

I – Course Code & Name: 23CE302 Fluid Mechanics

Prerequisite	Program Name	Sem	Category	L	T	P	C
Engineering Mechanics	B.E.- Civil Engineering	III	PCC	3	0	0	3

II - Course Objectives

1.	To understand basic properties of fluids.
2.	To learn fluid statics and dynamics
3.	To study basics of flow visualization
4.	To understand Bernoulli's theorem and its applications.
5.	To understand losses in flow, drag and lift forces
6.	To learn to establish relation between flow parameters..

III - Course Content

Preamble:.

Goal of this course is to expose the students to the fundamental concepts of fluid mechanics, hydraulics of pipes and to enhance the problem solving skills.

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Unit – I	FLUID PROPERTIES AND FLUID STATICS	9 Periods
Scope of fluid mechanics – Definitions of a fluid – Methods of analysis – Continuum hypothesis – System and Control volume approach – Fluid properties – Fluid statics – Manometers – Forces on plane and curved surfaces – Buoyancy and floatation		
Unit – II	**BASIC CONCEPTS OF FLUID FLOW**	**10 Periods**
Kinematics: Classification of flows – Streamline, streak-line and path-lines – Stream function and velocity potentials – Flow nets; Dynamics : Application of control volume to continuity, energy and momentum – Euler's equation of motion along a stream line – Bernoulli's equation – Applications to velocity and discharge measurements – Linear momentum equation – – Moment of momentum equation		
Unit – III	**FLOW THROUGH PIPES**	**10 Periods**
Reynolds experiment – Laminar flow in pipes and between parallel plates – Development of laminar and turbulent flows in pipes – Darcy-Weisbach equation – Moody diagram – Major and minor losses of flow in pipes – Total energy line – Hydraulic gradient line – Siphon – Pipes in series and parallel .		
Unit – IV	**DIMENSIONAL ANALYSIS AND MODEL STUDIES**	**8 Periods**
Fundamental dimensions – Dimensional homogeneity – Rayleigh's method and Buckingham Pi theorem – Dimensionless parameters – Similitude and model studies – Distorted and undistorted models.		
Unit – V	**BOUNDARY LAYERS**	**8 Periods**
Definition of boundary layers – Laminar and turbulent boundary layers – Displacement, momentum and energy thickness – Momentum integral equation – Applications – Separation of boundary layer – Drag and Lift forces		
		Total Periods: 45

Text Books:	1.Modi P.N and Seth Hydraulics and Fluid Mechanics including Hydraulic Machines Standard Book House New Delhi. 2017. 2.Bansal.R.K., "Fluid Mechanics and Hydraulic Machines", Laxmi Publications Pvt. Ltd., New Delhi, 2013. 3.Jain A. K. Fluid Mechanics including Hydraulic Machines, Khanna Publishers, New Delhi,2014.
Reference Books:	1.S K Som; Gautam Biswas and S Chakraborty, Introduction to Fluid Mechanics andFluid Machines,TataMcGrawHillEducationPvt.Ltd.,2012. 2. Pani B S, Fluid Mechanics: A Concise Introduction, Prentice Hall of India Private Ltd, 2016. 3.. Narayana Pillai N. Principles of Fluid Mechanics and Fluid Machines, (3rd Ed.) University Press (India) Pvt. Ltd. 2009 4.Streeter, V.L. Wylie, E. B. and Bedford K.W, Fluid Mechanics. (9th Ed.) Tata McGraw Hill,New Delhi, 1998
MOOC/Web Platforms:	1. Fluid Mechanics virtual labs. http://eerc03-iiith.vlabs.ac.in/ 2. https://nptel.ac.in/courses/Webcourse-contents/IIT-

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	%20Guwahati/fluid_mechanics/index.htm 3. https://nptel.ac.in/courses/105105119

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Determine various properties of fluid. Apply the laws of fluid statics and concepts of buoyancy	Apply (K3)
CO2	Identify types of fluid flow and terms associated in fluid kinematics & Dynamics	Apply (K3)
CO3	Apply principles of fluid dynamics to laminar flow. Estimate friction and minor losses in internal flows	Apply (K3)
CO4	Construct mathematical correlation considering dimensionless parameters, also Able to predict the performance of prototype using model laws	Apply (K3)
CO5	Determine boundary layer formation over an external surface.	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	-	1	-	-	2	-	-	-	1	2	3	2
CO2	2	3	-	1	-	-	2	-	-	-	1	2	3	2
CO3	2	3	-	1	-	-	2	-	-	-	1	2	3	1
CO4	2	3	-	2	-	-	2	-	-	-	1	3	3	3
CO5	2	3	-	2	-	-	2	-	-	-	1	3	3	3

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

VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓				✓			✓		✓	

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I – Course Code & Name: 23CE303 Surveying

Prerequisite	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Civil Engineering	III	PCC	3	0	0	3

II - Course Objectives

1.	To introduce the rudiments of plane surveying and geodetic principles to Civil Engineers.
2.	To learn the various methods of levelling to calculate earthwork.
3.	To gain knowledge on the usage of theodolite to carry out various complex survey.
4.	To introduce the concepts of Control Surveying.
5.	To introduce the usage of Modern Surveying methods and equipment for works of larger scale and require precision

III - Course Content

Preamble:.

Unit – I	FUNDAMENTALS OF CONVENTIONAL SURVEYING	10 Periods

Classifications – Basic principles – Equipment and accessories for ranging and chaining – Methods of ranging – Well conditioned triangles – Chain traversing – Compass – Basic principles – Types – Bearing – System and conversions – Sources of errors and Local attraction – Magnetic declination – Dip – compass traversing – Plane table and its accessories – Merits and demerits – Radiation – Intersection – Resection – Plane table traversing.

Unit – II	LEVELLING AND COMPUTATIONS	9 Periods

Level line – Horizontal line – Datum – Benchmarks – Levels and staves – Temporary and permanent adjustments – Methods of levelling – Fly leveling – Check levelling – Procedure in levelling – Booking - Reduction – Curvature and refraction – Reciprocal levelling – Precise levelling – Contouring – Computation of cross sectional areas and volumes - Earthwork calculations - Mass haul diagrams.

Unit – III	THEODOLITE SURVEYING	9 Periods

Horizontal and vertical angle measurements – Temporary and permanent adjustments – Heights and distances – Tacheometric surveying – Stadia Tacheometry – Tangential Tacheometry – Trigonometric leveling - Single Plane method – Double Plane method.

Unit – IV	CURVES AND CONTROL SURVEYING	9 Periods

Curves – Introduction of simple, circular, transition, reverse curve and setting out.- Horizontal and vertical control – Triangulation – Traversing – Gale's table – Trilateration – Concepts of measurements and errors – Adjustment methods - Least square methods – Angles, lengths and levelling network.

Unit – V	MODERN SURVEYING	8 Periods

Total Station: EDM– Parts and accessories – Working principle – Field procedure and applications– Advantages. GPS: components – Selective availability and anti-spoofing – basics of DGPS and GNSS – Field procedure and applications – Aerial Survey : Sensors and Platforms – LIDAR – UAV – Applications.

Total Periods: 45

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Text Books:	1. Dr. B. C. Punmia, Ashok K. Jain and Arun K Jain, Surveying Vol. I & II, Lakshmi Publications Pvt Ltd, New Delhi, Sixteenth Edition, 2016. 2. K. R. Arora, Surveying Vol I & II, Standard Book house, Twelfth Edition 2013. 3. Bannister and S. Raymond, Surveying, Seventh Edition, Longman .
Reference Books:	1. T. P. Kanetkarand S. V. Kulkarni, Surveying and Levelling, Parts 1 & 2, Pune Vidyarthi Griha Prakashan, Pune, 2008. 2. R. Subramanian, Surveying and Levelling, Oxford University Press, Second Edition, 2012. 3. James M. Anderson and Edward M. Mikhail, Surveying, Theory and Practice, Seventh Edition, Mc Graw Hill 2001. 4. S. K. Roy, Fundamentals of Surveying, Second Edition, Prentice Hall of India2010. 5. C. Venkatramaiah, Textbook of Surveying, Universities Press, Second Edition, 2011.
MOOC/Web Platforms:	1. UAV in Engineering Applications (English) - Course (swayam2.ac.in) 2. NPTEL :: Civil Engineering - NOC:Photogeology In Terrain Evaluation

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Know the usage of Conventional surveying instrument in plane surveying.	Understand (K2)
CO2	Gain knowledge in computation of levels of different terrain and ground features.	Apply (K3)
CO3	Apply the concepts of theodolite surveying for complex surveying operations.	Apply (K3)
CO4	Understand the procedure for establishing horizontal and vertical control.	Apply (K3)
CO5	Have a specific knowledge on modern surveying instruments and their utility in large scale projects.	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	-	-	-	3	2	3	2	2	-	-	2	2
CO2	3	2	-	-	-	3	2	3	2	2	-	-	2	-
CO3	3	2	-	2	2	3	2	3	2	2	-	2	2	-
CO4	3	2	-	2	2	3	2	3	3	2	-	2	2	-
CO5	3	2	-	-	3	3	2	3	2	2	-	2	2	2

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

VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓			✓		✓			✓	

I – Course Code & Name: 23CE304 Construction Materials and Technology

Prerequisite	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Civil Engineering	III	PCC	3	0	0	3

II - Course Objectives

1.	To familiarize students with the range of building materials.
2.	To understand the methods that are frequently employed in the field of civil engineering construction.

III - Course Content

Preamble:
It defines the criteria for selecting construction materials and technologies. Ensure consistency and reliability in the quality of materials used. Promote sustainable practices and the use of environmentally friendly materials. Integrate advanced technologies to enhance construction efficiency and effectiveness.

Unit –I	STONES – BRICKS – CONCRETE BLOCKS	9 Periods

Stone as building material – Criteria for selection – Tests on stones – Deterioration and Preservation of stone work – Bricks – Classification – Manufacturing of clay bricks – Tests on bricks – Compressive Strength – Water Absorption – Efflorescence – Bricks for special use – Refractory bricks – Concrete blocks – Lightweight concrete blocks.

Unit –II	LIME – CEMENT – MORTAR – AGGREGATES	9 Periods

Lime – Preparation of lime – Cement –Manufacturing process of cement – Types and Grades –Lime and cement mortar – fine aggregates – river sand – crushed stone sand – properties – coarse Aggregates – Crushing strength – Impact strength – Flakiness Index – Elongation Index – Abrasion Resistance – Grading

Unit – III	OTHER MATERIALS FOR CONSTRUCTION	9 Periods

Timber – Market forms– Plywood – Veneer – False ceiling materials – Panels of laminates – Steel – Aluminum – Aluminum composite panel – Market forms – Mechanical treatment – Paints – Varnishes – Distempers – Bitumen's - Glass – Ceramics – Sealants for joints – Composite materials – Types – Applications of laminar composites – Fibre textiles– Geosynthetics – sustainable construction materials.

Unit – IV	CONSTRUCTION PRACTICES & SERVICE REQUIREMENTS	10Periods

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Types of Foundations – Shallow and Deep Foundations – Stone Masonry – Brick Masonry – Plastering and Pointing – Cavity Walls – Diaphragm Walls – Formwork – Shoring – Scaffolding – Underpinning – Roofing – Flooring – Joints in concrete – Contraction/Construction/Expansion joints – Fire Protection – Thermal Insulation – Ventilation and Air conditioning – Acoustics and Sound Insulation – Damp Proofing.		
Unit – V	**CONSTRUCTION EQUIPMENTS**	**8 Periods**
Selection of equipment for earthwork excavation, concreting, material handling and erection of structures – Dewatering and pumping equipment - Equipment for foundation and pile driving - Equipment for dredging, trenching, tunnelling		
		Total Periods: 45
Text Books:	1. Varghese.P.C, Building Materials, Second Edition PHI Learning Ltd., 2015. 2. Arora S.P and Bindra S.P Building construction, Dhanpat Rai and sons, 2013.	
Reference Books:	1. Varghese.P.C, Building Construction, Second Edition PHI Learning ltd., 2016. 2. Punmia ,B.C Building construction , Laxmi publication (p)ltd..,2008. 3. Duggal.S.K., "Building Materials", 4th Edition, New Age International, 2008.	
MOOC/Web Platforms:	https://archive.nptel.ac.in/courses/105/103/105103206/ https://archive.nptel.ac.in/courses/105/106/105106206/	

IV - Course Outcomes

On completion of the course, the students will be able to		**Bloom's Level Mapped**
CO1	Identify the good quality brick, stone and blocks for construction.	Understand (K2)
CO2	Understand the typical and potential applications of lime, cement and aggregates	Understand (K2)
CO3	Understand the applications and importance of timber and modern material for construction.	Understand (K2)
CO4	Identify the best construction and service practices such as thermal insulations and air conditioning of the building	Understand (K2)
CO5	To select various equipment's for construction works conditioning of building.	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	2	-	1	1	1	1	2	1	-	-	1	2	2	2

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CO2	2	-	1	1	1	1	2	1	-	-	1	2	2	2
CO3	3	-	2	2	2	2	2	1	-	-	1	2	2	2
CO4	3	-	2	2	3	2	2	1	-	-	2	2	2	2
CO5	2	-	-	2	3	1	2	2	-	-	2	2	2	2

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

VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓		✓						✓	

I – Course Code & Name: 23CE311 Surveying Laboratory

Prerequisite	Program Name	Semester	Category	L	T	P	C
Nil	B.E. -Civil Engineering	III	PCC	0	0	4	2

II - Course Objectives

1.	To learn and apply chain and compass traversing techniques.
2.	To determine reduced levels using fly leveling with a Dumpy level.
3.	To measure horizontal and vertical angles with reiteration and repetition methods.
4.	To perform height and distance measurements using Tacheometry.
5.	To use total stations for setting out works and determining plot areas.

III - Course Content

Preamble:

The aim of this course is to develop hands-on skills with surveying instruments, emphasizing practical applications in field surveys and real-world projects.

List of Experiments

1. Chain traversing.
2. Compass traversing- open and closed Traversing.
3. Determination of reduced level Fly leveling using Dumpy level.
4. Check leveling.
5. Measurement of horizontal angles by reiteration and repetition and vertical angles.
6. Theodolite survey traverse.
7. Determination of Tacheometric Constants.
8. Heights and distances by stadia Tacheometry.

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	9. Heights and distances by Tangential Tacheometry. 10. Setting out works - Foundation marking. 11. Determination of latitude/longitude and area using GPS. 12. Determination of angles, height, and area measurement using total station. 13. Aerial Mobile LiDAR Survey. (Demonstration Only)
	Total Periods: 60
Text Books:	1. Arora, K.R., "Surveying", Vol. I, II and III, Standard Book House, 2019. 2. Duggal R.K, "Surveying", Vol. I & II, Tata McGraw Hill Publishing Company Ltd.,New Delhi 2017
Reference Books:	1. T. P. Kanetkarand S. V. Kulkarni, Surveying and Levelling, Parts 1 & 2, Pune Vidyarthi Griha Prakashan, Pune, 24th Reprint, 2015. 2. Dr. B. C. Punmia, Ashok K. Jainand Arun K Jain, Surveying Vol. I & II, Lakshmi Publications Pvt Ltd, New Delhi, 17th Edition, 2016.
MOOC/Web Platforms:	https://sl-iitr.vlabs.ac.in/List%20of%20experiments.html

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understanding of basic surveying techniques (chain and compass traversing).	Apply (K3)
CO2	Proficiency in leveling and elevation determination (fly leveling and check leveling).	Apply (K3)
CO3	Competence in angle measurement and theodolite surveying.	Apply (K3)
CO4	Application of tacheometry and GPS in surveying.	Apply (K3)
CO5	Knowledge of advanced surveying techniques and modern equipment (total stations and LiDAR).	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	-	2	-	3	3	-	-	3	2	3
CO2	3	2	-	2	-	2	-	3	3	-	-	3	2	3
CO3	3	2	-	2	-	2	-	3	3	-	-	3	2	3
CO4	3	2	-	2	3	2	-	3	3	-	-	3	2	3
CO5	3	2	-	2	3	2	-	3	3	-	-	3	2	3

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

VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment /Group Discussion	Simulation / Trouble shooting
					✓	✓				

I – Course Code & Name: 23CE312 Building Drawing Laboratory

Prerequisite	Program Name	Semester	Category	L	T	P	C
Engineering Graphics	B.E. -Civil Engineering	III	PCC	0	0	4	2

II - Course Objectives

1.	To understand the basics of AutoCAD
2.	To draft the plan of load bearing structure.
3.	To draft the plan of RCC framed structure.
4.	To draw the plan and elevation of the Doors, windows .
5.	To create the elevation and section of the industrial building.

III - Course Content

Preamble:

The aim of this course is to teach the students to draft the plan, elevation and sectional views of the buildings, industrial structures, and framed buildings using computer software.

List of Experiments

1. Introduction to computer aided drafting & coordinate system.
2. Basics commands of AutoCAD
3. Principles of planning, orientation of building
4. Panelled Doors and Windows
5. Buildings with load bearing walls with flat roof
6. Buildings with R.C.C. framed structures
7. Dog – legged staircase – Plan and elevation
8. Elevation of roof truss
9. Industrial building

Text Books:

1. Bhat N. D. and Panchal V. M., "Engineering Drawing Plane and Solid Geometry", 53rd Edition, Charotar Publishing House, 2019.
2. Ashit Bajaj and Mamta Kataria., "Building Drawing (Civil Engineering Drawing-1)", 1st Edition, North Publication, 2020.
3. Bhavikatti S.S and Chitawadagi M.V., "Building Planning and Drawing", 1st

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	Edition, Dreamtech Press India Pvt. Ltd, 2019.
Reference Books:	1. Rangwala, "Civil Engineering Drawing", 3rd Edition, Charotar Publishing House Pvt. Ltd.,2019. 2. Jeyapoovan T., "Engineering Drawing & Graphics Using AutoCAD", 3rd Edition, Vikas Publishing House Pvt. Ltd., 2019. 3. Sikka V.B., "A Course in Civil Engineering Drawing", 4th Edition, S.K. Kataria and Sons, 2015. 4. National Building Code of India 2016 (NBC 2016).
MOOC/Web Platforms:	-

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the basic commands required for drafting in AutoCAD	Understand (K2)
CO2	Draw the elevation and section of staircase, paneled door and Windows.	Create (K6)
CO3	Draw the plan, elevation and section of building with load bearing wall with flat roof.	Create (K6)
CO4	Draw the plan, elevation and section of building with load bearing wall framed structure.	Create (K6)
CO5	Prepare the plan and elevation of industrial building with roof truss.	Create (K6)

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	-	2	-	-
CO2	2	-	-	-	3	-	-	2	2	2	2	2	-	3
CO3	2	-	-	-	3	-	-	2	2	2	2	2	-	3
CO4	2	-	-	-	3	-	-	2	2	2	2	2	-	3
CO5	2	-	-	-	3	-	-	2	2	2	2	2	-	3

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

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VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment / Group Discussion	Simulation / Trouble shooting
						✓		✓		

I – Course Code & Name: 23CE313 Material Testing Laboratory

Prerequisite	Program Name	Semester	Category	L	T	P	C
Mechanics of Materials	B.E. -Civil Engineering	III	PCC	0	0	4	2

II - Course Objectives

1.	To develop skills to test material properties of steel.
2.	To develop skills to test material properties Aggregates.
3.	To develop skills to test material properties Cement.
4.	To develop skills to test material properties Concrete
5.	To develop skills to test material properties Wood.

III - Course Content

Preamble:

The aim of this course is to teach the students to test the properties of various construction materials such as Steel, Aggregate, Cement, Concrete and Wood.

I. TESTS ON METALS

a. Tension test on steel rod
b. Torsion test on mild steel rod
c. Deflection test on metal beam
d. Impact test on metal specimen (Izod and Charpy)
e. Hardness test on metals (Rockwell and Brinell Hardness Tests)
f. Compression test on helical spring

II. TESTS ON CEMENT

a. Determination of fineness of cement
b. Determination of consistency of cement
c. Determination of specific gravity of cement
d. Determination of initial and final setting time of cement

III. TESTS ON FINE AGGREGATE

a. Determination of specific gravity of fine aggregate.
b. Determination of grading of fine aggregate
c. Determination of water absorption for fine aggregate

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IV. TESTS ON COARSE AGGREGATE

a. Determination of compacted and loose bulk density of coarse aggregate
b. Determination of impact value of coarse aggregate
c. Determination of elongation index of coarse aggregate
d. Determination of flakiness index of coarse aggregate
e. Determination of aggregate crushing value of coarse aggregate
f. Determination of specific gravity and water absorption of coarse aggregate

V. TESTS ON BRICKS

a. Determination of compressive strength of bricks
b. Determination of water absorption of bricks
c. Determination of efflorescence of bricks

VI. TEST ON WOOD

a. Determination of Compression test on wood

Total Periods: 60

Text Books:	1. Varghese.P.C, Building Materials, Second Edition PHI Learning Ltd., 2015 2. Rajput R.K. "Strength of Materials (Mechanics of Solids)", S.Chand & company Ltd., New Delhi, 2018
Reference Books:	1. Arora S.P and Bindra S.P Building construction, Dhanpat Rai and sons, 2013. 2. Rattan.S.S., "Strength of Materials", Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2017.
MOOC/Web Platforms:	https://sm-nitk.vlabs.ac.in/Welcome to Virtual Labs (vlabs.ac.in)

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Determine the mechanical properties of steel.	Apply (K3)
CO2	Determine the physical properties of cement.	Apply (K3)
CO3	Determine the physical properties of fine and coarse aggregate.	Apply (K3)
CO4	Determine the workability and compressive strength of concrete.	Apply (K3)
CO5	Determine the strength of brick and wood.	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	2	1	3	-	2	2	-	3	-	-	1	1	1
CO2	3	2	1	3	-	2	2	-	3	-	-	1	1	1
CO3	3	3	2	3	-	1	2	-	3	-	-	1	1	1
CO4	3	3	2	3	-	1	2	-	3	-	-	1	1	1
CO5	3	3	2	3	-	1	2	-	3	-	-	1	1	1

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

VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment / Group Discussion	Simulation / Trouble shooting
						✓		✓		

Value Added Course - I

I – Course Code & Name: 23CEAO1 Revit Architecture

Prerequisite	Program Name	Semester	Category	L	T	P	C
Basic Computer Knowledge	B.E. -Civil Engineering	III	EEC	0	0	2	1

II - Course Objectives

1.	To Understand the basics of BIM and the role of Revit in architectural design.
2.	To Understand the tools required to create and modify architectural elements like walls, doors, windows, floors, roofs, and ceilings
3.	To explore the tools for rendering and producing visualizations within Revit.
4.	To Generate schedules, legends, and other documentation from the model.
5.	To Integrate with tools for energy modeling and sustainability assessments.

III - Course Content

Preamble: The course is to teach students the concepts of Building Information Modeling and introduce the tools for parametric building design and documentation using Revit Architecture.

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Unit – I INTRODUCTION TO BIM

Introduction - Proprietary and open-source software - Basic drawing and editing tools - file import - Setting up Unit –s, levels and grids - Working with a project - Drawing and modifying Walls - Wall Shapes and Openings - Plastering, Skirting and Dado - Wall Sweep and Wall reveal - Wall Layers – Stacked Wall - Dimensions and measurements - Adding, loading and Creating Doors and Windows, Wall opening.

Unit – II WORKING WITH STRUCTURAL ELEMENTS

Drawing and modifying structural element Footing, Column, Beam and Slab - Creating and working with Floor, Roof and Ceiling - Joining/Unjoining of Roof - Roof Soffit - Roof fascia - Creating Stairs, Ramps, lifts, Railings - Curtain wall, curtain grids and Mullions.

Unit – III WORKING WITH COMPONENTS, VIEWS AND ELEVATIONS

Adding Furniture and fixtures to a project - Working with Components - Creating interior elevations – Adding Lighting fixtures - Creating building sections - Site Design and modifying Topo surfaces – Site Components - Framing plans and elevations - Working with views - Adding Sun Setting – Applying Materials - Rendering and Walkthrough - Working with Rendered File - Schedule - BIM management.

Unit – IV ADVANCED STRUCTURAL MODELLING

Introduction - Starting a structural project based on a linked architectural model - Adding structural columns and walls - Adding foundations and structural slabs

Unit – V WORKING WITH COST & ESTIMATION

Cost Analysis - components and materials – Estimation on structure - Quantity takeoff

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Create and modify architectural elements like walls, doors, windows, floors, roofs, and ceilings.	Create (K6)
CO2	Create structural elements like Footing, Column, Beam and Slab.	Create (K6)
CO3	Create interior elevation, lighting fixtures and rendering.	Create (K6)
CO4	Design a structural project based on a linked architectural model.	Create (K6)
CO5	Prepare cost analysis and quantity take off for the structure.	Create (K6)

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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
CO2	2	-	-	-	3	-	-	-	-	2	-	2	-	3
CO3	2	-	-	-	3	-	-	-	-	2	3	2	-	3
CO4	2	-	-	-	3	-	-	-	-	2	3	2	-	3
CO5	2	-	-	-	3	-	-	-	-	2	3	2	-	3

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

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SEMESTER – IV

I - Course Code & Name: 23CE401 Geotechnical Engineering-I

Prerequisite	Program Name	Sem	Category	L	T	P	C
Nil	B.E. - Civil Engineering	IV	PCC	3	0	0	3

II - Course Objectives

1.	To classify the soil and is assess the index properties of soil.
2.	To compare the stress transformation, distribution and estimate the permeability of soils.
3.	To calculate the stress influence due to various loads and settlement in soils.
4.	To analyze the shear strength of soil.
5.	To analyze the compressibility.

III - Course Content

Preamble:
The fundamental understanding of the properties, behavior, and mechanics of soils, with a focus on their classification, compaction, effective stress, permeability, stress distribution, shear strength, and compressibility.

Unit – I	SOIL CLASSIFICATION AND COMPACTION	9 Periods

Origin and Properties of soils: Formation of soil- Soil Structures-Phase relationships- Index properties- Laboratory tests- particle size distribution analysis- Determination of consistency limits and their significance to the field behaviour of soil- BIS Soil mechanics classification system. Compaction -Standard Proctor Compaction Tests- Factors affecting compaction- Field compaction methods.

Unit – II	PERMEABILITY	9 Periods

Darcy's law and its validity- Determination of permeability in the laboratory (Constant head method and Falling head method) Concept of total and effective stress in saturated soil deposits- Factors affecting permeability-Seepage analysis-Laplace's equation- Introduction to flow nets.

Unit – III	STRESS DISTRIBUTION IN SOIL	9 Periods

Quick sand condition- Stresses due to external loads- Boussineq's theory (Point load, UDL, and Line Load)-Concept of pressure bulb-Approximate methods- Use of Newmark's influence chart- Westergaard's theory

Unit – IV	SHEAR STRENGTH	9 Periods

Shear strength of cohesive and cohesion less soils – Mohr-Coulomb failure theory – shear strength – Classification of shear test based on drainage conditions- Direct shear test- Unconfined compression test- Triaxial compression test- Vane shear test.

Unit – V	COMPRESSIBILITY	9 Periods

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Concept of consolidation- Terzaghi's theory of one-dimensional consolidation- components of settlement- computation of rate of settlement- Determination of cv by √t method and log time method-Calculation of consolidation settlement.	
Total Periods: 45	
Text Books:	1. Punmia, B.C., "Soil Mechanics and Foundations", Laxmi Publications Pvt. Ltd. New Delhi, 16th Edition, 2017. 2. Arora, K.R., "Soil Mechanics and Foundation Engineering", Standard Publishers and Distributors, New Delhi, 7th Edition, 2017(Reprint). 3. Murthy, V.N.S., "Text book of Soil Mechanics and Foundation Engineering", CBS Publishers Distribution Ltd., New Delhi. 2014
Reference Books:	1. Gopal Ranjan, A S R Rao, "Basic and Applied Soil Mechanics" New Age International Publication, 3rd Edition, 2016. 2. Palanikumar.M., "Soil Mechanics", Prentice Hall of India Pvt. Ltd, Learning Private Limited Delhi, 2013. 3. Purushothama Raj. P., "Soil Mechanics and Foundations Engineering",2nd Edition, Pearson Education, 2013. 4. Venkatramaiah.C., "Geotechnical Engineering", New Age International Pvt. Ltd., New Delhi, 2017
MOOC/Web Platforms:	https://nptel.ac.in/courses/105/104/105104162/

IV - Course Outcomes

On completion of the course, the students will be able to		**Bloom's Level Mapped**
CO1	Classify the soil and assess the engineering properties, based on index properties.	Understand (K2)
CO2	Understand the stress concepts in soil.	Understand (K2)
CO3	Understand and identify the settlement in soils.	Apply (K3)
CO4	Determine the shear strength of soil.	Apply (K3)
CO5	Analyze both consolidation and settlement.	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	-	-	-	-	-	-	-	-	2	-
CO2	3	2	-	2	-	-	-	-	-	-	-	-	2	2
CO3	3	2	3	-	-	-	-	-	-	-	-	-	3	3

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CO4	3	2	-	3	-	-	-	-	-	-	-	-	2	-
CO5	3	2	-	3	-	-	-	-	-	-	-	-	3	2

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

VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓	✓			✓				✓	

I - Course Code & Name: 23CE402 Concrete Technology

Prerequisite	Program Name	Sem	Category	L	T	P	C
Construction Materials and Technology	B.E. -Civil Engineering	IV	PCC	3	0	0	3

II - Course Objectives

1.	To study the properties of ingredients of concrete.
2.	To know about the usage of admixtures in concrete.
3.	To design the mix proportion of concrete.
4.	To evaluate the workability and strength of concrete.
5.	To show the importance and application of special concretes.

III - Course Content

Preamble:

This aim of this course is to impart knowledge to the students on the properties of materials for concrete by suitable tests, admixtures and special concretes.

Unit – I	MATERIALS FOR CONCRETE	9 Periods

Cement – Classification - Chemical composition and Properties - Tests on cement as per IS Standards- Aggregates – Classification - Properties and Testing of aggregates as per IS Grading requirements- Water - Quality of water for use in concrete.

Unit – II	FRESH CONCRETE & ADMIXTURES	9 Periods

Manufacturing of concrete - Workability - Factors affecting workability – Test for workability of concrete - Segregation and Bleeding- Chemical Admixtures - Accelerators - Retarders - Plasticizers- Super plasticizers - Water proofers - Corrosion Inhibitors - Mineral Admixtures - Fly Ash, Silica Fume, Nano silica, Ground Granulated Blast Furnace Slag (GGBS) and Metakaoline - Their effects on concrete properties.

Unit – III	CONCRETE MIX DESIGN	9 Periods

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Principles of Mix Proportioning- Properties of concrete related to Mix Design - Physical properties of materials required for Mix Design - Design Mix and Nominal Mix - IS Mix Design - with and without chemical and mineral admixture.		
Unit – IV	**HARDENED CONCRETE**	**9 Periods**
Properties of Hardened concrete – Determination of Compressive, Tensile and Flexural strength as per IS standards – Non – destructive test – Creep and shrinkage of concrete - Modulus of elasticity of concrete – durability – Water Absorption – Sorptivity test - Chloride permeability and Sulphate resistance, Corrosion of reinforcement - Carbonation		
Unit – V	**SPECIAL CONCRETES**	**9 Periods**
Light weight concretes – Foam Concrete - Prestressed Concrete - High strength concrete - Fibre reinforced concrete – Ferrocement - Ready mix concrete - Shotcrete – Polymer concrete - High performance concrete - Self compacting concrete – 3D printed Concrete - Sustainable Concrete - Geopolymer Concrete – Low Carbon Concrete - Bio - Concrete		
		Total Periods: 45

Text Books:	1. Shetty, M.S, "Concrete Technology", 8th Edition, S. Chand and Company Ltd, New Delhi, 2019. 2. Santhakumar. A.R; "Concrete Technology", 2nd Edition Oxford University Press, New Delhi, 2018. 3. Neville, A.M and Brooks J.J "Concrete Technology",2nd Edition, Pearson, 2019.
Reference Books:	1. Gambir, M.L; "Concrete Technology", 5th Edition, Tata McGraw Hill Publishing Co Ltd, New Delhi, 2017. 2. Mehta P. K., Concrete: Microstructure, Properties and Materials, 2014, McGraw-Hill, New Delhi. 3. IS 10262-2019 Recommended Guidelines for Concrete Mix Design, Bureau of Indian Standards, New Delhi.
MOOC/Web Platforms:	https://archive.nptel.ac.in/courses/105/104/105104030/

IV - Course Outcomes

On completion of the course, the students will be able to		**Bloom's Level Mapped**
CO1	Identify the quality of cement and aggregates by various testing methods as per standards.	Understand (K2)
CO2	Understand workability and effect of admixtures on the properties of concrete.	Understand (K2)
CO3	Design the concrete mix using IS methods.	Apply (K3)
CO4	Identify the behavior of concrete based on its hardened properties.	Understand (K2)

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CO5	Select a suitable type of concrete based on specific application.	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	-	3	2	-	-	-	-	-	-	2	3	2
CO2	3	2	-	2	2	-	-	-	-	-	-	2	3	2
CO3	3	3	3	3	2	-	-	-	-	-	-	2	3	3
CO4	3	2	-	3	2	-	-	-	-	-	-	2	3	2
CO5	3	2	2	3	2	-	-	-	-	-	-	2	3	3

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

VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓	✓			✓				✓	

I - Course Code & Name: 23CE403 Hydraulic Engineering

Prerequisite	Program Name	Sem	Category	L	T	P	C
Fluid Mechanics	B.E. - Civil Engineering	IV	PCC	3	0	0	3

II - Course Objectives

1.	To impart basic knowledge to the students about the open channel flows with analysis of uniform flow.
2.	To understand the open channel flows with analysis of gradually varied flow.
3.	To know the open channel flows with analysis of rapidly varied flow.
4.	To design Pelton wheel, Francis and Kaplan turbine.
5.	To expose them to various types of pumps and efficiency of Centrifugal pump, reciprocating pump, submersible pump and gear pump.

III - Course Content

Preamble:

Provide an in-depth understanding of the principles of hydraulics and their applications in engineering practice. It includes the Fundamental principles of hydraulics, including fluid properties, flow types, and hydraulic forces, Hydraulic machinery, including pumps and turbines, and their applications. It describes Open channel flow, including uniform and non-uniform flow

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analysis.		
Unit – I	**UNIFORM FLOW**	**9 Periods**
Definition and differences between pipe flow and open channel flow - Types of Flow - Properties of open channel - Fundamental equations - Sub-critical, Super-critical and Critical flow – Velocity distribution in open channel - Steady uniform flow: Chezy's equation, Manning equation - Best hydraulic sections for uniform flow - Computation in Uniform Flow - Specific energy and specific force.		
Unit – II	**GRADUALLY VARIED FLOW**	**9 Periods**
Dynamic equations of gradually varied - Water surface flow profile classifications: Hydraulic Slope, Hydraulic Curve – Profile determination by Numerical method: Direct step method and Standard step method- Change in Grades.		
Unit – III	**RAPIDLY VARIED FLOW**	**9 Periods**
Application of the momentum equation for RVF - Hydraulic jumps - Types - Energy dissipation – Positive and Negative surges.		
Unit – IV	**TURBINES**	**9 Periods**
Turbines - Classification - Impulse turbine – Pelton wheel - Reaction turbines - Francis turbine - Kaplan turbine - Draft tube - Cavitation - Performance of turbine - Governing of Turbines		
Unit – V	**PUMPS**	**9 Periods**
Classification of pumps - Centrifugal pumps - Working principle - Heads and efficiencies– Velocity triangles - Work done by the impeller - Performance curves - Reciprocating pump working principle - Indicator diagram and it's variations - Work saved by fitting air vessels – Introduction to Submersible pump and Gear pump.		
		Total Periods: 45

Text Books:	1. Jain. A.K., Fluid Mechanics, Khanna Publishers, Delhi,2010. 2. Chandramouli P N, Applied Hydraulic Engineering, Yes Dee Publisher, 2017.
Reference Books:	1. Ven Te Chow, Open Channel Hydraulics, McGraw Hill, New York, 2009. 2. Modi P.N. and Seth S.M., Hydraulics and Fluid Mechanics, Standard Book House, New Delhi, 19th edition, 2013. 3. Mays L. W., Water Resources Engineering, John Wiley and Sons (WSE), New York, 2019. 4. Subramanya K., Flow in open channels, Tata McGraw Hill, New Delhi, 2019.
MOOC/Web Platforms:	https://archive.nptel.ac.in/courses/105/105/105105203/

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IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Describe the basics of open channel flow, its classification and analysis of uniform flow in steady state conditions with specific energy concept and its application	Understand (K2)
CO2	Analyse steady gradually varied flow, water surface profiles and its length calculation using direct and standard step methods with changes in water surface profiles due to changes in grades.	Apply (K3)
CO3	Derive the relationship among the sequent depths of steady rapidly varied flow and estimating energy loss in hydraulic jump with exposure to positive and negative surges.	Analyze (K4)
CO4	Design turbines, pumps and explain the working principle characteristic curves and demonstrate the knowledge selection of turbines	Understand (K2)
CO5	Differentiate pumps and explain the working principle with characteristic curves and design centrifugal and reciprocating pumps.	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	-	-	-	-	-	-	2	-	-	3	-
CO2	3	3	3	-	-	-	-	-	-	2	-	-	3	-
CO3	3	3	3	-	-	-	-	-	-	2	-	2	3	3
CO4	3	3	3	2	1	-	-	2	-	2	1	2	3	-
CO5	3	3	3	2	1	-	-	2	-	2	1	2	3	3

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

VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓	✓	✓			✓		✓		

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I - Course Code & Name: 23CE404 Water Supply and Waste Water Engineering

Prerequisite	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Civil Engineering	IV	PCC	4	0	0	4

II - Course Objectives

1.	To introduce students to the characteristics and parameters of different water sources.
2.	To learn the various methods and processes of water treatment.
3.	To gain knowledge on water storage structures and distribution structures.
4.	To introduce students to the planning and design of sewerage systems.
5.	To foster an understanding of Sludge treatment and disposal methods.

III - Course Content

Preamble:

Water is an essential resource for life, economic development, and environmental sustainability. The field of Water Supply and Wastewater Engineering focuses on the planning, design, operation, and maintenance of systems that ensure the safe and efficient delivery of potable water and the Proper management, treatment, and disposal of wastewater.

Unit – I	WATER SUPPLY	12 Periods

Estimation of surface and subsurface water resources - Predicting demand for water- Impurities of water and their significance - Physical, chemical and bacteriological analysis - Waterborne diseases -Standards for potable water. Comparison from quality and quantity and other considerations – intakes – infiltration galleries

Unit – II	WATER TREATMENT	12 Periods

Objectives - Principles, functions, and design of water treatment plant Unit –s, aerators of flash mixers, Coagulation and flocculation – Clarifloccuator - Sand filters -Water Softening-Desalination-Reverse Osmosis-Demineralization-Adsorption-Ion exchange - Membrane Systems-RO Reject Management-Iron and Manganese removal - Defluoridation - Disinfection - Removal of iron and manganese

Unit – III	WATER STORAGE AND DISTRIBUTION	12 Periods

Storage and balancing reservoirs – types, location and capacity. Distribution systems-Requirements, layouts and methods- Distribution reservoirs-storage capacity, mass curve method-Leak detection-Analysis of distribution network- Hardy Cross method-Water supply system in buildings- house service connection, pipe fittings& fixtures, storage tanks, piping systems - Systems of plumbing.

Unit – IV	PLANNING AND DESIGN OF SEWERAGE SYSTEM	12 Periods

Characteristics and composition of sewage - Population equivalent - Sanitary sewage flow and storm runoff estimation - Sewer materials - Hydraulics of flow in sanitary sewers - Sewer design - Sewer appurtenances - Corrosion in sewers - Prevention and control – Sewage pumping- Drainage in buildings - Sanitary fittings-traps – one pipe and two pipe systems of plumbing examination of

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sewage – B.O.D. Equation – C.O.D.		
Unit – V	**SLUDGE TREATMENT AND DISPOSAL**	**12 Periods**
Objectives - Selection of Treatment Methods - Principles, Functions, - Activated Sludge Process Trickling filters - Sequencing Batch Reactor(SBR) - UASB - anaerobic filters and natural systems Ponds and Lagoons-Anaerobic systems-Sludge digestion-characteristics-digestion tanks, design-disposal of digested sludge- advances in sludge treatment and disposal		
		Total Periods: 60

Text Books:	1. Garg, S.K. Environmental Engineering, Vol.I, Khanna Publishers, New Delhi, 2010. 2. Garg, S.K., Environmental Engineering Vol.II, Khanna Publishers, New Delhi, 2015. 3. Punmia, B.C., Jain, A.K., and Jain.A.K.., Environmental Engineering, Vol.II, Laxmi Publications, 2010.
Reference Books:	1. Manual on Water Supply and Treatment, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 1999. 2. Syed R. Qasimand Edward M. Motley Guang Zhu, Water Works Engineering Planning, Design and Operation, Prentice Hall of India Learning Private Limited, New Delhi, 2009. 3. Metcalf and Eddy – Waste water Engineering – Treatment and Reuse, Tata McGraw – Hill Company, New Delhi, 2010. 4. Syed R.Qasim "Wastewater Treatment Plants", CRC Press WashingtonD.C.,2010.
MOOC/Web Platforms:	https://nptel.ac.in /courses/105/105/10510504/

IV - Course Outcomes

On completion of the course, the students will be able to		**Bloom's Level Mapped**
CO1	Understand the various components of water supply scheme and design of intake structure.	Understand (K2)
CO2	Understand the process of conventional treatment and design of water and wastewater treatment system and gain knowledge of selection of treatment process and biological treatment process.	Understand (K2)
CO3	Design and evaluate water distribution system and water supply in buildings.	Understand (K2)
CO4	Understand on the characteristics and composition of sewage, ability to Estimate sewage generation and design sewer system including sewage pumping stations.	Understand (K2)
CO5	Understand and design the various advanced treatment system and knowledge about the recent advances in Sludge treatment process and disposal.	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	-	2	-	-	-	-	-	-	-	-	-	-	3
CO2	3	2	3	-	-	-	-	-	-	-	-	-	-	2
CO3	3	-	3	-	-	-	2	-	-	-	-	-	-	2
CO4	3	2	3	-	2	-	2	2	-	-	-	-	-	3
CO5	3	-	-	-	-	2	2	2	-	-	-	2	-	3

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

VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓	✓			✓				✓	

I - Course Code & Name: 23CE405 Highway and Railway Engineering

Prerequisite	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Civil Engineering	IV	PCC	3	0	0	3

II - Course Objectives

1.	Learn the importance of highway planning, alignment, and different types of roads.
2.	Study the highway design elements like curves, gradients, and sight distances for safe transportation.
3.	Understand the components and design methods for flexible and rigid pavements using IRC guidelines.
4.	Learn about railway tracks, alignment, drainage, and safety features like signals and level crossings.
5.	Study railway track construction, urban transport systems, and track maintenance methods.

III - Course Content

Preamble:
Transportation Engineering course aims to teach students how to design safe, efficient, and environmentally friendly transportation systems.

Unit – I	HIGHWAY PLANNING AND ALIGNMENT	9 Periods

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Significance of highway planning - Modal limitations towards sustainability - History of road development in India- Factors influencing highway alignment - Engineering surveys for alignment, objectives, conventional and modern methods - Classification of highways - Typical cross sections of Urban and Rural roads.		
Unit – II	**GEOMETRIC DESIGN OF HIGHWAYS**	**9 Periods**
Geometric design - Cross sectional elements - Sight distances - Horizontal curves, Super elevation, transition curves, widening at curves - Vertical curves - Gradients, Special consideration for hill roads - Hairpin bends - Lateral and vertical clearance at underpasses.		
Unit – III	**DESIGN OF FLEXIBLE AND RIGID PAVEMENTS**	**9 Periods**
Pavement components and their role - Design principles -Design practice for flexible and rigid Pavements (IRC methods only) - Embankments- Problems in Flexible pavement design.		
Unit – IV	**RAILWAY PLANNING AND CONSTRUCTION**	**9 Periods**
Elements of permanent way – Rails, Sleepers, Ballast, rail fixtures and fastenings, Selection of gauges - Track Stress, coning of wheels, creep in rails, defects in rails – Route alignment surveys, conventional and modern methods-Geometric design of railway, gradient, super elevation, widening of gauge on curves (Problems)-Railway drainage- Level Crossings - Signaling.		
Unit – V	**RAILWAY TRACK CONSTRUCTION MAINTENANCE AND OPERATION**	**9 Periods**
Construction & Maintenance – Conventional, Modern methods and Materials, Layouts of Railway Stations and Yards, Rolling Stock, Tractive Power, Track Resistance - Role of Indian Railways in National Development – Railways for Urban Transportation – LRT & MRTS Feasibility study, Planning and construction.		
		Total Periods: 45
Text Books:	1. Khanna.S. K., Justo.C.E.G and Veeraragavan A. "Highway Engineering", Nemchand Publishers, 2014. 2. Subramanian K.P., "Highways, Railways, Airport and Harbour Engineering", Scitech Publications (India), Chennai, 2010. 3. C. Venkatramaiah., Transportation Engineering-Vol.2 Railways, Airports, Docks and Harbours, Bridges and Tunnels., Universities Press (India) Private Limited, Hyderabad, 2015.	
Reference Books:	1. Indian Road Congress (IRC), Guidelines for the Design of Flexible Pavements, IRC: 37-2018. 2. Indian Road Congress (IRC), Guidelines for the Design of Plain Jointed Rigid Pavements for Highways, IRC: 58-2018. 3. Venkatramaiah. C., Transportation Engineering-Vol.2 Railways, Airports, Docks and Harbours, Bridges and Tunnels., Universities Press (India) Private Limited, Hyderabad 2015. 4. Kadiyali.L.R. "Principles and Practice of Highway Engineering", Khanna Technical Publications, 8th edition Delhi, 2013.	
MOOC/Web Platforms:	https://nptel.ac.in/courses/105101087	

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IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Apply the principles of highway planning and alignment to design efficient road networks for urban and rural areas.	Apply (K3)
CO2	Implement geometric design concepts to ensure safe and effective road infrastructure, including sight distances, curves, and gradients.	Apply (K3)
CO3	Use IRC design methods to analyze and develop flexible and rigid pavements based on traffic and soil conditions.	Apply (K3)
CO4	Demonstrate knowledge of railway track components and geometric design principles to solve practical railway engineering problems.	Apply (K3)
CO5	Utilize modern construction and maintenance techniques for railway tracks and urban transportation systems like LRT and MRTS.	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	-	2	-	-	-	2	2	1
CO2	3	1	-	-	-	2	-	2	-	-	-	2	2	1
CO3	3	3	3	-	-	2	-	3	-	-	-	2	2	1
CO4	3	2	-	-	-	2	-	2	-	-	-	2	1	1
CO5	3	2	-	-	-	2	-	2	-	-	-	2	1	1

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

VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓				✓				✓	

I - Course Code & Name: 23GE901 Environmental Science and Sustainability

Prerequisite	Program Name	Sem	Category	L	T	P	C
Nil	B.E. /B.TECH. COMMON FOR MECH, CIVIL, EEE, 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.

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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.

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 Periods: 30

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,

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	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 Outcomes

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)

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	-	-	-	2	3	-	1	-	-	2	-	-
CO2	3	2	-	-	-	3	3	-	1	-	-	2	-	-
CO3	3	1	1	-	-	2	2	-	-	-	-	2	-	-
CO4	3	1	1	1	-	2	2	-	1	-	-	2	-	-

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CO5	3	2	1	-	-	2	2	-	1	-	-	1	-	-

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

VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓		✓		✓					

I – Course Code & Name: 23CE411 Hydraulic Engineering Laboratory

Prerequisite	Program Name	Semester	Category	L	T	P	C
Fluid Mechanics	B.E. -Civil Engineering	IV	PCC	0	0	4	2

II - Course Objectives

1.	To provide hands on experience in calibration of flow meters, performance characteristics of pumps and turbines.

III - Course Content

Preamble:

To provide hands on experience in calibration of flow meters, performance characteristics of pumps and turbines.

List of Experiments

A. FLOW MEASUREMENT

1. Calibration of Rotameter
2. Flow through Orifice meter
3. Flow through Venturimeter
4. Flow through Notches
5. Bernoulli's Experiment (demonstration)

B. LOSSES IN PIPES

6. Determination of friction factor in pipes.
7. Determination of minor losses

C. PUMPS

8. Characteristics of Centrifugal pumps
9. Characteristics of Gear pump
10. Characteristics of Reciprocating pump

D. TURBINES

11. Characteristics of Pelton wheel turbine
12. Characteristics of Francis turbine
13. Characteristics of Kaplan turbine

E. DETERMINATION OF METACENTRIC HEIGHT

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14. Determination of metacentric height of floating bodies. **Total Periods: 60**	
Text Books:	1. Hydraulic Laboratory Manual, Centre for Water Resources, Anna University, 2015. 2. Modi P.N. and Seth S.M., Hydraulics and Fluid Mechanics. Standard Book House. New Delhi, 2017. 3. Subramanya K, Fluid Mechanics and Hydraulic Machines, Tata McGraw Hill Edu. Pvt. Ltd. 2011
MOOC/Web Platforms:	https://eerc03-iiith.vlabs.ac.in/-

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Accurately measure and analyze fluid flow using various devices	Apply (K3)
CO2	Determine the friction factor and analyze major and minor losses in piping systems	Apply (K3)
CO3	Analyze the performance characteristics of various types of pumps, including centrifugal, gear, submersible, and reciprocating pumps	Apply (K3)
CO4	Investigate the performance characteristics of various turbines, including the Pelton wheel, Francis, and Kaplan turbines	Apply (K3)
CO5	Determine the metacentric height of floating bodies through practical experimentation, gaining an understanding of the stability of floating structures	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	2	1	3	-	2	2	-	3	-	-	1	1	1
CO2	3	2	1	3	-	2	2	-	3	-	-	1	1	1
CO3	3	3	2	3	-	1	2	-	3	-	-	1	1	1
CO4	3	3	2	3	-	1	2	-	3	-	-	1	1	1
CO5	3	3	2	3	-	1	2	-	3	-	-	1	1	1

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

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VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment / Group Discussion	Simulation / Trouble shooting
						✓				

I – Course Code & Name: 23CE412 Water and Waste Water Engineering Laboratory

Prerequisite	Program Name	Semester	Category	L	T	P	C
Nil	B.E. -Civil Engineering	IV	PCC	0	0	4	2

II - Course Objectives

1.	To equipment with the necessary knowledge and skills to analyze water and waste water samples Effectively, ensuring the provision of safe and high-quality water in diverse settings.

III - Course Content

Preamble:

Water and wastewater quality analysis plays a critical role in environmental monitoring, public health, and sustainable water management. This document outlines the essential procedures for the evaluation of water and wastewater samples.

List of Experiments

ANALYSIS OF WATER SAMPLE

1. Sampling and preservation methods for water and wastewater (Demonstration only)
2. Measurement of Electrical conductivity and turbidity.
3. Determination of fluoride in water by spectrophotometric method /ISE.
4. Determination Acidity
5. Determination of Sulphate in water.
6. Determination of Optimum Coagulant Dosage by Jar test apparatus.
7. Determination of available Chlorine in Bleaching powder and residual chlorine in water.

ANALYSIS OF WASTEWATER SAMPLE

8. Estimation of suspended, volatile and fixed solids.
9. Determination of Sludge Volume Index in waste water.
10. Determination of Dissolved Oxygen (Winkler method)
11. Estimation of B.O.D.
12. Estimation of C.O.D.

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13. Determination of TKN and Ammonia Nitrogen in wastewater

Total Periods: 60

Text Books:	1. Garg, S.K. Environmental Engineering, Khanna Publishers, New Delhi, 2010. 2. Punmia, B.C., Jain, A.K., and Jain.A.K.., Environmental Engineering, Vol.II, Laxmi Publications, 2010.
Reference Books:	1. APHA, "Standard Methods for the Examination of Water and Waste water", 22nd Ed. Washington, 2012. 2. "Laboratory Manual for the Examination of water, wastewater soil Rump", H.H. and Krist,H. – Second Edition, VCH, Germany, 3rd Edition, 1999. 3. "Methods of air sampling & analysis",James P.Lodge Jr(Editor) 3rd Edition, Lewis publishers,Inc,USA,1989.
MOOC/Web Platforms:	https://ee2-nitk.vlabs.ac.in/Course%20Alignment.html

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Calibrate and standardize the equipment.	Understand (K2)
CO2	Collect proper sample for analysis	Understand (K2)
CO3	To know the sample preservation methods	Understand (K2)
CO4	To perform field-oriented testing of water, wastewater	Understand (K2)
CO5	To perform coliform analysis	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	-	2	-	3	3	-	-	3	2	3
CO2	3	2	-	2	-	2	-	3	3	-	-	3	2	3
CO3	3	2	-	2	-	2	-	3	3	-	-	3	2	3
CO4	3	2	-	2	3	2	-	3	3	-	-	3	2	3
CO5	3	2	-	2	3	2	-	3	3	-	-	3	2	3

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

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VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment / Group Discussion	Simulation / Trouble shooting
	✓	✓	✓			✓				

I – Course Code & Name: 23CE413 Geotechnical Laboratory

Prerequisite	Program Name	Semester	Category	L	T	P	C
Nil	B.E. -Civil Engineering	IV	PCC	0	0	4	2

II - Course Objectives

1.	To develop skills to test the soils for their index properties.
2.	To characterize the soil based on their properties.
3.	To Determine the Engineering Properties of soil.
4.	To determine the Standard Penetration Test

III - Course Content

Preamble:

Students will gain a comprehensive understanding of the fundamental properties of soils, including texture, structure, density, moisture content, and shear strength.

List of Experiments

1. **DETERMINATION OF INDEX PROPERTIES**
   a. Specific gravity of soil solids
   b. Grain size distribution – Sieve analysis
   c. Grain size distribution - Hydrometer analysis
   d. Liquid limit and Plastic limit tests
   e. Shrinkage limit and Differential free swell tests
2. **DETERMINATION OF INSITU DENSITY AND COMPACTION CHARACTERISTICS**
   b. Field Density Test (Sand replacement method and Core cutter method)
   c. Determination of moisture–density relationship using standard proctor compaction test.
3. **DETERMINATION OF ENGINEERING PROPERTIES**
   a. Permeability determination (constant head and falling head methods)
   b. One-dimensional consolidation test (Determination of co-efficient of consolidation only)
   c. Direct shear test in cohesion less soil
   d. Unconfined compression test in cohesive soil
   e. Laboratory vane shear test in cohesive soil
   f. Tri-axial compression test in cohesion-less soil (Demonstration only)

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g. California Bearing Ratio Test h. Safe Bearing Capacity Test **4. Standard Penetration Test (SPT) (Demonstration only)**

Total Periods: 60

Text Books:	1. Punmia, B.C., "Soil Mechanics and Foundations", Laxmi Publications Pvt.Ltd., New Delhi, 2017.
Reference Books:	1. Soil Engineering Laboratory Instruction Manual" published by Engineering College Co-operative Society, Anna University, Chennai, 2010. 2. "Saibaba Reddy, E. Ramasastri, K. "Measurement of Engineering Properties of Soils", New age International (P) limited publishers, New Delhi, 2008. 3. Lambe T.W., "Soil Testing for Engineers", John Wiley and Sons, New York, 1951.Digitized 2008. 4. IS Code of Practice (2720) Relevant Parts, as amended from time to time, Bureau of Indian Standards, New Delhi. 5. G.Venkatappa Rao and Goutham .K. Potable, "Geosynthetics Testing – A laboratory Manual", Sai Master Geoenvironmental Services Pvt. Ltd., 1st Edition 2008. 6. Braja M.Das., "Soil Mechanics: Laboratory Manual", Oxford University Press, eighth edition, 2012
MOOC/Web Platforms:	https://smfe-iiith.vlabs.ac.in/

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Conduct tests to determine the index properties of soils	Apply (K3)
CO2	Determine the in-situ density and compaction characteristics.	Apply (K3)
CO3	Conduct tests to determine the compressibility, permeability, and shear Strength of soils.	Apply (K3)
CO4	Understand the Standard Penetration Test	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	2	3	3	1	1	1	1	3	1	1	3	3	3
CO2	1	2	3	3	1	1	1	1	3	2	1	3	2	3
CO3	3	3	3	3	1	1	1	1	3	1	1	3	2	3
CO4	1	2	2	3	2	1	1	1	3	1	1	3	2	2

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

VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment / Group Discussion	Simulation / Trouble shooting
	✓	✓	✓			✓				

Value Added Course - II

I – Course Code & Name: 23CEAO2 Sketch Up

Prerequisite	Program Name	Semester	Category	L	T	P	C
Basic Computer Knowledge	B.E.- Civil Engineering	IV	EEC	0	0	2	1

II - Course Objectives

1.	To introduce students to the SketchUp interface, navigation tools, and basic 2D and 3D modeling techniques.
2.	To develop skills in object manipulation, precision modeling, and measurement tools for accurate designs
3.	To enable students to create and manage components, apply materials, and enhance models with realistic textures.
4.	To teach advanced modeling techniques, including terrain design, solid operations, and architectural detailing.
5.	To equip students with rendering and visualization techniques for producing high-quality presentations and project walkthroughs

III - Course Content

Preamble: The course is to teach students the concepts of Building Information Modeling and introduce the tools for parametric building design and documentation using SketchUp.

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Unit – I: INTRODUCTION TO SKETCHUP

Installing and setting up Sketch Up- Starting Sketch Up for the first time - Understanding system requirements - Getting to Know the Interface - Interface basics - Adding toolbars and customizing the workspace - Navigating the 3D workspace - Changing perspectives (orthographic vs. perspective views) - Basic Drawing Tools - Line tool fundamentals – Using the Rectangle tool - Creating circles, polygons, and arcs - 3D Modeling Basics - Pushing and pulling faces into 3D - Using the Offset tool to create outlines - Using the Follow Me tool for complex shapes - Creating 3D text

Unit – II: MANIPULATING OBJECTS AND MEASUREMENTS

Object Selection and Transformation - Selecting and moving objects - Scaling and rotating models- Advanced selection tools - Grouping and organizing objects - Measurement and Dimensioning Tools - Using the Tape Measure tool for precision - Applying the Protractor tool for accurate angles - Creating and formatting text labels - Using the Dimension tool for technical drawings

Unit – III: COMPONENTS, MATERIALS, AND TEXTURES

Working with Components - Understanding the Component Window - Using the 3D Warehouse to import pre-made components - Creating and editing custom components - Applying Textures and Materials - Applying materials and textures - Editing and adjusting materials - Modeling with floor plans and real-world references

Unit – IV: ADVANCED MODELING AND TERRAIN DESIGN

Terrain and Site Modeling - Using the Sandbox Tools - Creating terrain from contours - Modeling objects with contours - Solid Tools for Advanced Modeling - Creating and editing solid objects - Boolean operations: Union, Intersect, Subtract

Advanced Architectural Elements - Creating complex structures - Stairs, ramps, and railings - Roof modeling: pitched, flat, and complex roofs

Unit – V: RENDERING, VISUALIZATION, AND PROJECT WORK

Rendering and Visualization - Introduction to V-Ray for Sketch Up - Applying realistic materials and textures - Lighting techniques for better rendering - Creating high-quality renders - Exporting images and animations - Project Classes and Practical Application - Designing real-world structures - Applying rendering techniques to project work - Reviewing and improving Sketch Up models

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Demonstrate proficiency in navigating the Sketch Up interface and using basic drawing and modeling tools.	Create (K6)
CO2	Apply transformation and measurement tools to modify objects accurately and enhance model precision.	Create (K6)
CO3	Utilize components, materials, and textures effectively to create realistic and organized 3D models	Create (K6)

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CO4	Develop complex architectural and site models using advanced modeling techniques, terrain tools, and solid operations.	Create (K6)
CO5	Produce high-quality rendered images, animations, and project presentations using Sketch Up and rendering tools.	Create (K6)

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
CO2	2	-	-	-	3	-	-	-	-	2	-	2	-	3
CO3	2	-	-	-	3	-	-	-	-	2	3	2	-	3
CO4	2	-	-	-	3	-	-	-	-	2	3	2	-	3
CO5	2	-	-	-	3	-	-	-	-	2	3	2	-	3

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

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SEMESTER -V

I – Course Code & Name: 23CE501 Design of RC Structural Elements

Prerequisite	Program Name	Semester	Category	L	T	P	C
Mechanics of Materials	B.E. -Civil Engineering	V	PCC	3	1	0	4

II - Course Objectives

1	To understand the different design philosophy for reinforced concrete.
2	To understand the limit state design for flexure, shear, torsion, bond and anchorage.
3	To design of RC slabs and staircase.
4	To design the short RC and slender columns.
5	To design the RC footing for walls, pad, sloped and combined rectangular footings.

III - Course Content

Preamble:
This aim of this course is to understand the physical design of structural elements as per to the guidelines of IS 456: 2000. It constitutes a significant facet of civil engineering practice.

Unit – I	METHODS OF DESIGN OF RC STRUCTURES	12 Periods

Introduction to Working stress method, Ultimate Load Method and Limit State Method – Advantages of Limit State Method over other methods – Properties of concrete and reinforcing steel - Type of loads on structures and load combinations – Design of singly reinforced beams by working stress method.

Unit – II	LIMIT STATE DESIGN FOR FLEXURE	12 Periods

Design of singly and doubly reinforced beams, flanged beams - Behavior of RC members in bond and Anchorage - Behavior of RC beams in shear and torsion - Design of RC members for combined bending, shear and torsion

Unit – III	LIMIT STATE DESIGN OF SLABS AND STAIRCASE	12 Periods

Design of Cantilever Slab – Design of one way simply supported slab and continuous slab, two-way slabs for different edge conditions - Staircases - different types – Dog-legged staircase.

Unit – IV	LIMIT STATE DESIGN OF COLUMNS	12 Periods

Types of columns – Design of short Rectangular and circular columns for axial, uniaxial and biaxial bending using interaction diagrams – Introduction to Slender column

Unit – V	LIMIT STATE DESIGN OF FOOTINGS	12 Periods

Types of footing - Design of wall footing – Design of axially and eccentrically loaded rectangular pad and sloped footings – Design of combined rectangular footing

Total Periods: 60

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Text Books:	1. Krishna Raju, N., Reinforced Concrete Design: IS:456-2000 Principles and Practice, New Age International Publishers, 2018 2. Unnikrishna Pillai, S., Devdas Menon, Reinforced Concrete Design, Tata McGraw Hill Publishing Company Ltd., 2021
Reference Books:	1. Gambhir. M.L., "Fundamentals of Reinforced Concrete Design", Prentice Hall of India Private Limited, New Delhi, 2011. 2. Punmia. B.C., Ashok Kumar Jain, Arun Kumar Jain, "Limit State Design of Reinforced Concrete", Laxmi Publication Pvt. Ltd., New Delhi, 2016. 3. Subramanian N., Design of Reinforced Concrete Structures, 2014, First Edition, Oxford University Press, USA. 4. IS456 - 2000 Code of practice for Plain and reinforced concrete code of practice, Bureau of Indian Standards, New Delhi. 5. SP- 16, Design Aids for Reinforced Concrete to IS 456:1978, Bureau of Indian Standards, New Delhi.
MOOC/Web Platforms:	https://archive.nptel.ac.in/courses/105/105/105105105/

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand and apply the basic design concepts and design RC rectangular beams by working stress method.	Apply (K3)
CO2	Apply limit state concepts to Analyze and design the beam using the limit state method, incorporating the concepts of shear, torsion, anchorage, and development length.	Apply (K3)
CO3	Apply IS 456:2000 guidelines to design one-way slab, two-way RC slab and staircases with reinforcement detailing.	Apply (K3)
CO4	Apply standard design procedures to analyze and design the short & long columns.	Apply (K3)
CO5	Apply appropriate methods to design the wall footings, isolated footings & combined rectangular footing based on soil and load conditions.	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	PSO1	PSO2
CO1	3	2	2	1	-	-	-	-	-	-	-	2	2
CO2	3	3	3	2	-	-	-	-	-	-	2	3	2
CO3	3	3	3	2	-	-	-	-	-	-	2	3	2
CO4	3	3	3	2	-	-	-	-	-	-	2	3	2
CO5	3	3	3	2	-	-	-	-	-	-	2	3	2

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

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VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓			✓	✓		✓	✓	✓	

I – Course Code & Name: 23CE502 Structural Analysis – I

Prerequisite	Program Name	Semester	Category	L	T	P	C
Mechanics of Materials	B.E. -Civil Engineering	V	PCC	3	0	0	3

II - Course Objectives

1	To learn classical methods for determining slope and deflection of beams.
2	To understand the slope deflection method for analyzing indeterminate structures
3	To apply the moment distribution method for analyzing beams and rigid frames.
4	To study the analysis and behavior of arches under various loading conditions.
5	To introduce the analysis of suspension bridges and space trusses.

III - Course Content

Preamble:
This course equips students with analytical techniques for evaluating indeterminate structures such as beams, frames, arches, and trusses. It emphasizes classical and modern methods to understand structural behavior under various loading and support conditions.

Unit – I	DEFLECTION OF BEAMS	9 Periods

Double Integration method–Macaulay's method–Area moment method–Conjugate beam method- Strain energy method for determinate beams.

Unit – II	SLOPE DEFLECTION METHOD	9 Periods

Slope deflection equations - Equilibrium conditions- Analysis of continuous beams and rigid frames – Rigid frames with inclined members Support settlements– symmetric frames with symmetric and skew- symmetric loadings.

Unit – III	MOMENT DISTRIBUTION METHOD	9 Periods

Stiffness - distribution and carry over factors - Analysis of continuous Beams – Plane rigid frames with and without sway – Support settlement – symmetric frames with symmetric and skew-symmetric loading

Unit – IV	ARCHES	9 Periods

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Arches -Eddy'stheorem-Types of arches – Analysis of three - hinged,two- hinged and fixed arches-Parabolic and circular arches – influence lines,ribshortening – Settlement and temperature effects.		
Unit – V	**SUSPENSION BRIDGES AND SPACE TRUSSES**	**9 Periods**
Analysis of suspension bridge – Unstiffened cables and cables with three hinged stiffening g irders– Influence lines for three hinged stiffening girders - Introduction to analysis of space trusses using method of tension coefficients.		

Total Periods: 45

Text Books:	1. Bhavikatti, S.S., Structural Analysis – Volumes I and II, 2020 Edition, Vikas Publishing House Pvt. Ltd., New Delhi. 2. Menon, Devdas, *Structural Analysis*, 2021 Edition, Narosa Publishing House, New Delhi. 3. Hibbeler, R.C., *Structural Analysis*, 2022 Edition, Pearson Education, New Delhi. 4. Punmia, B.C., Jain, A.K., Jain, A.K., *Theory of Structures*, 2017 Edition, Laxmi Publications, New Delhi.
Reference Books:	1. Vazirani, V. N. and Ratwani, M. M., Analysis of Structures – Volume II, 16th Edition (2015), Khanna Publishers, New Delhi 2. Ramamrutham, S., Narayan, R., Theory of Structures, 2018 Edition, Dhanpat Rai Publishing Company, New Delhi. 3. Norris, C.H., Wilbur, J.B., Utku, S., Elementary Structural Analysis, 2014 Edition, Tata McGraw Hill Education, New Delhi. 4. Reddy, C.S., Basic Structural Analysis, Third Edition, 2017, McGraw Hill Education (India) Pvt. Ltd., New Delhi.
MOOC/Web Platforms:	1. *https://nptel.ac.in/courses/105105166* 2. https://onlinecourses.nptel.ac.in/noc25_ce110/preview 3. https://online.vtu.ac.in/program-details/890e8b0e-6422-4491-a1f3-d1f96717fdd6

IV - Course Outcomes

On completion of the course, the students will be able to		**Bloom's Level Mapped**
CO1	Determine slope and deflection of determinate beams using classical methods.	Apply (K3)
CO2	Analyze continuous beams and rigid frames using the slope deflection method.	Apply (K3)
CO3	Apply moment distribution method to analyze beams and frames.	Apply (K3)

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CO4	Evaluate forces in various types of arches under different loading conditions.	Apply (K3)
CO5	Analyze suspension bridges and space trusses using appropriate structural methods.	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	2	1	2	–	2	2	–	2	–	–	1	1	2
CO2	2	2	1	2	–	2	2	–	2	–	–	1	1	2
CO3	3	2	2	2	–	1	2	–	2	–	–	1	1	3
CO4	3	2	2	2	–	1	2	–	2	–	–	1	1	3
CO5	3	2	2	3	–	1	2	–	3	–	–	1	1	3

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

VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓			✓	✓		✓	✓	✓	

I - Course Code & Name: 23CE503 Geotechnical Engineering-II

Prerequisite	Program Name	Sem	Category	L	T	P	C
Geotechnical Engineering-I	B.E. – Civil Engineering	V	PCC	3	0	0	3

II - Course Objectives

1	To understand the scope and methods of site investigation for foundation design.
2	To evaluate the bearing capacity of shallow foundations using theoretical and field methods.
3	To learn the design principles of various shallow foundations including footings and rafts.
4	To analyze the behavior and load-carrying capacity of different types of pile foundations.
5	To study earth pressure theories and design aspects of retaining walls.

III - Course Content

Preamble:
This course imparts essential knowledge on site investigation, foundation design, and earth

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pressure analysis for safe and effective substructure construction.		
Unit – I	**SITE INVESTIGATION AND SELECTION OF FOUNDATION**	**9 Periods**
Scope and objectives – Methods of exploration – Auguring and boring – Wash boring and rotary drilling – Depth and spacing of bore holes – Soil samples Penetration tests (SPT, SCPT and DCPT) - Interpretation - Bore log report dynamic penetrations tests-geophysical explorations		
Unit – II	**BEARING CAPACITY OF SHALLOW FOUNDATION**	**9 Periods**
Introduction – Location and depth of foundation – Codal provisions Bearing capacity of shallow foundation on homogeneous deposits - Terzaghi''s formula and BIS formula - Bearing Capacity from insitu tests (SPT, SCPT and Plate load test. Terzaghi's bearing capacity analysis Bearing capacity based on settlement and building codes		
Unit – III	**FOOTINGS AND RAFTS**	**9 Periods**
Contact pressure distribution below footings - Types and uses of shallow footings - Proportioning of Isolated and Combined footings - Strap footings - Floating foundation – Special foundations – Seismic force consideration – Codal provision.		
Unit – IV	**PILE FOUNDATION**	**9 Periods**
Types of piles and their functions – Factors influencing the selection of pile – Carrying capacity of single pile in granular and cohesive soil – Static formula – Dynamic formulae (Engineering news and Hileys) – Capacity from insitu tests (SPT, SCPT) and Pile load test – Negative skin friction – Uplift capacity- Group capacity by different methods (Field's rule, Converse – Labarra formula and block failure criterion) – Settlement of pile group.		
Unit – V	**RETAINING WALLS**	**9 Periods**
Active and passive earth pressure - Rankine''s theory - Coloumb''s wedge Rebhann's and Culmann's graphical solutions, Stability analysis .		

Total Periods: 45

Text Books:	1. Murthy, V.N.S., "Soil Mechanics and Foundation Engineering", CBS Publishers and Distributers Ltd., New Delhi, 2017. 2. Gopal Ranjan and Rao A.S.R. "Basic and Applied soil mechanics", New Age International (P) Ltd, New Delhi,2023. 3. Punmia, B.C., "Soil Mechanics and Foundations", Laxmi Publications Pvt.Ltd., New Delhi, 2017.
Reference Books:	1. B. N. D. Narasinga Rao, Soil Mechanics and Foundation Engineering, Wiley India Pvt. Ltd., New Delhi, 2015. 2. B. C. Punmia, Soil Mechanics and Foundations, Laxmi 2. Das, B.M. "Principles of Foundation Engineering" (Eigth edition), Thompson Asia Pvt. Ltd., Singapore, 2017. 3. Kaniraj, S.R. "Design aids in Soil Mechanics and Foundation Engineering", Tata McGraw Hill publishing company Ltd., New Delhi, 2017.

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MOOC/Web Platforms:	https://onlinecourses.nptel.ac.in/noc22_ce96/preview

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the site investigation methods to determine geotechnical design parameters and recommend suitable types of foundations.	Understand (K2)
CO2	Understand the design principles to develop shallow foundation systems based on soil and load conditions.	Understand (K2)
CO3	Apply design techniques to develop combined footings and raft foundations for various structural requirements.	Apply (K3)
CO4	Apply appropriate design procedures to plan and design deep foundations such as piles.	Apply (K3)
CO5	Apply geotechnical principles to design retaining walls that meet stability and safety requirements.	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	3	2	2	2	1	2	–	–	2	3	2
CO2	3	3	2	3	–	2	1	–	–	–	–	1	3	2
CO3	3	3	3	3	–	1	1	–	–	–	–	1	3	2
CO4	3	3	3	3	–	1	1	–	–	–	–	1	3	3
CO5	3	3	3	3	–	2	1	–	–	–	–	1	3	3

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

VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓	✓			✓				✓	

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I – Course Code & Name: 23CE511 Concrete -Highway Engineering Laboratory

Prerequisite	Program Name	Semester	Category	L	T	P	C
Concrete Technology, Highway and Railway Engineering	B.E. -Civil Engineering	V	PCC	0	0	4	2

II - Course Objectives

1	To understand the properties and behavior of fresh and hardened concrete through standard testing methods.
2	To familiarize with quality assessment techniques for aggregates used in construction.
3	To impart knowledge of various tests conducted on bitumen and bituminous mixes.
4	To develop competency in handling laboratory equipment and interpreting test results.
5	To promote awareness of material standards and specifications relevant to civil engineering materials.

III - Course Content

Preamble:

This course aims to provide practical experience in testing concrete, aggregates, and bituminous materials to evaluate the quality and performance of construction materials in civil engineering.

List of Experiments

I. **Test on Fresh Concrete**
   1. Slump test
   2. Compaction factor test
   3. Flow Table Test

II. **Test on hardened concrete**
   1. Compression test on cubes & Cylinders
   2. Flexure test
   3. Split Tension Test

III. **Test on aggregate**
   1. Los Angeles Abrasion Test

IV. **Tests on Bitumen and Bituminous mix**
   1. Specific gravity determination of the bitumen/asphalt sample.
   2. Determination of consistency of the bituminous material.
   3. Estimation of loss of bitumen on heating.
   4. Determination of softening point of the asphalt/bitumen sample
   5. Determination of ductility value of the bitumen sample
   6. Determination of optimum binder content by Marshall method
   7. Determination of stripping value of the bituminous mix Demonstration

Total Periods: 60

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Text Books:	3. Concrete Manual by M.L. Gambhir, Dhanpat Rai & Sons Co.2012 4. Highway Material Testing manual, Khanna, Justo and Veeraraghavan, Nem Chand and Brothers Rorkee, 2023
Reference Books:	3. IS 10262 :2009 "Concrete Mix Proportioning – Guidelines" 4. 1S 516:2006 "Methods of Tests on Strength of Concrete" 5. 1S 1201 -1220 (1978) "Methods for testing tars and bituminous materials" 6. IRC SP 53 -2010 "Guidelines on use of modified bitumen" 7. MS-2 Manual for Marshalls Mix design 2002
MOOC/Web Platforms:	https://cs-iitd.vlabs.ac.in/List%20of%20experiments.html https://ts-nitk.vlabs.ac.in/List%20of%20experiments.html

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Assess the workability of fresh concrete using slump, compaction factor, and flow table tests.	Apply (K3)
CO2	Evaluate the strength characteristics of hardened concrete through compression, flexural, and split tensile tests.	Evaluate (K5)
CO3	Determine the abrasion resistance of aggregates using the Los Angeles abrasion test.	Apply (K3)
CO4	Conduct standard tests on bitumen to assess physical properties like consistency, ductility, and softening point.	Apply (K3)
CO5	Analyze bituminous mix properties using Marshall method and evaluate stripping value for mix durability.	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	3	2	1	3	-	2	2	-	3	-	-	2	1	1
CO2	3	2	1	3	-	2	2	-	3	-	-	2	1	1
CO3	3	3	2	3	-	2	2	-	3	-	-	2	1	1
CO4	3	3	2	3	-	2	2	-	3	-	-	2	1	1
CO5	3	3	2	3	-	2	2	-	3	-	-	2	1	1

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

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
					✓	✓		✓		

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I Course Code & Name: 23CE512 Survey Camp

Prerequisite	Program Name	Semester	Category	L	T	P	C
Surveying and Surveying Laboratory	B.E. -Civil Engineering	V	PCC	0	0	0	1

II - Course Objectives

1	To provide practical exposure to modern and conventional surveying instruments like theodolite, total station, and GPS.
2	To train students in the execution of large-scale field surveys such as traversing, contouring, and leveling.
3	To develop competency in plotting, mapping, and data interpretation for various civil engineering projects.
4	To inculcate skills for real-time data collection, error correction, and teamwork in field conditions.
5	To promote understanding of survey applications in infrastructure development, including road, canal, and building layout.

III - Course Content

Preamble:

The Survey Camp offers hands-on training in modern and traditional surveying techniques, enhancing practical skills in data collection, mapping, and layout. It bridges theoretical knowledge with real-world applications, preparing students for professional challenges in civil engineering projects.

Two weeks Survey Camp will be conducted during summer vacation in the following activities:

1. Traverse – using Theodolite / Total station
2. Contouring

(i). Radial tachometric contouring - Radial Line at Every 45 Degree and Length not less than 60 Meter on each Radial Line

(ii). Block Level/ By squares of size at least 100 Meter x 100 Meter atleast 20 Meter interval

(iii). L.S & C.S - Road and canal alignment for a Length of not less than 1 Kilo Meter atleast

L.S at Every 30M and C.S at every 90 M

3. Offset of Buildings and Plotting the Location
4. Sun observation to determine azimuth (guidelines to be given to the students)
5. Use of GPS to determine latitude and longitude and locate the survey camp location
6. Traversing using GPS
7. Curve setting by deflection angle

Text Books:	1. Dr. B. C. Punmia, Ashok K. Jain and Arun K Jain, Surveying Vol. I & II, Lakshmi Publications Pvt Ltd, New Delhi, Sixteenth Edition, 2016.

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	2. K. R. Arora, Surveying Vol I & II, Standard Book house, Twelfth Edition 2013. 3. Bannister and S. Raymond, Surveying, Seventh Edition, Longman .
Reference Books:	1. T. P. Kanetkarand S. V. Kulkarni, Surveying and Levelling, Parts 1 & 2, Pune Vidyarthi Griha Prakashan, Pune, 2008. 2. R. Subramanian, Surveying and Levelling, Oxford University Press, Second Edition, 2012. 3. James M. Anderson and Edward M. Mikhail, Surveying, Theory and Practice, Seventh Edition, Mc Graw Hill 2001.

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Apply surveying principles and techniques using instruments like total station, theodolite, and GPS.	Apply (K3)
CO2	Analyze and process traverse, leveling, and contouring surveys independently in field conditions.	Apply (K3)
CO3	Apply Set out curves and alignments for road and canal projects using deflection angle methods.	Apply (K3)
CO4	Analyze, and interpret survey data for map preparation and engineering design.	Apply (K3)
CO5	Apply demonstrate teamwork, leadership, and effective communication during collaborative field work.	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	3
CO2	3	2	-	-	3	-	-	-	-	-	-	-	3	2
CO3	3	2	2	-	3	-	-	-	-	-	-	-	3	3
CO4	3	3	3	3	3	-	-	-	-	-	-	-	3	3
CO5	3	-	-	-	-	-	-	-	3	3	3	2	-	-

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

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation / Trouble shooting
						✓		✓		

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I -Course Code & Name: Industry Internship-I

Prerequisite	Program Name	Semester	Category	L	T	P	C
Nil	B.E. -Civil Engineering	V	EEC	0	0	0	1

II - Course Objectives

1	Apply theoretical knowledge and technical skills acquired in the academic program to analyze and address authentic, complex challenges within a professional work environment.
2	Demonstrate key professional competencies, including effective communication, teamwork, ethical responsibility, and time management, in a real-world organizational setting.
3	Analyze the structure, culture, and operational processes of the host organization to understand its business model and industry context.
4	Execute assigned projects and responsibilities with a high degree of initiative and accountability, delivering outcomes that meet or exceed the expectations of the industry mentor.
5	Critically reflect on the internship experience to self-assess personal and professional growth, identify acquired skills, and articulate career goals for future employment.

III - Strategy

The student undertakes an internship at a pre-approved host organization under the dual guidance of an industry mentor and a faculty advisor. The student is expected to apply academic knowledge to real-world challenges, develop professional competencies, and contribute meaningfully to the host organization. Upon completion, the student prepares a comprehensive internship report and will be evaluated based on this report, a formal presentation, and a viva voce examination conducted by a panel of faculty.

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Able to use classroom knowledge to solve real problems at work.	Apply (K3)
CO2	Develop professional skills like communication, teamwork, and time management.	Apply (K3)
CO3	Understand how a real company operates and functions day-to-day.	Apply (K3)
CO4	Complete tasks and projects effectively	Apply (K3)
CO5	Identify strengths and interests for future career.	Apply (K3)

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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 Reading**	**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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Books for study & Reference:	• *M.V. Rodrigues*, **"English for Effective Communication"**, Oxford University Press • Simon Sweeney, **"English for Business Communication"**, Cambridge University Press • *Krishna Mohan & Meera Banerji, "Developing* **Communication Skills"**, Macmillan India • 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

IV - Course Outcomes

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.	Analyse (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 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	PO12	PSO 1	PSO 2
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

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I - Course Name: 23MA902 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.
Web Source	https://archive.nptel.ac.in/courses/109/107/109107191/?utm_source=chatgpt.com

IV. Course Outcomes

On the completion of this course, 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 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	PO1 2	PSO 1	PSO 2
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

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	Hazards, 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,

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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, Panchayat 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 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

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	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 Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	To impart knowledge on the concepts of Disaster, Vulnerability and Disaster Risk reduction (DRR).	Apply (K3)
CO2	To enhance understanding on Hazards, Vulnerability and Disaster Risk Assessment prevention and risk reduction.	Apply (K3)
CO3	To 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)

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	PO12	PSO 1	PSO 2
CO1	3	3	3	3	-	-	2	2	-	-	2	-	-	-
CO2	3	3	3	3	-	-	2	1	-	-	2	-	-	-
CO3	3	3	3	3	-	-	2	2	-	-	-	-	-	-
CO4	3	3	3	3	-	-	2	1	-	-	2	-	-	-
CO5	3	3	3	3	-	-	2	2	-	-	2	-	-	-

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

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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		

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Science and Technology on the eve of British conquest		
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

Books for study & Reference:	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. 3.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. 4.Jaggi, O. P., 1977. Medicines in Medieval India, Delhi, Atma Ram & Sons, Delhi. 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:	Web source 1. https://dst.gov.in/ 2. https://www.india.gov.in/topics/science-technology

IV - Course Outcomes

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.	Apply (K3)
CO2	Evaluate the impact of these historiographical works on the understanding of indigenous knowledge systems and colonial influence on science and technology.	Apply (K3)

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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)

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	PO12	PSO 1	PSO 2
CO1	2	1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2	1	-	-	-	-	-	-	-	-	-	-	-	-
CO3	2	1	-	-	-	-	-	-	-	-	-	-	-	-
CO4	2	1	-	-	-	-	-	-	-	-	-	-	-	-
CO5	2	1	-	-	-	-	-	-	-	-	-	-	-	-

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

I - Course Name: 23MC905 Political and Economic Thought for a Human 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 Human Society**	**9 Periods**

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Considerations for human 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		

Text Books:	1. 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/UHV-II%20Course%20Material%202024/L%2022%20Sum%20Up%20and%20Program%20v5.pdf?utm_source=chatgpt.com

IV - Course Outcomes

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.	Understand (K2)

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	Future directions	
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 their personal development in terms of values and ethics, and articulate ways in which they can continue to grow and apply these in their lives.	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	PO12	PSO 1	PSO 2
CO1	1	3	-	3	3	-	3	-	3	3	3	-	-	-
CO2	1	3	-	2	3	-	3	2	2	3	3	1	-	-
CO3	1	3	-	3	3	-	2	2	2	2	3	-	-	-
CO4	1	3	-	2	2	-	2	3	2	3	1	-	-	-
CO5	1	3	-	2	3	-	3	3	3	3	2	1	-	-

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

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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

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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 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:

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

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

IV - Course Outcomes

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 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	PO1 2	PSO 1	PSO 2
CO1	-	-	-	-	-	-	-	-	2	3	-	2	-	-

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CO2	-	-	-	-	-	-	-	-	2	3	-	2	-	-
CO3	-	-	-	-	-	-	-	-	2	3	-	2	-	-
CO4	-	-	-	-	-	-	-	-	2	3	-	2	-	-
CO5	-	-	-	-	-	-	-	-	2	3	-	2	-	-

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

I - Course Name: 23MC907 State, Nation Building and Politics 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.		

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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

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 Outcomes

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)

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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)

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	PO12	PSO 1	PSO 2
CO1	3	3	1	1	-	3	-	2	2	-	1	3	-	-
CO2	3	3	1	1	-	3	-	2	2	-	1	3	-	-
CO3	3	3	1	1	-	3	-	2	2	-	1	3	-	-
CO4	3	3	1	1	-	3	-	2	2	-	1	3	-	-
CO5	3	3	-	-	-	3	-	2	2	-	-	2	-	-

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

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 Occurrence.
4.	To analyze the accidents under different industrial settings.
5.	To analyze the Environmental condition to avoid noise pollution.

III - Course Content

Preamble:

Students will be able to: Understand the premises informing the twin themes of Industrial Safety

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techniques to avoid the accidents.		
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	**Environmental Control**	**9 Periods**
Industrial Health Hazards – Environmental Control – Industrial Noise – Noise measuring instruments, Control of Noise, Vibration – Personal Protection.		

TOTAL: 45 Periods

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, England Society of Safety Engineers, USA

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MOOC/Web Platforms:	1. https://archive.nptel.ac.in/courses/110/105/110105094/ 2. https://www.shiksha.com/online-courses/industrial-safety-courses-certification-training-by-nptel-st575-tg1307

IV - Course Outcomes

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 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	PO12	PSO 1	PSO 2
CO1	2	1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2	1	-	-	-	-	-	-	-	-	-	-	-	-
CO3	2	1	-	-	-	-	-	-	-	-	-	-	-	-
CO4	2	1	-	-	-	-	-	-	-	-	-	-	-	-
CO5	2	1	-	-	-	-	-	-	-	-	-	-	-	-

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

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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,		

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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

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 Outcomes

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)

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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	PO1 2	PSO 1	PSO 2
CO1	2	1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2	1	-	-	-	-	-	-	-	-	-	-	-	-
CO3	2	1	-	-	-	-	-	-	-	-	-	-	-	-
CO4	2	1	-	-	-	-	-	-	-	-	-	-	-	-
CO5	2	1	-	-	-	-	-	-	-	-	-	-	-	-

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

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		
Unit – II	**Elements of Fiction**	**9 Periods**

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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

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 Outcomes

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)

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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	PO1 2	PSO 1	PSO 2
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

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PROFESSIONAL ELECTIVE COURSES

VERTICAL – I: STRUCTURES

I – Course Code & Name: 23PCE01 Concrete Structures

Prerequisite	Program Name	Sem	Category	L	T	P	C
Mechanics of Materials	B.E. -Civil Engineering	V/VI/VII	PEC	3	0	0	3

II - Course Objectives

1.	To understand the concept of yield line theory.
2.	To understand the design of earth retaining structures.
3.	To understand the design of liquid retaining structures.
4.	To study the design of flat slab, brick wall and deep beam.
5.	To study the design of bridges subjected to IRC loading.

III - Course Content

Preamble:
This course focuses on the advanced design of reinforced concrete structures including yield line theory of slabs, earth and liquid retaining structures, flat slabs, and bridges. It introduces students to IS codes and their practical application for ensuring structural safety and serviceability.

Unit – I	**INTRODUCTION TO YIELD LINE THEORY**	**9 Periods**
Introduction to yield line theory of slabs - Application to square, rectangular, triangular and circular slabs with simply supported or fixed boundary conditions subjected to uniformly distributed loads (by upper bound theorem).		
Unit – II	**EARTH RETAINING STRUCTURES**	**9 Periods**
Retaining walls – types - Design of cantilever and counterfort retaining walls		
Unit – III	**LIQUID RETAINING STRUCTURES**	**9 Periods**
Classification - Underground rectangular tanks – Domes - Overhead circular and rectangular tank		
Unit – IV	**SELECTED TOPICS**	**9 Periods**
Design of flat slabs – Design of reinforced concrete walls – Design of axially and eccentrically loaded brick walls - Design of deep beams		
Unit – V	**BRIDGES**	**9 Periods**
Types of bridges - IRC loadings - Design of single span slab bridges for class a loading only (Restricted to two lane).		

Total Periods: 45

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Text Books:	1. Unnikrishnan Pillai, S., Devdas Menon, "Reinforced Concrete Design", Tata McGraw Hill Publishing Company Ltd., 2021. 2. Advanced Reinforced Concrete Design", Krishna Raju N., CBS Publishers and Distributors, Delhi, 2016.
Reference Books:	1. Raju N. K., Advanced Reinforced Concrete Design, CBS Publishers and Distributors Pvt. Ltd., India, 2016 2. Varghese P.C., Advanced Reinforced Concrete Design, PHI, India, 2nd Edition, 2010. 3. IS 456 - 2000 Code of Practice for Plain and Reinforced Concrete, Bureau of Indian Standards, New Delhi. 4. IS 3370 (Part I) - 2021 - Code of Practice for Concrete Structures for the Storage of Liquid, Bureau of Indian Standards, New Delhi. 5. IS 3370 (Part IV) – 2021 - Code of practice for Concrete Structures for the Storage of Liquids, Bureau of Indian Standards, New Delhi. 6. IRC: 5 - 1998 - Standard Specification and Code of Practice for Road Bridges (Section I), Bureau of Indian Standards, New Delhi. 7. IRC: 6 - 1966 - Standard Specification and Code of Practice for Road Bridges (Section II),Bureau of Indian Standards, New Delhi. 8. IRC: 21 - 2000 - Standard Specification and Code of Practice for Road Bridges (Section III, Bureau of Indian Standards, New Delhi.
MOOC/Web Platforms:	https://onlinecourses.nptel.ac.in/noc23_ce109/

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand and apply yield line theory to slabs of various shapes under different support conditions.	Apply (K3)
CO2	Analyze and design cantilever and counterfort retaining walls as per IS codes.	Apply (K3)
CO3	Design underground and overhead liquid retaining structures such as tanks and domes in accordance with codal provisions.	Apply (K3)
CO4	Design special reinforced concrete elements such as flat slabs, RC walls, deep beams, and axially/eccentrically loaded brick walls.	Apply (K3)
CO5	Design single-span slab bridges for IRC Class A loading considering standard specifications for two-lane traffic.	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	2	2	1	-	-	-	-	-	2	1	3	2
CO2	3	2	3	2	1	-	-	-	-	-	2	1	3	3
CO3	3	2	3	2	2	-	-	-	-	-	2	1	3	3
CO4	3	3	3	2	2	-	-	-	-	-	2	2	3	3
CO5	3	2	3	2	1	-	-	-	-	-	2	1	3	3

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

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓				✓			✓	✓	✓	

I- Course Code and Name: 23PCE02 Prestressed Concrete Structures.

Prerequisite	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Civil Engineering	V/VI/VII	PEC	3	0	0	3

II - Course Objectives

1.	To understand the methods and types of prestressing and to enable the students to design prestressed concrete structural elements and systems

III - Course Content

Preamble:

This course imparts knowledge on the principles, behavior, analysis, and design of prestressed concrete structures with emphasis on IS code provisions and practical applications.

Unit – I	INTRODUCTION – THEORY AND BEHAVIOUR	9 Periods

Basic principles of prestressing – Classification and types – Advantages over ordinary reinforced concrete – Materials – High strength concrete and high tensile steel – Methods of prestressing – Freyssinet, Magnel, Lee-McCall and Gifford Udall anchorage systems – Losses of Prestress: Loss of prestress in pretensioned and post-tensioned members due to various causes like elastic shortage of concrete, shrinkage of concrete, creep of concrete, relaxation of stress in steel, slip in anchorage, frictional losses. Analysis of sections of stresses by stress concept, strength concept and load balancing concept.

Unit – II	DESIGN FOR FLEXURE AND SHEAR	9 Periods

Basic assumptions of flexural design – Permissible stresses in steel and concrete as per I.S.1343

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Code – Different Types of sections - Design of sections of Type I and Type II post-tensioned and pre-tensioned beams – Principal tension and compression- Improving shear resistance of concrete by horizontal and vertical prestressing and by using inclined or parabolic cables- Analysis of rectangular and I beams for shear – Design of shear reinforcements- IS Code provisions.		
Unit – III	**DEFLECTION AND DESIGN OF ANCHORAGE ZONE**	**9 Periods**
Factors influencing deflections – Short-term deflections of uncracked members – Prediction of long- term deflections due to creep and shrinkage – Check for serviceability limit states. Determination of anchorage zone stresses in post-tensioned beams by Mangel's method, Guyon's method and I.S. Transfer of Prestress.Pretensioned Members: Transmission of prestressing force by bond – Transmission length – Flexural bond stresses – IS code provisions		
Unit – IV	**COMPOSITE BEAMS AND CONTINUOUS BEAMS**	**9 Periods**
Composite beams - Analysis and design. Partial prestressing - non-prestressed reinforcements. Differential shrinkage - Methods of achieving continuity in continuous beams – Analysis for secondary moments – Concordant cable and linear transformation – Calculation of stresses – Principles of design.		
Unit – V	**MISCELANEOUS STRUCTURES**	**9 Periods**
Role of prestressing in members subjected to Tensile forces and compressive forces Design of compression members and tension members. Special topics Circular prestressing - Design of Tanks, Pipes, Sleepers and Poles – Partial prestressing		

Total Periods: 45

Text Books:	1. Krishna Raju N., "Prestressed concrete", 5th Edition, Tata McGraw Hill Company, New Delhi, 2012. 2. Pandit.G.S. and Gupta. S.P., "Prestressed Concrete", CBS Publishers and Distributers Pvt. Ltd, 2014
Reference Books:	3. Lin T.Y. and Ned.H.Burns, "Design of prestressed Concrete Structures", Third Edition, Wiley India Pvt. Ltd., New Delhi, 2013. 4. Rajagopalan.N, "Prestressed Concrete", Narosa Publishing House, 2017. 5. Dayaratnam.P., "Prestressed Concrete Structures", Oxford and IBH, 2017 6. Sinha.N.C. And Roy.S.K. Fundamentals of Prestressed Concrete, S.Chand and Co. Ltd., 2011
MOOC/Web Platforms:	https://nptel.ac.in/courses/105106117

IV - Course Outcomes

On completion of the course, the students will be able to		**Bloom's Level Mapped**
CO1	Apply a prestressed concrete beam accounting for losses.	Apply (K3)
CO2	Analyze for flexure and shear.	Analyze (K4)
CO3	Apply the anchorage zone for post-tensioned members and estimate the deflection in beams.	Apply (K3)

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CO4	Analyze composite members and continuous beams.	Analyze (K4)
CO5	Analyze water tanks, pipes, poles and sleepers.	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	3	3	3	1	1	1	1	2	1	1	1	2	3	1
CO2	3	2	3	1	1	1	1	2	1	1	1	2	3	3
CO3	3	2	3	1	1	1	1	2	1	1	1	2	3	3
CO4	2	2	3	1	1	1	1	2	1	1	1	2	3	2
CO5	2	2	3	1	1	1	1	2	1	1	1	2	3	1

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

VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓	✓			✓				✓	

I Course Code & Name: 23PCE03 Prefabricated Structures

Prerequisite	Program Name	Sem	Category	L	T	P	C
Nil	B.E. -Civil Engineering	V/VI/VII	PEC	3	0	0	3

II - Course Objectives

1.	To introduce the need, types, and advantages of prefabrication and compare it with conventional construction.
2.	To Familiarize with prefabricated components, structural systems, and their behavior.
3.	To understand the design principles in prefabrication.
4.	To perceive the types of joints and connections in structural members.

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5.	To impart knowledge about the structural stability.

III - Course Content

Preamble:
This course introduces the principles and practices of prefabricated construction. It covers component systems, joints, design for abnormal loads, and the advantages of prefabrication over traditional construction methods. The emphasis is on sustainable and economical structural design.

Unit – I	INTRODUCTION	9 Periods
Need for prefabrication -Types of prefabrication- Advantages and Disadvantages – Comparison between prefabrication and monolithic construction methods - Principles & Economy of prefabrication – Modular coordination – Standardization – Materials – Production – Transportation – Erection.		
Unit – II	**PREFABRICATED COMPONENTS AND SYSTEMS**	**9 Periods**
Behaviour and types of structural components– roof and floor slabs – Walls panels - Shear walls - Beams - Columns – skeletal system- portal frame system - Large panel systems- block system		
Unit – III	**DESIGN PRINCIPLES**	**9 Periods**
DisUnit –ing of Structures - Design of cross section based on efficiency of material used – Problems in design because of joint flexibility – Allowance for joint deformation - Demountable precast concrete systems- Handling and erection stresses		
Unit – IV	**JOINTS AND CONNECTIONS IN STRUCTURAL MEMBERS**	**9 Periods**
Types of Joints – based on action of forces - compression joints - shear joints - tension joints - based on function - construction joints, contraction joints, expansion joints. Design of expansion joints - Dimensions and detailing - Types of structural connections - Beam to Column - Column to Column - Beam to Beam - Column to foundation.		
Unit – V	**DESIGN FOR ABNORMAL LOADS**	**9 Periods**
Progressive collapse - Codal provisions – Equivalent design loads for considering abnormal effects such as earthquakes, cyclones, etc., - Progressive collapse – - Importance of avoidance of progressive collapse - case study.		

Total Periods: 45

Text Books:	1. 1.Bruggeling A.S. G and Huyghe G.F. "Prefabrication with Concrete", A.A. Balkema Publishers, USA,1991. 2. Lewitt,M. " Precast Concrete- Materials, Manufacture, Properties and Usage, CRC Press, 2019.
Reference Books:	1. "Handbook on Precast Concrete Buildings", Indian Concrete Institute, 2016. 2. "Precast concrete connection details", Structural Design manual, Society for the studies in the use of precast concrete, Netherland Betor Verlag, 2009. 3. IS 15916-2010: —Indian Standard Code of Practice for Building Design and erection using Prefabricated Concrete, Bureau of Indian Standards, New Delhi.
MOOC/Web Platforms:	https://www.coursera.org/specializations/precast-structural-system

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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 need, types, principles, and economic aspects of prefabrication and compare with monolithic construction methods.	Understand (K2)
CO2	Identify and classify various prefabricated components and structural systems used in modern construction.	Understand (K2)
CO3	Apply design principles for precast elements considering joint behavior, erection stresses, and efficiency of material usage.	Apply (K3)
CO4	understand various types of joints and structural connections in precast components ensuring stability and functionality.	Understand (K2)
CO5	Apply the codal provisions and design considerations to resist abnormal loads and prevent progressive collapse.	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	2	-	-	-	-	-	-	-	2	3	2
CO2	3	3	2	2	-	-	-	-	-	-	-	1	3	2
CO3	3	2	3	3	-	-	-	-	-	-	-	2	3	2
CO4	3	3	3	2	-	-	-	-	-	-	-	2	3	2
CO5	3	2	3	3	-	-	-	-	-	-	-	2	3	2

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

VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓		✓	✓	✓				✓	

I Course Code & Name: 23PCE04 Repair and Rehabilitation of Structures

Prerequisite	Program Name	Sem	Category	L	T	P	C
Nil	B.E. -Civil Engineering	V/VI/VII	PEC	3	0	0	3

II - Course Objectives

1.	This course provides a knowledge on quality of concrete
2.	This course provides a knowledge on durability aspects, causes of deterioration, assessment of distressed structures
3.	This course provides a knowledge on Assessment of distressed structures

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4.	This course provides a knowledge on Repairing of structures
5.	This course provides a knowledge on Restoration of Heritage structures and demolition procedures

III - Course Content

Preamble:
This course provides a knowledge on quality of concrete, durability aspects, causes of deterioration, assessment of distressed structures, repairing of structures, Restoration of Heritage structures and demolition procedures

Unit – I	**MAINTENANCE AND REPAIR STRATEGIES**	**9 Periods**
Maintenance, Repair and Rehabilitation - Facets of Maintenance - Importance of Maintenance - Various aspects of Inspection - Assessment procedure for evaluating a damaged structure - causes of deterioration		
Unit – 2	**STRENGTH AND DURABILITY OF CONCRETE**	**9 Periods**
Quality assurance for concrete – Strength and Durability of concrete - Cracks, different types, causes-Effects due to climate, temperature, Sustained elevated Temperature, Corrosion – Causes, Effects and Remedial measures – Methods of corrosion		
Unit – III	**SPECIAL CONCRETES**	**9 Periods**
Polymer concrete - Sulphur infiltrated concrete - Fibre reinforced concrete - High strength concrete- High performance concrete - Durability of concrete in seawater Concrete made with industrial wastes.		
Unit – IV	**TESTING TECHNIQUES AND PROTECTION METHODS**	**9 Periods**
Non-destructive Testing Techniques, Epoxy injection, Shoring, Underpinning, Corrosion protection techniques – Corrosion inhibitors, Corrosion resistant steels, Coatings to reinforcement, cathodic protection.		
Unit – V	**STRENGTHENING, REPAIR, REHABILITATION AND RESTORATION OF STRUCTURES**	**9 Periods**
Strengthening of Structural elements, Repair of structures distressed due to corrosion, fire, leakage and earthquake - Restoration of Heritage structures- Case studies.		

Total Periods: 45

Text Books:	1. Shetty. M.S. Jain A K., Concrete Technology – Theory and Practice, S. Chand and Company, Eighth Edition, 2019. 2. B. Vidivelli, Rehabilitation of Concrete Structures Standard Publishes Distribution.1st edition 2009.
Reference Books:	1. Hand book on Seismic Retrofit of Buildings, CPWD and Indian Buildings Congress, Narosa Publishers, 2008. 2. Hand Book on Repair and Rehabilitation of RCC Buildings – Director General works CPWD, Govt of India, New Delhi – 2002 3. P. C. Varghese, Maintenance Repair and Rehabilitation & Minor works of building, Prentice Hall India Pvt Ltd 2014. 4. Dodge Woodson, Concrete Structures, Protection, Repair and Rehabilitation, Butterworth-Heinemann, Elsevier, New Delhi 2012

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MOOC/Web Platforms:	https://nptel.ac.in/courses/105106202

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Interpret the need for maintenance and inspection of structures.	Understand (K2)
CO2	Classify the causes of cracks and deterioration in concrete.	Understand (K2)
CO3	Differentiate the types and applications of special concretes.	Understand (K2)
CO4	Summarize the testing and protection methods for concrete structures.	Apply (K3)
CO5	Discuss the methods of repair, strengthening, and restoration of structures.	Apply (K3)

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
CO1	3	3	-	2	2	-	1	1	2	-	-	1	-	1
CO2	3	2	-	-	-	-	1	1	1	-	-	1	1	1
CO3	3	2	-	-	-	-	1	1	1	-	-	1	-	1
CO4	2	2	-	-	-	-	1	1	1	-	-	1	-	2
CO5	2	2	-	-	-	-	1	1	1	-	-	1	1	1

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

VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board / Video	Demo Model	Case Study Video	Google Classroom	Flipped Classrooms	Activity based	Tutorial	Project/ Problem based	Assignment / Group Discussion	Simulation / Trouble shooting
✓	✓		✓	✓				✓	✓	

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I – Course Code & Name: 23PCE05 Dynamics and Earthquake Resistant Structures

Prerequisite	Program Name	Sem	Category	L	T	P	C
Nil	B.E. -Civil Engineering	V/VI/VII	PEC	3	0	0	3

II - Course Objectives

1.	To understand the basic concepts of vibrations and dynamic systems with single and multiple degrees of freedom.
2.	To explain the response of structures under various types of dynamic and harmonic loading.
3.	To understand the fundamentals of engineering seismology and seismic hazards.
4.	To study the behavior of different structural systems under earthquake loads.
5.	To understand the principles of earthquake-resistant design and relevant IS codes.

III - Course Content

Preamble:
This course provides a foundational understanding of structural dynamics, vibration analysis, and earthquake engineering. It includes modeling of SDOF and MDOF systems, response under dynamic loads, and seismic-resistant design based on codal provisions.

Unit – I	THEORY OF VIBRATIONS	9 Periods

Concept of inertia and damping – Types of Damping – Difference between static forces and dynamic excitation – Definition of degree of freedom – Formulation of equation of motion for various SDOF system– D' Alemberts Principles– Effect of damping– Free and forced vibration of damped and undamped structures– Response to harmonic forces and periodic forces–Impulse and response to unit impulse – Duhamel integral

Unit – II	MULTI DEGREE OF FREEDOM SYSTEM	9 Periods

Formulation of equation of motion for Multi Degree of Freedom (MDOF) system– Evaluation of natural frequencies and modes– Eigen values and Eigen vectors– Response to free and forced vibration of undamped and damped MDOF systems– Modal superposition methods.

Unit – III	INTRODUCTION TO EARTHQUAKE ENGINEERING	9 Periods

Elements of Engineering Seismology– Definitions, Introduction to Seismic hazard, Earthquake phenomenon– Seismotectonics– Seismic Instrumentation– Characteristics of Strong Earthquake motion– Estimation of Earthquake Parameters – Seismic zone map - Lessons learnt from past earthquakes.

Unit – IV	EARTHQUAKE EFFECTS ON STRUCTURES	9 Periods

Effect of earthquake on different types of structures– Behaviour of RCC, Steel and prestressed Concrete Structures under earthquake loading– Pinching Effect– Bouchinger Effects– Energy dissipation - P-delta effect - storey drift Evaluation of Earthquake forces– IS Code 1893: 2016– Response Spectra

Unit – V	CONCEPTS OF EARTHQUAKE RESISTANT DESIGN	9 Periods

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Causes of damage– Planning considerations/Architectural concept (IS 4326–1993)– Guidelines for Earthquake resistant design– Earthquake resistant design of masonry buildings– Design consideration– Guidelines– Earthquake resistant design of R.C.C. buildings– Lateral load analysis – Design and detailing (IS 13920:2016) - Introduction to time-history method of analysis **Total Periods: 45**	
Text Books:	1. Mario Paz, Structural Dynamics– Theory and Computations, Fourth Edition, CBS publishers, 2006. 2. Agarwal.P and Shrikhande.M. - Earthquake Resistant Design of Structures, Prentice Hall of India Pvt. Ltd. 2011.
Reference Books:	1. Clough.R.W, and Penzien.J, Dynamics of Structures, Second Edition, McGraw Hill International Edition, 1995. 2. Jai Krishna, Chandrasekaran.A.R., and Brijesh Chandra, Elements of Earthquake Engineering, South Asia Publishers, 1994. 3. Minoru Wakabayashi, Design of Earthquake Resistant Buildings, Mc Graw–Hill Book Company, 1986 4. Humar.J.L, Dynamics of Structures, Prentice Hall Inc., 1990. 5. Anil K Chopra, Dynamics of structures– Theory and applications to Earthquake Engineering, Prentice Hall Inc., 2007. 6. Moorthy.C.V.R., Earthquake Tips, NICEE, IIT Kanpur,2002. 7. IS 4326: 2013 Earthquake Resistant Design and Construction of Buildings – Code of Practice, Bureau of Indian Standards, New Delhi. 8. IS 1893: 2016 Criteria For Earthquake Resistant Design of Structures – Part 1 General Provisions and Buildings, Bureau of Indian Standards, New Delhi. 9. IS 13920:2016 Ductile Design and Detailing of Reinforced Concrete Structures Subjected to Seismic Forces – Code of Practice, Bureau of Indian Standards, New Delhi.
MOOC/Web Platforms:	https://sd-iiith.vlabs.ac.in/List%20of%20experiments.html

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Develop and solve equations of motion for single-degree-of-freedom (SDOF) systems under various loading conditions and understand the role of damping and inertia.	Analyze (K4)
CO2	Formulate and analyze equations of motion for MDOF systems and evaluate natural frequencies and mode shapes using eigenvalue methods.	Analyze (K4)
CO3	Understand the fundamentals of engineering seismology and evaluate seismic parameters using seismic zone maps and instrumentation	Analyze (K4)
CO4	Analyze the behavior of different types of structural systems under earthquake loads and evaluate earthquake forces using IS 1893.	Analyze (K4)
CO5	Apply IS codes and design guidelines for planning and detailing of earthquake-resistant masonry and RCC buildings using lateral load analysis.	Analyze (K4)

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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	3	2	2	-	-	-	-	-	-	1	3	2
CO2	3	3	3	3	2	-	-	-	-	-	-	2	3	3
CO3	3	2	2	2	1	-	-	-	-	-	-	1	2	2
CO4	3	3	3	2	2	2	2	-	-	-	-	2	3	3
CO5	3	3	3	3	2	2	2	-	-	-	-	3	3	3

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

VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓		✓	✓				✓	✓	

I – Course Code & Name: 23PCE06 Introduction to Finite Element Method

Prerequisite	Program Name	Sem	Category	L	T	P	C
Nil	B.E. -Civil Engineering	V/VI/VII	PEC	3	0	0	3

II - Course Objectives

6.	To understand the fundamentals and mathematical formulation of the finite element method (FEM) for engineering problems.
7.	To develop the ability to model and analyze 1D and 2D problems using FEM.
8.	To understand the concept of shape functions, interpolation, stiffness matrices, and the role of convergence.
9.	To explain the direct stiffness method and its application to trusses, beams, and frames.
10.	To provide insights into plate and shell element analysis and the use of FEM software in solving practical problem

III - Course Content

Preamble:
This course introduces the fundamental concepts and mathematical formulations of the Finite Element Method (FEM). It enables students to apply FEM to analyze structures like trusses, beams, plates, and shells using direct stiffness methods and software-based tools.

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Unit – I	INTRODUCTION	9 Periods
Historical Background - General field problems in Engineering – Modelling – Discrete and Continuous models – Characteristics – Difficulties involved in solution – The relevance and place of the finite element method – Basic concept of FEM, Boundary and initial value problems – Gradient and divergence theorems – Functionals – Variational calculus Variational formulation of VBPS. The method of weighted residuals – The Ritz method.		
Unit – II	**FINITE ELEMENT ANALYSIS OF ONE -DIMENSIONAL PROBLEMS**	**9 Periods**
One dimensional second order equations – Differential equilibrium equations – strain displacement relation - linear constitutive relation - special cases - Principle of stationary potential energy - application to finite element methods - Some numerical techniques in finite element Analysis Continua Elements - Displacement models - convergence requirements. Natural coordinate systems - Shape function. Interpolation function. Linear and quadratic elements - Lagrange & Serendipity elements. Strain displacement matrix - element stiffness matrix and nodal load vector.		
Unit – III	**FINITE ELEMENT ANALYSIS OF TWO -DIMENSIONAL PROBLEMS**	**9 Periods**
Two dimensional isoparametric elements - Four noded quadrilateral elements - triangular elements. Computation of stiffness matrix for isoparametric elements - numerical integration (Gauss quadrature) Convergence criteria for isoparametric elements.		
Unit – IV	**DIRECT STIFFNESS METHOD**	**9 Periods**
Concept of direct stiffness, Element Stiffness - Element Assembly to Global Stiffness Matrix, Boundary Condition - Plane truss - displacement of joints, forces in members - Space truss, numerical examples Direct Stiffness for Beams and Frames - stiffness matrix for beam element, principle of superposition - Continuous beams, assembly of element stiffness matrices - application of boundary conditions, consistent load vector - evaluation of displacements at nodes, element end forces -shear force and bending moment diagrams		
Unit – V	**ANALYSIS OF PLATES**	**9 Periods**
Introduction to Plate Bending Problems - displacement functions – Analysis of Thin Plate - Analysis of Thick Plate - Analysis of Skew Plate, Finite Element Analysis of Shell, plane stress and plane strain analysis, Example problem using any general-purpose finite element software		
		Total Periods: 45

Text Books:	1. Rao, S.S., "The Finite Element Method in Engineering", 6th Edition, Butterworth Heinemann,2018. 2. Rajasekaran S, "Finite Element Analysis in Engineering Design", S Chand & Co, New Delhi, 2003
Reference Books:	1. C S Krishnamoorthy, "Finite element analysis - Theory and programming", Tata McGraw Hill Publishing Co, New Delhi, 2011. 2. Chandrapatla and Belegundu, "Introduction to Finite Elements in Engineering", Prentice Hall of India, New Delhi, 2014. 3. David Hutton, Fundamentals of Finite Element Analysis, Tata McGraw Hill Publishing Company Limited, New Delhi, 2005. 4. Chennakesava R. Alavala Finite Element Methods: Basic Concepts and Applications, Prentice Hall Inc., 2010 5. S. S. Bhavikatti, Finite Element Analysis, New Age Publishers, 2007.

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MOOC/Web Platforms:	-

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the basic principles of finite element method, variational formulation, and methods like weighted residuals and Ritz method in solving boundary value problems.	Understand (K2)
CO2	Apply FEM to solve one-dimensional structural problems using appropriate numerical techniques.	Apply (K3)
CO3	Apply finite element techniques to solve two-dimensional structural problems using isoparametric elements and numerical integration	Apply (K3)
CO4	Apply the direct stiffness method to analyze trusses, beams, and frames by assembling global stiffness matrices and applying boundary conditions.	Apply (K3)
CO5	Analyze thin and thick plates, skew plates, and shell structures using finite element formulations and interpret results using general-purpose FEM software.	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	3	2	2	2	-	-	-	-	-	-	-	2	3	2
CO2	3	3	3	2	2	-	-	-	-	-	-	2	3	2
CO3	3	3	3	3	2	-	-	-	-	-	-	2	3	3
CO4	3	3	3	2	2	-	-	-	-	-	-	2	3	3
CO5	3	3	3	3	3	-	-	-	1	1	-	2	3	3

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

VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓			✓			✓	✓	✓	✓

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VERTICAL – II: CONSTRUCTION TECHNIQUES AND PRACTICES

I - Course Code & Name: 23PCE07 Formwork Engineering

Prerequisite	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Civil Engineering	V/VI/VII	PEC	3	0	0	3

II - Course Objectives

1.	To provide fundamental knowledge about the purpose and importance of formwork in construction.
2.	To introduce various materials, tools, and systems used in formwork.
3.	To enable students to plan and design formwork for different structural components.
4.	To develop skills in analysing formwork requirements considering safety, cost, and efficiency.
5.	To train students in methods of erection, supervision, and dismantling of formwork at site.

III - Course Content

Preamble:		
Unit – I	**INTRODUCTION TO FORM WORK**	**9 Periods**
Introduction to Formwork and false work, Temporary work systems, Requirements, Construction planning and site constraints, Selection, and Classification (Types) of Formwork, General objectives of formwork building - Planning for safety - Development of a Basic System - Key Areas of cost reduction - Planning examples - Overall Planning - Detailed planning - Overall programme - Detailed programme - Costing - Planning crane arrangements - Site layout plan - Transporting plant - Formwork beams - Scaffold frames - Framed panel formwork.		
Unit – II	**FORMWORK MATERIALS ASSESORIES & PRESSURES**	**9 Periods**
Formwork Materials, Accessories and consumables – Application of tools, Reconstituted wood - Steel – Aluminum Plywood - Types and grades Standard Unit –s - Corner Unit –s – Pass Unit –s, Calculation of labour constants - Formwork Periods - Labour Requirement. Hardware and fasteners - Nails in Plywood - Allowable withdrawal load and lateral load. Pressures on formwork - Examples - Finish - Sheathing boards working stresses - Repetitive member stress Vertical loads for design of slab forms - Uplift on shores - Laterals loads on slabs and walls.		
Unit – III	**FORMWORK DESIGN**	**9 Periods**
Concepts, Formwork Systems – components, assembly, De-shuttering, safety of work and Design for Tall Structures, Foundation Wall, Column, Slab and Beam formworks. Design of Decks and False works. Effects of various loads. Loading and moment of formwork, IS Code provisions		
Unit – IV	**FORMWORK FOR SPECIAL STRUCTURES**	**9 Periods**
Formwork for Bridge Structures, Shells, Domes, Folded Plates, Overhead Water Tanks, Natural Draft Cooling Tower, Nuclear Reactor, Tunnel, Lift Shaft, stairs and Formwork for Precast Concrete.		

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Various climbing system, Table lifting system.		
Unit – V	**CASE STUDIES**	**9 Periods**
Formwork failures: Causes of failures – Inadequate shoring inadequate bracing of members – improper vibration – Premature stripping Errors in design – Case studies – Finish of exposed concrete design deficiencies – Safety factors – Prevention of rotation – Stripping sequence – failure formwork issues in multi - story building construction – vertical and horizontal elements used in the industry.		

Total Periods: 45

Text Books:	1. Peurify R.L and Oberlender G.D , Formwork for Concrete Structures, , McGraw Hill Education India ,2015 2. Jha K N, Formwork for Concrete Structures, Tata McGraw Hill Education, 2012.
Reference Books:	1. Austin, C.K., Formwork for Concrete, Cleaver -Hume Press Ltd., London, 1996. 2. Hurd, M.K., Formwork for Concrete, Special Publication No.4, American Concrete Institute, Detroit, 1996 3. Michael P. Hurst, Construction Press, London and New York, 2003. 4. Christopher Souder , (2014), Temporary Structure Design, Wiley Publications, London. 5. IS 14687: 1999, False work for Concrete Structures - Guidelines, BIS.
MOOC/Web Platforms:	https://digitalskills.iitmpravartak.org.in/course_details.php?courseID=250

IV - Course Outcomes

On completion of the course, the students will be able to		**Bloom's Level Mapped**
CO1	To understand the overall and detailed planning of formwork.	Understand (K2)
CO2	To impart knowledge on formwork materials, accessories, pressures and labor requirement.	Understand (K2)
CO3	To develop the conceptual understanding of design, construction and erection of formwork.	Apply (K3)
CO4	To impart the knowledge about different types of form work used for special structures	Apply (K3)
CO5	To understand the errors in design and judge the formwork failures through 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	2	3	3	2	2	2	2	-	3	-	3	2	3	3
CO2	3	3	3	2	1	1	2	-	3	-	2	2	3	3

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CO3	3	3	2	3	-	-	2	-	3	-	2	2	3	2
CO4	2	1	3	2	-	-	-	-	2	-	2	2	3	-
CO5	2	3	-	-	-	-	-	-	2	-	3	2	3	-

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

VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓	✓	✓						✓	✓

I - Course Code & Name: 23PCE08 Construction Equipment and Machinery

Prerequisite	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Civil Engineering	V/VI/VII	PEC	3	0	0	3

II - Course Objectives

1.	To familiarize students with various types of construction equipment and their applications in civil engineering projects.
2.	To develop knowledge of the working principles, selection criteria, and operation of construction machinery.
3.	To enable students to understand the role of equipment management in improving project efficiency and cost-effectiveness.
4.	To provide exposure to safety practices and maintenance procedures associated with construction equipment.
5.	To equip students with practical insights for planning and executing engineering tasks using modern construction machinery.

III - Course Content

Preamble: To expose the students in the field of construction equipment and machineries so as to gain knowledge in carrying out engineering tasks.

Unit –I	CONSTRUCTION EQUIPMENTS	9 Periods

Identification - Planning of equipment - Selection of equipment - Equipment management in projects - Maintenance management - Equipment cost - Operating cost - Cost control of equipment - Depreciation analysis - Replacement analysis - Safety management

Unit –II	EQUIPMENT FOR EARTHWORK	9 Periods

Fundamentals of earthwork operations - Earth moving operations - Types of earthwork equipment - Tractors, motor graders, scrapers, front end waders - Dozer, excavators, rippers, loaders, trucks

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and hauling equipment, compacting equipment, finishing equipment - Case studies on earthwork equipment.		
Unit –III	**OTHER CONSTRUCTION EQUIPMENT**	**9 Periods**
Equipment for dredging, trenching, drag line and clamshells, tunnelling - Jacking equipment - Equipment for drilling and blasting - Pile driving equipment - Erection equipment - Crane, mobile crane - Types of pumps used in construction - Equipment for dewatering, grouting and demolition		
Unit –IV	**ASPHALT AND CONCRETE PLANTS**	**9 Periods**
Aggregate production - Different crushers - Feeders - Screening equipment - Handling equipment - Batching and mixing equipment - Ready mix concrete equipment, concrete pumping equipment - Asphalt plant - Asphalt pavers - Asphalt compacting equipment. CONCRETE PRODUCTION EQUIPMENT: Concrete mixers, truck mixers, pneumatic concrete placer, concrete vibrators.		
Unit –V	**MATERIALS HANDLING EQUIPMENT**	**9 Periods**
Forklifts and related equipment - Portable material bins - Material handling conveyors - Material handling cranes - Industrial trucks - Aerial transporting equipment. Driving Equipment - Tunnelling and rock drilling equipment -- drilling techniques		

Total Periods: 45

Text Books:	-
Reference Books:	1. Deodhar, S.V. Construction Equipment and Job Planning, 4th Edn. Khanna Publishers, New Delhi, 2020. 2. Arora S.P. and Bindra S.P., Building Construction, Planning Techniques and Method of Construction, Dhanpat Rai and Sons, 2018. 3. Sharma S.C. Construction Equipment and Management, Khanna Publishers, New Delhi, 2008. 4. Dr. Mahesh Varma., Construction Equipment and its Planning and Application, Metro-politan Book Company, New Delhi., 2003.
MOOC/Web Platforms:	-

IV - Course Outcomes

On completion of the course, the students will be able to		**Bloom's Level Mapped**
CO1	Develop knowledge on planning of equipment and selection of equipment	Understand (K2)
CO2	Explain the knowledge on fundamentals of earth work operations, earth	Understand (K2)

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	moving operations and types of earth work equipment	
CO3	Develop the knowledge on special construction equipment	Apply (K3)
CO4	Apply the knowledge on asphalt and concrete plants	Apply (K3)
CO5	Apply the knowledge and select the proper materials handling equipment	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	2	1	2	-	-	1	-	2	2	2
CO2	3	3	2	2	3	-	1	-	-	1	2	2	3	2
CO3	2	-	3	2	3	1	2	-	1	-	-	2	2	3
CO4	2	2	-	2	2	3	2	3	1	1	-	2	2	2
CO5	3	-	3	2	3	1	2	-	2	2	3	3	3	3

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

VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓	✓	✓						✓	✓

I - Course Code & Name: 23PCE09 Sustainable Construction and Lean Construction

Prerequisite	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Civil Engineering	V/VI/VII	PEC	3	0	0	3

II - Course Objectives

1.	To impart knowledge about the principles of sustainable construction.
2.	To introduce students to the concepts of sustainable materials.
3.	To enable students to perform basic energy calculations in construction practices.
4.	To provide an understanding of green building concepts and practices.

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5.	To examine the environmental impacts associated with construction activities.

III - Course Content

Preamble:
To impart knowledge about sustainable construction and to understand the concepts of sustainable materials, energy calculations, green buildings and environmental effects.

Unit –I	INTRODUCTION & MATERIALS USED IN SUSTAINABLE CONSTRUCTION	9 Periods

Introduction and definition of Sustainability - Carbon cycle - role of construction material: concrete and steel, etc. - CO2 contribution from cement and other construction materials - Recycled and Manufactured aggregate - Role of QC and durability - Life cycle and sustainability.

Unit –II	ENERGY CALCULATIONS	9 Periods

Components of embodied energy - calculation of embodied energy for construction materials - Energy concept and primary energy - Embodied energy via-a-vis operational energy in conditioned building - Life Cycle energy use.

Unit –III	GREEN BUILDINGS	9 Periods

Control of energy use in building – National Building Code (NBC), ECBC code, codes in neighboring tropical countries - OTTV concepts and calculations – Features of LEED and TERI – Griha ratings - Role of insulation and thermal properties of construction materials - influence of moisture content and modeling -Performance ratings of green buildings - Zero energy building'

Unit –IV	CORE CONCEPTS IN LEAN	9 Periods

Introduction to the Course; Lean Overview; Need for Productivity Measurement and improvement; Productivity Measurement System (PMS).

Unit –V	LEAN CONSTRUCTION TOOLS AND TECHNIQUES	9 Periods

Sampling/ Work Sampling; Survey/ Foreman delay survey; Value Stream/ Process Mapping– 5S , Collaborative Planning System (CPS)/ Last Planner™ System (LPS) – Big Room Approach, IT/BIM and Lean, How to Start Practicing Lean Tools in Project Site.

Total Periods: 45

Text Books:	-
Reference Books:	1. Charles J Kibert, Sustainable Construction: Green Building Design & Delivery, 4th Edition, Wiley Publishers 2016. 2. Steve Goodhew, Sustainable Construction Process, Wiley Blackwell,UK, 2016. 3. Craig A. Langston & Grace K.C. Ding, Sustainable Practices in the Built Environment, Butterworth Heinemann Publishers, 2011. 4. Ballard, G., Tommelein, I., Koskela, L. and Howell, G., Lean construction tools and techniques, 2002. 5. Salem, O., Solomon, J., Genaidy, A. and Luegring, M., Site implementation and Assessment of Lean Construction Techniques, Lean Construction Journal, 2005.

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MOOC/Web Platforms:	https://archive.nptel.ac.in/courses/105/106/105106213/

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Describe the various sustainable materials used in construction.	Understand (K2)
CO2	Explain the method of estimating the amount of energy required for building.	Understand (K2)
CO3	Describe the features of LEED, TERI and GRIHA ratings of buildings.	Apply (K3)
CO4	Explain the core concepts of lean construction tools and techniques and their importance in achieving better productivity.	Apply (K3)
CO5	Apply lean tools & techniques to achieve sustainability in construction projects.	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	1	–	2	3	1	1	–	2	1	3	2
CO2	3	1	3	2	1	2	2	–	1	1	1	2	3	2
CO3	2	2	3	1	1	1	1	–	–	–	3	1	3	3
CO4	3	1	3	2	2	1	3	1	1	1	3	2	3	3
CO5	3	1	2	2	2	2	3	1	–	1	3	2	3	3

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

VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓	✓	✓						✓	✓

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I - Course Code & Name: 23PCE10 Construction Management and Safety

Prerequisite	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Civil Engineering	V/VI/VII	PEC	2	0	2	3

II - Course Objectives

1.	To provide knowledge on principles and practices of construction project management.
2.	To develop skills in planning, scheduling, and controlling construction activities.
3.	To enable students to understand contract management, cost control, and resource optimization.
4.	To create awareness on safety regulations, standards, and risk management in construction.
5.	To equip students with practical insights for implementing safe and efficient construction practices.

III - Course Content

Preamble:
To study and understand the formulation, costing of construction projects, scheduling and various safety concepts and its requirements applied to construction projects.

Unit –-I	GENERAL OVERVIEW AND PROJECT ORGANIZATION	9 Periods

Introduction - Interdisciplinary nature of modern construction projects – execution of project management Project Management Practice Roles and Functions and Responsibility of Construction Managers and Major causes of Project failure.

Unit –-II	ESTIMATION OF PROJECT COST & ECONOMICS	9 Periods

Estimating quantities – description of items – estimation of project cost – Accounts Control of Project Cash– decision making in construction projects – depreciation of construction equipment – case study

Unit –-III	ESTIMATION OF PROJECT COST & ECONOMICS	9 Periods

Introduction – project scheduling – uncertainties in duration of activities using PERT – Project monitoring and control system – resource levelling and allocation – crashing of network

Unit –-IV	SAFETY DURING CONSTRUCTION	9 Periods

Basic terminology and General requirements in safety - types of injuries - safety pyramid - Accident patterns - Planning for safety budget, safety culture - Introduction to OSHA regulations - Site safety programs - Job hazard analysis, accident investigation & accident indices-violation, penalty

Unit –-V	SAFE OPERATING PROCEDURES	9 Periods

Safety during alteration, Concerns in Construction Organizing for Quality and Safety demolition works – Earthwork, steel construction, temporary structures, masonry & concrete construction, cutting & welding - Construction equipment, materials handling-disposal & hand tools - Other hazards – fire, confined spaces, electrical safety.

Total Periods: 45

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List of experiments:
Experiment 1 -Introduction to various construction management software Experiment 2 -Planning and creating new project Experiment 3 -Scheduling and constraints using PRIMAVERA Experiment 4 -Project cost management using PRIMAVERA Experiment 5 -Construction project safety management using BIM
Total Periods: 15

Total Periods: 45+15 = 60

Text Books:	-
Reference Books:	1. Barcus, S.W. and Wilkinson.J.W., Hand Book of Management Consulting Services, McGraw Hill, New York, 1986. 2. Joy P.K., Total Project Management - The Indian Context, New Delhi, Macmillan India Ltd., 1992 3. Albert Lester, Project Management, Planning and Control, 7th Edition, Butterworth- Heinemann, USA , 2017. 4. Patrick X.W. Zou ,Riza YosiaSunindijo, Strategic Safety Management in Construction and Engineering John Wiley & Sons, Ltd 2015.
MOOC/Web Platforms:	https://onlinecourses.nptel.ac.in/noc21_ce16/preview

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Perform formulations of projects.	Understand (K2)
CO2	Analyze project costing.	Understand (K2)
CO3	Identify and estimate the activity in the construction.	Apply (K3)
CO4	Develop the knowledge on accidents and their causes.	Apply (K3)
CO5	Plan, assess, analyse and manage the construction project sites.	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	-	-	3	2	-	2	2	3	3	1	2	2

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CO2	2	3	-	-	3	2	-	2	2	3	3	1	2	2
CO3	-	3	3	-	3	-	1	-	-	-	3	-	3	3
CO4	2	3	-	2	3	-	2	-	-	-	3	2	-	-
CO5	2	2	2	2	-	-	-	-	2	-	2	-	2	2

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

VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓	✓	✓						✓	✓

I - Course Code & Name: 23PCE11 Advanced Construction Techniques

Prerequisite	Program Name	Sem	Category	L	T	P	C
Concrete Technology	B.E. – Civil Engineering	V/VI/VII	PEC	3	0	0	3

II - Course Objectives

1.	Select advanced techniques for complex sub-structure and foundation construction.
2.	Plan modern concreting and erection methods for superstructure projects.
3.	Formulate construction sequences for specialized and heavy civil structures.
4.	Design rehabilitation strategies for strengthening existing structural elements.
5.	Plan safe demolition sequences using mechanical or explosive methods.

III - Course Content

Preamble: To study and understand the latest construction techniques applied to engineering construction for sub structure, super structure, special structures, rehabilitation and strengthening techniques and demolition techniques

Unit –I	SUB STRUCTURE CONSTRUCTION	9 Periods

Construction Methodology - Box jacking - Pipe jacking - Under water construction of diaphragm walls and basement - Tunneling techniques - Piling techniques - Driving well and caisson - sinking cofferdam - cable anchoring and grouting - Driving diaphragm walls, Sheet piles - Laying operations for built up offshore system - Shoring for deep cutting - Large reservoir construction - well points - Dewatering for underground open excavation.

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Unit –II	SUPER STRUCTURE CONSTRUCTION FOR BUILDINGS	9 Periods
Vacuum dewatering of concrete flooring – Concrete paving technology – Techniques of construction for continuous concreting operation in tall buildings of various shapes and varying sections – Erection techniques of tall structures, Large span structures – launching techniques for heavy decks – in-situ prestressing in high rise structures, Post tensioning of slab- aerial transporting – Handling and erecting lightweight components on tall structures.		
Unit –III	**CONSTRUCTION OF SPECIAL STRUCTURES**	**9 Periods**
Erection of lattice towers - Rigging of transmission line structures – Construction sequence in cooling towers, Silos, chimney, sky scrapers - Bow string bridges, Cable stayed bridges – Launching and pushing of box decks – Construction of jetties and break water structures – Construction sequence and methods in domes – Support structure for heavy equipment and machinery in heavy industries – Erection of articulated structures and space decks.		
Unit –IV	**REHABILITATION AND STRENGTHENING TECHNIQUES**	**9 Periods**
Seismic retrofitting - Strengthening of beams - Strengthening of columns - Strengthening of slab - Strengthening of masonry wall, Protection methods of structures, Mud jacking and grouting for foundation – Micro piling and underpinning for strengthening floor and shallow profile - Sub grade water proofing, Soil Stabilization techniques.		
Unit –V	**DEMOLITION**	**9 Periods**
Demolition Techniques, Demolition by Machines, Demolition by Explosives, Advanced techniques using Robotic Machines, Demolition Sequence, Dismantling Techniques, Safety precaution in Demolition and Dismantling.		

Total Periods: 45

Text Books:	1. Robertwade Brown, Practical foundation engineering hand book, McGraw Hill Publications, 1995. 2. Sankar, S.K. and Saraswati, S., Construction Technology, Oxford University, New Delhi, 2008
Reference Books:	1. Jerry Irvine, Advanced Construction Techniques, CA Rocket, 1984 2. Patrick Powers. J., Construction Dewatering: New Methods and Applications, John Wiley & Sons, 1992. 3. Peter H.Emmons, "Concrete repair and maintenance illustrated", Galgotia Publications Pvt. Ltd., 2001.Press, 2008.
MOOC/Web Platforms:	https://nptel.ac.in/courses/105103206

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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 modern construction techniques used in the sub structure construction.	Understand (K2)
CO2	Demonstrate knowledge and understanding of the principles and concepts relevant to super structure construction for buildings	Understand (K2)
CO3	Understand the concepts used in the construction of special structures	Apply (K3)
CO4	Knowledge on Various strengthening and repair methods for different cases.	Apply (K3)
CO5	Identify the suitable demolition technique for demolishing a building.	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	-	-	-	-	-	-	-	-	-	3	2
CO2	3	2	2	-	-	-	-	-	-	-	-	-	3	2
CO3	3	3	3	2	-	2	-	-	-	-	-	-	3	3
CO4	3	3	3	2	2	2	-	2	-	-	-	-	3	3
CO5	3	3	3	2	2	3	2	3	2	-	-	-	3	3

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

VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓	✓	✓						✓	✓

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I Course Code & Name: 23PCE12 Energy Efficient Buildings

Prerequisite	Program Name	Sem	Category	L	T	P	C
Nil	B.E. -Civil Engineering	V/VI/VII	PEC	3	0	0	3

II - Course Objectives

1.	To understand the concepts of climate-responsive architecture and the energy challenges in building design.
2.	To provide knowledge of passive design strategies for heating, cooling, and ventilation to reduce energy consumption in buildings.
3.	To design and assess lighting systems (natural and artificial) in energy-efficient buildings.
4.	To acquire knowledge on heat transfer mechanisms, thermal comfort, and ventilation design in different climatic conditions.
5.	To design energy-efficient buildings tailored to various climatic zones using appropriate tools and case studies.

III - Course Content

Preamble:
This course introduces the principles of energy-efficient building design, focusing on climate-responsive architecture and passive design strategies. It equips students with skills to analyze, design, and optimize buildings for thermal comfort, lighting, and energy conservation across various climatic zones.

Unit – I	INTRODUCTION	9 Periods

Climate adapted and climate rejecting buildings – Heat Transfer – Measuring Conduction – Thermal Storage – Measurement of Radiation – The Greenhouse Effect – Convection – Measuring latent and sensible heat – Psychrometry Chart – Thermal Comfort – Microclimate, Site Planning and Development – Temperature – Humidity – Wind – Optimum Site Locations – Sun Path Diagrams – Sun Protection – Types of Shading Devices – Design responses to energy conservation strategies.- case studies on climate sensitive buildings

Unit – II	PASSIVE SOLAR HEATING AND COOLING	9 Periods

General Principles of passive Solar Heating – Key Design Elements – Sunspace – Direct gain – Trombe Walls, Water Walls – Convective Air loops – Concepts – Case Studies – General Principles of Passive Cooling – Ventilation – Air flow calculation - Principles – Case studies – Courtyards – Roof Ponds– Cool Pools – Predicting ventilation in buildings – Window Ventilation Calculations – Room Organization Strategies for Cross and Stack Ventilation – Radiation – Evaporation and dehumidification – Wind Catchers – Mass Effect – Zoning – Load Control – Air Filtration and odor removal.

Unit – III	DAYLIGHTING AND ELECTRICAL LIGHTING	9 Periods

Materials, components and details – Insulation – Optical materials – Radiant Barriers – Glazing materials – Glazing Spectral Response – Day lighting – Sources and concepts –Building Design Strategies – Case Studies – Daylight apertures – Light Shelves – Codal requirements – Day lighting design – Electric Lighting – Light Distribution – Electric Lighting control for day lighted buildings – Switching controls – Coefficient of utilization – Electric Task Lighting – Electric Light Zones – Power Adjustment Factors. – Integration of day lighting and artificial lighting

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Unit – IV	HEAT CONTROL AND VENTILATION	9 Periods
Hourly Solar radiation – Heat insulation – Terminology – Requirements – Heat transmission through building sections – Thermal performance of Building sections – Orientation of buildings – Building characteristics for various climates – Thermal Design of buildings – Influence of Design Parameters – Mechanical controls – Examples. Ventilation – Requirements – Minimum standards for ventilation – Ventilation Design – Energy Conservation in Ventilating systems – Design for Natural Ventilation – Calculation of probable indoor wind speed.		
Unit – V	**DESIGN FOR CLIMATIC ZONES**	**9 Periods**
Energy efficiency – An Overview of Design Concepts and Architectural Interventions – Embodied Energy – Low Embodied Energy Materials – Passive Downdraft Evaporative Cooling – Design of Energy Efficient Buildings for Various Zones – Cold and cloudy – Cold and sunny – Composite – Hot and dry – Moderate – Warm and humid – Case studies of residences, office buildings and other buildings in each zones – Commonly used software packages in energy efficient building analysis and design - Energy Audit & Certification - Green building rating system –ECBC, LEED, GRIHA, IGBC & BEE		

Total Periods: 45

Text Books:	1. Koenigsberger O.H, Ingersoll T.G, "Manual of Tropical Housing and Building - Climatic Design", University Press, Hyderabad, Reprint 2015. 2. Punmia B C, Ashok K Jain, "Building Construction Engineering", Lakshmi Publications (P) Ltd, New Delhi, 2016.
Reference Books:	1. Energy Conservation Building Code, cau of Energy Efficiency, New Delhi, 2018. 2. Handbook on Functional Requirements of Buildings Part 1 to 4 SP : 41 (S and T) 1995 3. Residential Energy: Cost Savings and Comfort for Existing Buildings by John Krigger and Chris Dorsi, Published by Saturn Resource Management, 2013. 4. Brown, G.Z. and DeKay, M., Sun, Wind and Light - Architectural Design Strategies, John Wiley and Sons Inc,3rd Edition, 2014 5. Majumdar, M (Ed), Energy - Efficient Buildings in India, Tata Energy Research Institute, Ministry of Non-Conventional Energy Sources, 2009. 6. Wayne Forster and Dean Hawkes, "Energy Efficient Buildings: Architecture, Engineering, and Environment" W.W. Norton Company Inc. 2002. 7. SP: 41 (1987), "Handbook on Functional Requirements of Buildings (other than Industrial Buildings)", 1987.
MOOC/Web Platforms:	

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Explain the fundamental principles of climate-responsive architecture and environmental factors affecting building energy efficiency.	Understand (K2)

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CO2	Apply passive solar heating and cooling strategies, including natural ventilation techniques, in the design of energy-efficient buildings.	Apply (K3)
CO3	Analyze and design daylighting and electrical lighting systems in buildings for improved energy performance	Analyze (K4)
CO4	Evaluate and design thermal control and ventilation systems for maintaining indoor thermal comfort in various climatic conditions.	Analyze (K4)
CO5	Design energy-efficient buildings suitable for different climatic zones using relevant simulation tools, case studies, and low-energy techniques.	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	3	2	2	1	-	-	-	-	-	-	-	-	2	3
CO2	3	3	3	2	-	-	-	-	-	-	-	-	3	3
CO3	2	2	3	2	-	-	-	-	-	-	-	-	2	2
CO4	3	3	3	2	-	-	-	-	-	-	-	-	3	3
CO5	2	3	3	3	-	-	-	-	-	-	-	-	3	3

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

VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓		✓	✓					✓	

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VERTICAL 3: GEOTECHNICAL

I Course Code & Name: 23PCE13 Geo Environmental Engineering

Prerequisite	Program Name	Sem	Category	L	T	P	C
Geotechnical Engineering	B.E. – Civil Engineering	V/VI/VII	PEC	3	0	0	3

II - Course Objectives

1.	To provide fundamental knowledge on the sources, classification, and impacts of solid and hazardous wastes on soil and the environment.
2.	To study soil–waste interactions and understand the changes in soil properties due to contamination.
3.	To analyze contaminant transport mechanisms in soil and groundwater and methods for site characterization.
4.	To impart knowledge on waste containment and remediation techniques for contaminated soils and groundwater.
5.	To introduce design principles of landfills and waste utilization methods for sustainable waste management and soil stabilization

III - Course Content

Preamble:

The rapid growth of population, urbanization, and industrialization has increased solid and hazardous waste generation. Improper disposal leads to soil and groundwater contamination, affecting public health and the environment. This course imparts knowledge on soil–waste interaction, contaminant transport, waste containment, landfill design, and remediation techniques to develop sustainable waste management solutions.

Unit –-I	SOIL – WASTE INTERACTION	9 Periods

Role of Geo-environmental Engineering – sources, generation and classification of wastes – causes and consequences of soil pollution – case studies in soil failure -factors influencing soil pollutant interaction – modification of index, chemical and engineering properties – physical and physio-chemical mechanisms.

Unit –-II	CONTAMINANT TRANSPORT AND SITE CHARACTERISATION	9 Periods

Transport of contaminant in subsurface – advection, diffusion, dispersion – chemical process – biological process, sorption, desorption, precipitation, dissolution, oxidation, complexation, ion exchange, Volatization, biodegradation – characterization of contaminated sites – soil and rock data – hydrological and chemical data – analysis and evaluation.

Unit –-III	WASTE CONTAINMENT AND REMEDIATION OF CONTAMINATED SITES	9 Periods

In-situ containment – vertical and horizontal barrier – surface cover – ground water pumping system on subsurface drain – soil remediation – Soil Vapour extraction, soil waste stabilization, solidification of soils, electrokinetic remediation, soil heating, vitrification, bio remediation, Phyto-remediation – ground water remediation – pump and treat , In-situ flushing, permeable reacting barrier, In-situ air sparging.

Unit –-IV	LANDFILLS AND SURFACE IMPOUNDMENTS	9 Periods

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system – Source and characteristics of waste - site selection for landfills – components of landfills – liner soil, geomembrane, geosynthetic clay, geo-composite liner system – leachate collection – final cover design – monitoring landfill - Environmental laws and regulations		
Unit –-V	**STABILISATION OF WASTE**	**9 Periods**
Evaluation of waste materials – flyash, municipal sludge, plastics, scrap tire, blast furnace slag, construction waste, wood waste and their physical, chemical and biological characteristics – potential reuse – utilization of waste and soil tabilization.		

Total Periods: 45

Text Books:	1. Daniel B.E, Geotechnical Practice for waste disposal, Chapman & Hall, London, 1993. 2. Hari D. Sharma and Krishna R.Reddy, Geo-Environmental Engineering – John Wiley and Sons, INC, USA, 2004.
Reference Books:	1. Westlake, K., Landfill Waste pollution and Control, Albion Publishing Ltd., England, 1995. 2. Wentz, C.A., Hazardous Waste Management, McGraw Hill, Singapore, 1989. 3. Proceedings of the International symposium of Environmental Geotechnology (Vol.I and II), Environmental Publishing Company, 1986 and 1989.
MOOC/Web Platforms:	https://nptel.ac.in/courses/105103025

IV - Course Outcomes

On completion of the course, the students will be able to		**Bloom's Level Mapped**
CO1	Understand the various causes and consequences of waste interaction with soil and their modification.	Understand (K2)
CO2	Understand the various mechanism of transport of contaminants into the subsurface and characterization of contaminated sites and their risk analysis.	Understand (K2)
CO3	Understand on how to decontaminate the site so as to reuse the site for human settlement.	Understand (K2)
CO4	Understand how to safely dispose the waste through different containment process.	Understand (K2)
CO5	Understand on how to convert the waste into a resource material through soil waste stabilization techniques with or without chemical stabilization.	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	2	1	1	1	2	3	-	-	1	-	2	3	2
CO2	3	3	2	2	2	2	3	-	-	2	-	3	3	3
CO3	2	3	3	2	2	2	3	-	-	2	1	3	3	3
CO4	2	2	3	2	2	2	3	-	-	2	1	3	3	2
CO5	3	2	3	2	2	2	3	-	-	2	-	3	3	3

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

VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board / Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ GroupDiscussion	Simulation/ Trouble shooting
✓	✓	✓			✓				✓	

I Course Code & Name : 23PCE14 Ground Improvement Techniques

Prerequisite	Program Name	Sem	Category	L	T	P	C
Geotechnical Engineering	B.E. – Civil Engineering	V/VI/VII	PEC	3	0	0	3

II - Course Objectives

1.	To understand the engineering problems associated with weak and problematic soil deposits.
2.	To study different methods for evaluating soil properties and their suitability for construction.
3.	To learn various ground improvement techniques for enhancing soil strength and stability.
4.	To develop skills for designing ground improvement solutions for different geotechnical conditions.
5.	To gain practical knowledge for implementing soil improvement methods in real-world engineering projects.

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III - Course Content

Preamble:

Rapid urbanization and infrastructure development demand construction on sites with weak or problematic soils. Conventional foundation solutions often become uneconomical or unsafe in such conditions. Ground Improvement Techniques provide effective methods to enhance soil properties, ensure stability, and support sustainable construction practices. This course equips students with the knowledge of soil behavior, evaluation methods, and modern techniques to improve the performance of difficult soils, enabling them to address complex geotechnical challenges in real-world projects.

Unit –I	HYDRAULIC MODIFICATIONS	9 Periods
Scope and necessity of ground improvement in Geotechnical engineering basic concepts. Drainage – Ground Water lowering by well points, deep wells, vacuum and electro-osmotic methods. Stabilization by thermal and freezing techniques - Applications.		
Unit –II	**MECHANICAL MODIFICATIONS**	**9 Periods**
Insitu compaction of granular and cohesive soils, Shallow and Deep compaction methods – Sand piles – Concept, design, factors influencing compaction. Blasting and dynamic consolidation design and relative merits of various methods – Soil liquefaction mitigation methods.		
Unit –III	**PHYSICAL MODIFICATION**	**9 Periods**
Preloading with sand drains, fabric drains, wick drains – theories of sand drain - Stone column with and without encased, lime stone – functions – methods of installation – design, estimation of load carrying capacity and settlement. Root piles and soil nailing – methods of installation – Design and Applications.		
Unit –IV	**MODIFICATION BY INCLUSIONS**	**9 Periods**
Reinforcement – Principles and basic mechanism of reinforced earth, simple design: Synthetic and natural fiber based Geotextiles and their applications. Filtration, drainage, separation, erosion control.		
Unit –V	**CHEMICAL MODIFICATION**	**9 Periods**
Grouting – Types of grout – Suspension and solution grouts – Basic requirements of grout. Grouting equipment – injection methods – jet grouting – grout monitoring – Electro – Chemical stabilization – Stabilization with cement, lime - Stabilization of expansive clays.		

Total Periods: 45

Text Books:	1. Pappala, A.J.,Huang,J., Han, J., and Hoyos, L.R., Ground Improvement and Geosynthetics; Geotechnical special publication No.207, Geo Institute, ASCE, 2010 2. 2. Cox, B.R., and Grifiths S.C., Practical Recommendation for Evaluation and mitigation of Soil Liquefaction in Arkansas, (Project Report), 2010
Reference Books:	3. Day, R.W., Foundation Engineering Handbook, McGraw – Hill Companies, Inc. 2006. 4. Rowe, R.K., Geotechnical and Geo-Environmental Engineering Handbook, Kluwer Academic Publishers, 2001. 5. Das, B.M., Principles of Foundation Engineering, Fourth Edition, PWS Publishing, 1999.

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	6. Moseley, M.P., Ground Treatment, Blackie Academic and Professionals, 1998. 7. Koerner, R.M., Designing with Geosynthetics, Third Edition, Prentice Hall 1997. 8. Hehn, R.W., Practical Guide to Grouting of Underground Structures, ASCE, 1996. 9. Jewell, R.A., Soil Reinforcement with Geotextiles, CIRIA, London, 1996.
MOOC/Web Platforms:	https://onlinecourses.nptel.ac.in/noc23_ce78/preview

IV - Course Outcomes

On completion of the course, the students will be able to		**Bloom's Level Mapped**
CO1	Apply and evaluate soil deficiencies and apply hydraulic modification techniques	Apply (K3)
CO2	Apply mechanical modification methods and design ground improvement systems	Apply (K3)
CO3	Understand and apply physical modification techniques, design solutions	Understand (K2)
CO4	Apply reinforcement techniques and design soil improvement systems	Apply (K3)
CO5	Apply ground conditions and evaluate suitable chemical methods	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	2	2	1	-	-	-	1	-	2	3	2
CO2	3	3	3	2	2	1	-	-	-	1	-	2	3	3
CO3	3	2	3	2	2	-	-	-	-	1	-	2	3	3
CO4	3	2	3	2	3	1	-	-	-	1	-	2	3	3
CO5	2	3	2	3	2	1	-	-	-	1	-	2	3	2

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

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VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board / Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation / Trouble shooting
✓	✓	✓			✓				✓	

I Course Code & Name: 23PCE15 Soil Dynamics and Machine Foundations

Prerequisite	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Civil Engineering	V/VI/VII	PEC	3	0	0	3

II - Course Objectives

1.	To design different types of machine foundations based on the dynamic properties of soils and to get an exposure on vibration isolation techniques.

III - Course Content

Preamble: NIL		
Unit – I	**THEORY OF VIBRATION**	**9 Periods**
Introduction – Nature of dynamic loads – Basic definitions – Simple harmonic motion – Fundamentals of vibration – Single degree and multi degree of freedom systems – Free vibrations of spring – Mass systems		
Unit – II	**DYNAMIC SOIL PROPERTIES**	**9 Periods**
Dynamic stress-strain characteristics – Principles of measuring dynamic properties – Laboratory techniques – Field tests – Block vibration test – Factors affecting dynamic properties – Typical values. Liquefaction of soils and its evaluation using simple methods.		
Unit – III	**MACHINE FOUNDATIONS**	**9 Periods**
Introduction – Types of machine foundations – General requirements for design of machine foundations – Design approach for machine foundation. Analysis of piles under torsion, Design procedure for a pile supported machine foundation.		
Unit – IV	**DESIGN OF MACHINE FOUNDATION**	**9 Periods**
Evaluation of design parameters – Types of Machines and foundations – General requirements – their importance – Analysis and design of block type and framed type machine foundations Analysis and design of block foundations for reciprocating engines, Dynamic analysis and design procedure for foundations of reciprocating and impact type machines. Vibration isolation and absorption techniques.		
Unit – V	**VIBRATION ISOLATION**	**9 Periods**

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Vibration isolation – Types of isolation – Transmissibility – Passive and active isolation – Methods of isolation – Use of springs and damping materials – dynamic response of embedded block foundation, Vibration isolation.

Total Periods: 45

Text Books:	1. Swami Saran - Soil Dynamics and Machine Foundation, Galgotia Publications Pvt. Ltd. (2010) 2. Prakash, S. - Soil Dynamics, McGraw Hill Book Company (1981)
Reference Books:	1. KameswaraRao, N.S.V., Dynamics soil tests and applications, Wheeler Publishing, New Delhi, 2000. 2. Prakash, S and Puri, V.K., Foundations for machines, McGraw Hill, 1987. 3. Moore, P.J.,Analysis and Design of Foundations for Vibrations, Oxford and IBH, 1985. 4. Vaidyanathan, C.V., and Srinivasalu, P., Handbook of Machine Foundations, McGraw Hill, 1995. 5. Arya, S., O'Nelt; S., Design of Structures and Foundations for Vibrating Machines, Prentice Hall, 1981. 6. Major, A., Vibration Analysis and Design of Foundations for Machines and Turbines, Vol. I. II and III Budapest, 1964. 7. Barkan, D.D., Dynamics of Basis of Foundation, McGraw Hill, 1974. 8. Swami Saran, Soil Dynamics and Machine Foundation, Galgotia publications Pvt. Ltd. New Delhi 2010. 9. Das B.M., Principles of Soil Dynamics, McGraw Hill, 1992. 10. Krammer S.L., Geotechnical Earthquake Engineering, Prentice Hall, International series, Pearson Education (Singapore) Pvt Ltd, 2004. 11. KameswaraRao, Vibration Analysis and Foundation Dynamics, Wheeler Publishing, New Delhi, 1998.
MOOC/Web Platforms:	-

IV - Course Outcomes

On completion of the course, the students will be able to		**Bloom's Level Mapped**
CO1	Apply theories of vibration to solve dynamic soil problems.	Apply (K3)
CO2	Understand the dynamic properties of soil using laboratory and field tests.	Understand (K2)
CO3	Apply fundamental knowledge of machine foundations to analyze dynamic loads and determine suitable foundation types for different machines	Apply (K3)
CO4	Apply principles of vibration analysis to select appropriate types of vibration isolation materials for dynamic systems and soil conditions.	Apply (K3)
CO5	Apply vibration isolation techniques to solve field problems involving machinery-induced vibrations in industrial and civil structures.	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	2	2	1	1	1	1	3	2	2
CO2	2	2	2	3	2	2	1	2	2	1	1	3	2	2
CO3	2	3	3	3	2	3	2	3	2	-	-	3	3	3
CO4	2	3	3	3	2	3	2	3	2	3	2	1	3	3
CO5	2	3	3	3	3	-	3	3	3	2	1	1	3	3

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

VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓	✓			✓				✓	

I Course Code & Name: 23PCE16 EARTH AND EARTH RETAINING STRUCTURES

Prerequisite	Program Name	Semester	Category	L	T	P	C
Geotechnical Engineering	B.E. -Civil Engineering	V/VI/VII	PEC	3	0	0	3

II - Course Objectives

1.	To introduce students to the concepts of earth pressure theories and their applications in geotechnical design.
2.	To develop understanding of design principles for retaining walls and sheet pile structures under static and seismic conditions.
3.	To provide knowledge on seepage analysis, stability assessment, and methods for analyzing earth dams.
4.	To familiarize students with slope stability concepts, analysis methods, and remedial measures.

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5.	To impart practical knowledge of construction techniques, instrumentation, and performance evaluation in retaining and embankment structure

III - Course Content

Preamble: This course introduces the principles and design of retaining structures, earth dams, and slope stability with emphasis on geotechnical analysis and construction practices. It equips students with theoretical knowledge and practical skills for safe and sustainable infrastructure development.		
Unit – I	**EARTH PRESSURE THEORIES**	**9 Periods**
Introduction – State of stress in retained soil mass – Earth pressure theories – Classical and graphical techniques (Culmann's method) – Active and passive cases – Earth pressure due to external loads.		
Unit – II	**COMPACTION, DRAINAGE AND STABILITY OF RETAINING STRUCTURES**	**9 Periods**
Retaining structure – Selection of soil parameters - Lateral pressure due to compaction, strain softening, wall flexibility, drainage arrangements and its influence. – Stability analysis of retaining structure both for regular and earthquake forces		
Unit – III	**SOCIO-ECONOMIC IMPACT ASSESSMENT**	**9 Periods**
Types of sheet piles - Analysis and design of cantilever and anchored sheet pile walls – free earth support method – fixed earth support method. Design of anchor systems - isolated and continuous		
Unit – IV	**PREDICTION, ASSESSMENT AND MITIGATION**	**9 Periods**
Classification, seepage control in embankments and foundations, seepage analysis, stability analysis upstream and downstream for steady seepage, rapid draw down, end of construction, method of slices and Bishops method.		
Unit – V	**EARTH DAMS PROTECTION**	**9 Periods**
Slope protection, filters, embankment construction materials and construction, quality control, grouting techniques. Instrumentation and performance observations in earth dams.		

Total Periods: 45

Text Books:	1. Terzaghi, K., Peck, R.B. and Mesri, G., Soil Mechanics in Engineering Practice, 3rd Edition, Wiley India Pvt. Ltd., 2010. 2. Das, B.M., Principles of Geotechnical Engineering, 9th Edition, Cengage Learning, 2021. 3. Clayton, C.R.I., Earth Pressure and Earth-Retaining Structures, 3rd Edition, CRC Press (Taylor & Francis), 2013. 4. Das, B.M. and Sivakugan, N., Principles of Foundation Engineering, 9th Edition, Cengage Learning, 2021. 5. Coduto, D.P., Yeung, M.R. and Kitch, W.A., Geotechnical Engineering: Principles and Practices, 3rd Edition, Pearson, 2016.
Reference Books:	1. Winterkorn, H.F. and Fang, H.Y., Foundation Engineering Handbook, Galgotia Booksource, Latest Reprint, 2000. 2. Duncan, J.M. and Wright, S.G., Soil Strength and Slope Stability, 2nd Edition, Wiley, 2014. 3. Powrie, W., Soil Mechanics: Concepts and Applications, 4th Edition, CRC Press (Taylor & Francis), 2021.

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	4. Budhu, M., Soil Mechanics and Foundations, 4th Edition, Wiley, 2020.
MOOC/Web Platforms:	1. https://onlinecourses.nptel.ac.in/noc22_ce74/preview 2. https://onlinecourses.nptel.ac.in/noc20_ce25/preview?utm_source=chatgpt.com 3. https://onlinecourses.nptel.ac.in/noc23_ce48/preview

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Explain earth pressure theories and evaluate stresses in retained soil under different loading conditions.	Apply (K3)
CO2	Analyze and design retaining structures considering compaction, wall flexibility, drainage, and earthquake forces.	Apply (K3)
CO3	Design sheet pile walls and anchor systems using free and fixed earth support methods.	Apply (K3)
CO4	Assess seepage control, stability of embankments and slopes under steady, rapid drawdown, and end-of-construction conditions.	Apply (K3)
CO5	Apply construction practices, protection measures, grouting, instrumentation, and performance monitoring in earth dams.	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	-
CO2	3	2	3	2	-	-	-	-	-	-	-	-	3	2
CO3	3	2	3	-	-	-	-	-	-	-	-	-	3	2
CO4	3	2	3	2	-	-	-	-	-	-	-	-	3	2
CO5	2	-	3	-	2	-	2	-	-	-	-	-	3	2

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

VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓			✓	✓		✓	✓	✓	

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I Course Code & Name : 23PCE17 Pile Foundation.

Prerequisite	Program Name	Sem	Category	L	T	P	C
Soil Mechanics and Foundation Engineering	B.E. – Civil Engineering	V/VI/VII	PEC	3	0	0	3

II - Course Objectives

1.	To expose students to the necessity, classification, and load transfer mechanisms of pile foundations under various field conditions.
2.	To equip students with the knowledge to determine the axial load-carrying capacity of single piles and pile groups using static and dynamic methods.
3.	To enable students to analyze piles under lateral and uplift loads using analytical and field-based approaches.
4.	To impart skills for structural design of piles and pile caps, considering group effects and load combinations including seismic and wind loads.
5.	To introduce the concept, design principles, and construction of caissons and well foundations, and ensure understanding of their stability and applications.

III - Course Content

Preamble:
This course introduces advanced concepts related to pile foundations and their applications in civil engineering. Students will gain in-depth knowledge of pile classification, load transfer mechanisms, axial and lateral load capacity, and group behavior. The course also covers structural design of piles, pile caps, and the design and analysis of caissons and well foundations. Emphasis is placed on both theoretical understanding and practical design methods in accordance with current geotechnical engineering practices.

Unit –I	PILE CLASSIFICATIONS AND LOAD TRANSFER	9 Periods

Necessity of pile foundation – classification of piles – Factors governing choice of type of pile – Load transfer mechanism – piling equipments Concept of a piled raft - Examples, definitions and terminology; Piled raft as a composite construction.

Unit –II	AXIAL LOAD CAPACITY OF PILES AND PILE GROUPS	9 Periods

Allowable load of piles and pile groups – Static and dynamic methods – for cohesive and cohesionless soil – negative skin friction – group efficiency – pile driving formulae – limitation - Settlement of single pile. Determination of temporary elastic compression - Driving stresses in piles - Field measurement - Wave equation analysis

Unit –III	LATERAL AND UPLIFT LOAD CAPACITIES OF PILES	9 Periods

Piles under Lateral loads – Broms method, elastic, p-y curve analyses – Batter piles – response to moment – piles Load capacity of piles in sands and clays Laterally loaded piles; Uplift capacity of piles; Pile group capacity; Pile load test.

Unit –IV	STRUCTURAL DESIGN OF PILE AND PILE GROUPS	9 Periods

Structural design of pile – structural capacity – pile and pile cap connection – pile cap design – shape, depth, assessment and Group action in piled foundations-Minimum spacing of piles - group efficiency - Estimation of group bearing capacity

Unit –V	CAISSONS	9 Periods

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Necessity of caisson – type and shape - Stability of caissons – principles of analysis and design Well Foundations - Types of wells or caissons – Drilled shafts and caissons - Design and construction

Total Periods: 45

Text Books:	1. Bowles, J. E., (2011), Foundation Analysis and Design, 7th Edition, McGraw Hill Book Co., New York. 2. Das. B. M., (2010), Principles of Foundation Engineering, CL Engineering. 2. Poulos, H.G., Davis, E.H., Pile foundation analysis and design, John Wiley and Sons, New York, 1980.
Reference Books:	1. Das, B.M., Principles of Foundation Engineering, Design and Construction, Fourth Edition, PWS Publishing, 1999. 2. Tomlinson, M.J. Foundation engineering, ELBS, Longman Group, U.K. Ltd., England 1995. 3. Michael Tomlinson and John Woodward, Pile design and construction practice, Taylor & Francis Group, London & New York, 2008. 4. Cernica, J.N. Geotechnical Engineering Foundation Design, John Wiley and Sons, Inc. 1995. 5. Bowles, J.E., Foundation Analysis and Design, Fifth Edition, McGraw Hill, New York, 1996. 6. Donald, P., Coduto, Foundation Design Principles and Practices, Prentice Hall, Inc. Englewood Cliffs, New Jersey, 1996. 7. Varghese P.C.," Foundation Engineering", PHI Learning Private Limited, New Delhi, 2005. 8. Reese,L.C., Isenhower,W.M. and Wang,S.T. Analysis and Design of Shallow and Deep Foundations, John Wiley and Sons, New York, 2005. 9. Varghese P.C.," Design of Reinforced Concrete Foundations", PHI Learning Private Limited, New Delhi, 2009. 10. Reese, L. C. and Van Impe, W. F., Single Piles and Pile Groups Under Lateral Loading, Taylor and Francis, London, 2011.
MOOC/Web Platforms:	https://onlinecourses.nptel.ac.in/noc21_ce39/preview https://onlinecourses.nptel.ac.in/noc23_ce33/preview https://nptel.ac.in/courses/105105176

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the importance of pile foundations and describe the roles and responsibilities of the geotechnical engineer and contractor, including piling equipment.	Understand (K2)
CO2	Apply the vertical load-carrying capacity of single piles and pile groups, considering settlement behavior based on field practices and codal provisions.	Apply (K3)
CO3	Analyze the performance and design of piles subjected to lateral and uplift loads using case studies and codal provisions.	Analyze (K4)

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CO4	Apply principles to design piles and pile caps, accounting for wind and seismic loads.	Apply (K3)
CO5	Explain the significance of caisson foundations and check their stability using codal provisions.	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	-	-	-	-	-	-	-	-	-	1	3	2
CO2	3	3	2	2	2	-	-	-	-	-	-	2	2	3
CO3	3	3	2	2	2	-	-	-	-	-	-	2	3	3
CO4	3	3	3	2	3	-	-	--	-	-	1	2	2	3
CO5	3	3	3	2	2	-	-	-	-	-	2	2	2	3

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

VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓	✓			✓				✓	

I Course Code & Name: 23PCE18 TUNNELING ENGINEERING

Prerequisite	Program Name	Semester	Category	L	T	P	C
Geotechnical Engineering	B.E. -Civil Engineering	V/VI/VII	PEC	3	0	0	3

II - Course Objectives

6.	To understand the history, applications, and significance of tunnels and underground spaces in civil engineering.
7.	To learn various excavation techniques for tunnels in soft ground and hard rock conditions.
8.	To analyze planning, geometric design, and alignment considerations for tunnels.
9.	To study modern construction methods such as TBM, NATM, and shield tunneling.

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10.	To evaluate tunnel support systems, lining, grouting, and ventilation techniques for safe operation.

III - Course Content

Preamble: This course introduces the principles, planning, and construction methods of tunnels and underground spaces, emphasizing modern excavation techniques, design considerations, and safety measures. It equips students with the knowledge of support systems, ventilation, and practical applications in infrastructure and defense.

Unit – I	**TUNNELS AND UNDERGROUND SPACE APPLICATION**	**9 Periods**
History-caves-tunnels for transport water, power supply-storage of LPG –nuclear waste disposal-defense facilities-submerged tunnels-underground library, museums		
Unit – II	**EXCAVATION TECHNIQUES**	**9 Periods**
Types and purpose of tunnels-choice of excavation methods-soft ground tunneling-hard rock tunneling-tunnel drilling-blasting-impact hammers-problems encountered and remedial measures.		
Unit – III	**PLANNING AND GEOMETRIC DESIGN OF TUNNELS**	**9 Periods**
Topographical –geological survey-rock sampling-testing-determination of location size shape and alignment-subsidence problem on soft ground –tunneling design in hard rock.		
Unit – IV	**CONSTRUCTION OF TUNNEL**	**9 Periods**
Advanced drilling techniques –TBM-cuttability assessment-shield tunneling-advantages-types of shield tunneling-factors affecting selection of shield-twin tunnel-NATM		
Unit – V	**DESIGN OF TUNNEL SUPPORTING SYSTEMS AND VENTILATION**	**9 Periods**
Classification of supports-active –passive-permanent-temporary-excavation support-steel supports- lining-grouting-ground freezing-environment in underground-various methods of ventilation.		

Total Periods: 45

Text Books:	1. Bickel, J.O., Kuesel, T.R. & King, E.H., Tunnel Engineering Handbook, 2nd Edition, Springer, 2010. 2. Gramberg, J., Underground Excavations in Rock, Springer, 2012. 3. Bieniawski, Z.T., Engineering Rock Mass Classifications: A Complete Manual for Engineers and Geologists in Mining, Civil, and Petroleum Engineering, Wiley, 2011. 4. Brown, E.T., Rock Characterization, Testing and Monitoring: ISRM Suggested Methods, Pergamon, 2014 (Latest Reprint). 5. Lunardi, P., Design and Construction of Tunnels: Analysis of Controlled Deformation in Rocks and Soils (ADECO-RS), Springer, 2008.
Reference Books:	1. Singh, B. & Goel, R.K., Engineering Rock Mass Classification: Tunneling, Foundations, and Landslides, Elsevier, 2011. 2. Hoek, E. & Bray, J., Rock Slope Engineering, 4th Edition, CRC Press, 2013. 3. Palmström, A. & Broch, E., Rock Engineering, CRC Press, 2020. 4. Kovári, K., Mechanics of Tunnelling Machine Performance, Taylor & Francis, 2016.

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MOOC/Web Platforms:	1. https://www.coursera.org/learn/tunnel-construction-practices 2. https://www.coursera.org/learn/underground-metros-shafts-and-caverns

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the applications of tunnels and underground structures in modern infrastructure.	Apply (K3)
CO2	Analyze various excavation techniques and their suitability for different ground conditions.	Apply (K3)
CO3	Apply knowledge of planning, surveys, and geometric design in tunnel alignment and construction.	Apply (K3)
CO4	Evaluate construction practices including TBM, NATM, shield tunneling, and advanced methods.	Apply (K3)
CO5	Design tunnel supporting systems and ventilation strategies ensuring safety and sustainability.	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	–
CO2	3	2	3	–	–	–	–	–	–	–	–	–	3	–
CO3	3	–	3	2	2	–	–	–	–	–	–	–	3	2
CO4	3	2	3	3	2	–	–	–	–	–	–	–	3	2
CO5	3	–	3	2	3	–	–	2	–	–	–	–	3	2

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

VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓			✓	✓		✓	✓	✓	

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VERTICAL 4: GEO-INFORMATICS

I -Course Code & Name: 23PCE19 TOTAL STATION AND GPS SURVEYING

Prerequisite	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Civil Engineering	V/VI/VII	PEC	3	0	0	3

II - Course Objectives

1.	To introduce students to modern surveying instruments and their applications in civil engineering.
2.	To develop an understanding of the scientific principles underlying electromagnetic waves and satellite-based positioning systems.
3.	To familiarize students with the concepts and functionalities of Global Navigation Satellite Systems (GNSS).
4.	To provide insights into the principles and methodologies of electro-optical and microwave measurement techniques.
5.	To equip students with knowledge and skills for processing, analysing, and applying survey data in mapping and related engineering tasks.

III - Course Content

Preamble: To understand the working of Total Station and GPS and solve the surveying problems		
Unit –I	**FUNDAMENTALS OF TOTAL STATION AND ELECTROMAGNETIC WAVES**	**9 Periods**
Methods of Measuring Distance, Basic Principles of Total Station, Historical Development, Classifications, applications and comparison with conventional surveying - Applications of Electromagnetic waves, Propagation properties, wave propagation at lower and higher frequencies – Refractive index (RI) – factors affecting RI -Computation of group for light and near infrared waves at standard and ambient conditions – Computation of RI for microwaves at ambient condition – Reference refractive index -Real-time application of first velocity correction. Measurement of atmospheric parameters - Mean refractive index – Second velocity correction -Total atmospheric correction - Use of temperature -pressure, transducers.		
Unit –II	**ELECTRO-OPTICAL AND MICROWAVE**	**9 Periods**
Electro - optical system: Measuring principle, Working principle, Sources of Error, Infrared and Laser Total Station instruments. Microwave system: Measuring principle, working principle, Sources of Error, Microwave Total Station 143 instruments. Comparison between Electro-optical and Microwave system. Care and maintenance of Total Station instruments. COGO functions: Area, Inverse / MLM, REM, Resection, offsets and stakeout - Land survey applications		
Unit –III	**SATELLITE SYSTEM**	**9 Periods**
Basic concepts of GPS – Historical perspective and development – applications -Geoid and Ellipsoid – satellite orbital motion –Geodetic satellite – Doppler effect – Positioning concept -surveying Methods – static, Rapid static, DGPS and Kinematic methods – visibility diagram – GNSS and IRNSS – SBAS: GAGAN and WAAS Different segments - space, control and user segments – satellite configuration – GPS signal structure – Orbit determination and representation – Anti Spoofing and		

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Selective Availability -Task of control segment – GPS receivers.		
Unit –IV	**GPS DATA PROCESSING**	**9 Periods**
GPS observables – code and carrier phase observation – linear combination and derived observables – concept of parameter estimation – downloading the data – RINEX Format– Differential data processing – software modules - solutions of cycle slips, ambiguities - Multi path and other observational errors – satellite geometry and accuracy measures – Continuously Operating Reference System (CORS)– long base line processing - use of different processing software's: Open Source, Scientific and Commercial.		
Unit –-V	**SURVEYING METHODS AND APPLICATIONS**	**9 Periods**
Total Station: Traversing and Trilateration measurement and adjustment –Planimetric map and Contour map and Topography Mapping. GNSS: Concepts of rapid, static, semi-Kinematic, pure Kinematic and RTK methods. Observation by Radiation, Lee frog and Trilateration measurement and processing -Topography mapping using PPK and RTK methods Total Station and GNSS applications		

Total Periods: 45

Text Books:	1. Rueger, J.M. Electronic Distance Measurement, Springer-Verlag, Berlin, 4th Edition, 1996. 2. SatheeshGopi, rasathishkumar, N.madhu, — Advanced Surveying , Total Station GPS and Remote Sensing — Pearson education , 2nd Edition,2017. isbn: 978-81317 00679. 3. Gunter Seeber , Satellite Geodesy, Walter De Gruyter, Berlin, 2nd Edition, 2003
Reference Books:	1. R.Subramanian, Surveying and Levelling, Oxford University Press, Second Edition, 2012. 2. Laurila, S.H. Electronic Surveying in Practice, John Wiley and Sons Inc, 1983 3. Guocheng Xu, GPS Theory, Algorithms and Applications, Springer - Verlag, Berlin, 3rdEdition, 2016. 4. Alfred Leick, GPS satellite surveying, John Wiley & Sons Inc., 4th Edition, 2015.
MOOC/Web Platforms:	https://nptel.ac.in/courses/1055435212

IV - Course Outcomes

On completion of the course, the students will be able to		**Bloom's Level Mapped**
CO1	Learn about the fundamental concept of Total station.	Understand (K2)
CO2	Provide knowledge about electromagnetic waves and its usage in Total station and GNSS.	Understand (K2)
CO3	Gain Knowledge on basic concepts of GNSS	Apply (K3)

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CO4	Understand the measuring and working principle of electro optical and Microwave Total station and GPS.	Understand (K2)
CO5	Gain knowledge about Total station and GNSS data processing and Mapping	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	2	3	2	–	–	1	–	–	2	3	3
CO2	3	2	3	2	3	3	–	–	1	–	–	2	3	3
CO3	3	2	2	2	3	2	–	–	1	–	–	2	3	3
CO4	3	2	3	3	3	3	–	–	1	–	–	2	3	3
CO5	3	3	3	3	3	3	–	–	2	–	–	2	3	3

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

VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓	✓	✓						✓	✓

I Course Code & Name: 23PCE20 Remote Sensing Concepts

Prerequisite	Program Name	Sem	Category	L	T	P	C
Nil	B.E. -Civil Engineering	V/VI/VII	PEC	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

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Preamble:
This course introduces the fundamentals of remote sensing, including its principles, components, and satellite systems. It also covers image interpretation and modern tools, such as Google Earth Engine, for geospatial data analysis.

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 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 Periods: 45

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

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	JacobVan Zyl, 2006 Edition II, Wiley Publication
MOOC/Web Platforms:	--

IV - Course Outcomes

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	2	2
CO2	3	1	-	1	1	1	1	-	-	-	-	1	2	2
CO3	3	1	-	1	1	1	1	-	-	-	-	1	2	2
CO4	3	1	-	1	1	1	1	-	-	-	-	1	2	2
CO5	3	1	-	1	1	1	1	-	-	-	-	1	2	2

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

VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓	-	-	✓	-	-	✓	✓	✓	✓

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I Course Code & Name: 23PCE21 Satellite Image Processing

Prerequisite	Program Name	Sem	Category	L	T	P	C
Nil	B.E. -Civil Engineering	V/VI/VII	PEC	3	0	0	3

II - Course Objectives

1.	To impart fundamental knowledge of digital image processing and satellite data handling.
2.	To familiarize students with different sensor models, image acquisition, and preprocessing techniques.
3.	To develop understanding of image enhancement methods for improving interpretability and analysis.
4.	To provide knowledge on image classification approaches, pattern recognition, and accuracy assessment.
5.	To expose students to advanced classifiers and intelligent systems for satellite image interpretation.

III - Course Content

Preamble:
This course introduces the concepts and techniques of satellite image processing, from fundamentals to advanced classification methods, for effective analysis and interpretation of remotely sensed data.

Unit – I	FUNDAMENTALS OF IMAGE PROCESSING	9 Periods

Information Systems - Encoding and decoding - acquisition, storage and retrieval – data products - satellite data formats - Digital Image Processing Systems - Hardware and software design consideration Scanner, digitizer - photo write systems.

Unit – II	SENSORS MODEL AND PRE PROCESSING	9 Periods

Image Fundamentals – Sensor models – spectral response – Spatial response – IFOV,GIFOV& GSI – Simplified Sensor Models – Sampling & quantization concepts – Image Representation& geometry and Radiometry – Colour concepts – Sources of Image degradation and Correction procedures- Atmospheric, Radiometric, Geometric Corrections Image Geometry Restoration-Interpolation methods and resampling techniques.

Unit – III	IMAGE ENHANCEMENT	9 Periods

Image Characteristics - Histograms - Scattergrams – Univariate and multi variate statisticsenhancement in spatial domain – global, local & colour Transformations – PC analysis, edge detections, merging - filters - convolution – LPF, HPF , HBF, directional box, cascade – Morphological and adaptive filters – Zero crossing filters – scale space transforms – power spectrum – texture analysis – frequency transformations - Fourier, wavelet and curvelet transformations.

Unit – IV	IMAGE CLASSIFICATION	9 Periods

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Spectral discrimination - pattern recognition concepts - Baye's approach - Signature and training sets – Separability test –Supervised Classification – Minimum distance to mean, Parallelepiped, MLC – Unsupervised classifiers – ISODATA,K-means-Support Vector Machine – Segmentation (Spatial, Spectral) – Tree classifiers - Accuracy assessment – Error matrix – Kappa statistics – ERGAS, RMS.		
Unit – V	**ADVANCED CLASSIFIERS**	**9 Periods**
Fuzzy set classification – sub- pixel classifier – hybrid classifiers, Texture based classification – Object based classifiers – Artificial Neural nets – Hebbian leaning – Expert system, types and examples – Knowledge systems.		

Total Periods: 45

Text Books:	1. John, R. Jensen, Introductory Digital Image Processing, Prentice Hall, New Jersey, 4 th Edition, 2015. 2. Robert, A. Schowengergt, Techniques for Image Processing and classification in Remote Sensing, Academic Press, 2012.
Reference Books:	1. Robert, G. Reeves,- Manual of Remote Sensing Vol. I & II - American Society of Photogrammetry, Falls, Church, USA, 1983. 2. Richards, Remote sensing digital Image Analysis - An Introduction 5th Edition, 2012,Springer -Verlag 1993. 3. Digital Image Processing by Rafael C. Gonzalez,Richard Eugene Woods-Pearson/Prentice Hall,2008 4. Fundamentals of Digital Image Processing by Annadurai Pearson Education (2006) 5. Digital Image Processing: PIKS Scientific Inside by William K. Pratt 4th Edition,Wiley Interscience, 2007.

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Demonstrate the concepts of digital image processing and satellite data formats for information	Apply (K3)
CO2	Implement preprocessing techniques such as corrections, resampling, and interpolation on satellite imagery.	Apply (K3)
CO3	Utilize image enhancement methods in spatial and frequency domains for better visualization and feature extraction.	Apply (K3)
CO4	Perform classification using supervised, unsupervised, and hybrid algorithms to analyze satellite images.	Apply (K3)
CO5	Employ advanced classifiers including fuzzy sets, neural networks, and expert systems for satellite image interpretation.	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	1	1	1	-	-	-	-	1	2	2
CO2	3	1	-	1	1	1	1	-	-	-	-	1	2	2
CO3	3	1	-	1	1	1	1	-	-	-	-	1	2	2
CO4	3	1	-	1	1	1	1	-	-	-	-	1	2	2
CO5	3	1	-	1	1	1	1	-	-	-	-	1	2	2

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

VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓	-	-	✓	-	-	✓	✓	✓	-

I – Course Code & Name: 23PCE22 Cartography and GIS

Prerequisite	Program Name	Semester	Category	L	T	P	C
Nil	B.E. -Civil Engineering	V/VI/VII	PEC	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

Preamble:

Cartography and GIS together form the fundamental discipline for understanding and representing our world. Cartography is the ancient art and science of mapmaking, focused on crafting clear and effective visual representations of space. GIS provides the modern analytical

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power, a dynamic toolset for capturing, managing, analyzing, and modeling geographic data to solve complex spatial problems and inform critical decisions.		
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.		
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 Periods: 45

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:

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	9789332581883
MOOC/Web Platforms:	https://www.my-mooc.com/en/categorie/gis https://www.my-mooc.com/en/mooc/fundamentals-of-gis

IV - Course Outcomes

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)

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

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓		✓	✓					✓	

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I Course Code & Name: 23PCE23 Photogrammetry

Prerequisite	Program Name	Semester	Category	L	T	P	C
Surveying	B.E. -Civil Engineering	V/VI/VII	PEC	3	0	0	3

II - Course Objectives

1.	Introduce principles and applications of aerial photography and photogrammetry.
2.	Explain geometry, scale, relief displacement, and photo interpretation.
3.	Familiarize students with stereoplotters, orientation methods, and transformations.
4.	Develop skills in aerotriangulation, DTM generation, and orthophoto preparation.
5.	Expose learners to digital photogrammetry, image matching, DEM/DSM, and satellite data

III - Course Content

Preamble:
This course equips students with analytical techniques for evaluating indeterminate structures such as beams, frames, arches, and trusses. It emphasizes classical and modern methods to understand structural behavior under various loading and support conditions.

Unit – I	PRINCIPLES AND PROPERTIES OF PHOTOGRAPHY	9 Periods

History - Definition, Applications – Types of Photographs, Classification – Photographic overlaps – Camera: metric vs. non-metric, Digital Aerial cameras – Multiple frame and Line cameras – Linear array scanner – Flight Planning – Crab & Drift– Computation of flight plan - Photogrammetry project Planning.

Unit – II	GEOMETRIC PROPERTIES OF AERIAL PHOTOGRAPHS	9 Periods

Photo coordinate measurement – Vertical photographs -geometry, scale, Coordinate system, Relief displacement – Stereoscopes – Stereoscopic parallax – parallax equations -Geometry, Scale, Coordinate system – Relief displacement – Photo Interpretation.

Unit – III	STEREOPLOTTERS & ORIENTATION	9 Periods

Projection system, Viewing, Measuring and Tracing system Stereo plotters–Classification: Analog, semi analytical, Analytical and Digital systems – Interior orientation - Relative orientation – Absolute orientation - Collinearity condition and Coplanarity condition - Orientation: Two-dimensional coordinate transformations –Three-dimensional conformal coordinate transformation

Unit – IV	AEROTRIANGULATION, TERRAIN MODELING, ORTHOPHOTO	9 Periods

Model – Strip and blocks of photographs – Aerotriangulation: strip adjustment, independent model triangulation, Bundle block Adjustment and GPS Aerotriangulation (INS and GNSS integration) - feature collection – DTM generation and Contour mapping – ortho rectification - mono plotting – stereo plotting

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Unit – V	DIGITAL PHOTOGRAMMETRY	9 Periods
Photogrammetric Scanner – Digital Photogrammetry WorkStation – Work Station Basic system function – Storage System – Stereoscopic Viewing and Measuring System – Image properties - Image matching: template matching, feature based matching - DEM and DSM - Satellite photogrammetry principles		

Total Periods: 45

Text Books:	1. Paul. R Wolf., Bon A. De Witt, Elements of Photogrammetry with Application in GIS McGraw Hill International Book Co., 4thEdition, 2014. 2. E. M. Mikhail, J. S. Bethel, J. C. McGlone, Introduction to Modern Photogrammetry, Wiley Publisher, 200
Reference Books:	1. Gollfried Konecny, Geoinformation: Remote Sensing, Photogrammetry and Geographical Information Systems, CRC Press, 2nd Edition, 2014. 2. Karl Kraus, Photogrammetry: Geometry from Images and Laser Scans, Walter de Gruyter GmbH & Co.2nd Edition, 2007. 3. Manual of Photogrammetry – American society of Photogrammetry & amp; R. S by Albert. D, 1980. 4. Digital Photogrammetry – A practical course by Wilfried Linder, 3rd edition, Springer, 2009. 5. Digital Photogrammetry by – Y. Egels& amp; Michel Kasser, Taylor & amp; Francis group, 2003
MOOC/Web Platforms:	1. https://www.archernet.org/en/2021/03/02/online-course-3d-photogrammetry-with-uav/ 2. https://dev.epicgames.com/commUnit –y/learning/courses/blA/unreal-engine-realityscan-photogrammetry-basics-by-quixel 3. https://www.udemy.com/course/photo-to-3d-to-ar-free-and-easy/

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand and appreciate the importance of photography as means of mapping, functional and physical elements of photography.	Understand (K2)
CO2	Understand the need of the photogrammetric mapping and the relevance of accuracy standards and means to achieve them for precise large-scale maps with scientific methods.	Understand (K2)
CO3	Evaluate the standards of map based on the state-of-the-art tool and techniques and assess the production standards for photogrammetric map making	Apply (K3)
CO4	Acquire knowledge on the current development, issues methods and solutions in map making and evaluate methods of production.	Apply (K3)
CO5	Analyze critically and evaluate methods by applying the knowledge gained	Apply (K3)

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	and to be a part of innovation and integration of mapping technology.	

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	2	1	3	–	2	2	–	3	–	–	1	1	2
CO2	2	2	1	3	–	2	2	–	3	–	–	1	1	2
CO3	3	3	2	3	–	1	2	–	3	–	–	1	1	3
CO4	3	2	2	3	–	1	2	–	3	–	–	1	1	3
CO5	3	3	2	3	–	1	2	–	3	–	–	1	1	3

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

VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓			✓	✓		✓	✓	✓	

I -Course Code& Name: 23PCE24 Airborne and Terrestrial Laser Mapping

Prerequisite	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Civil Engineering	V/VI/VII	PEC	3	0	0	3

II - Course Objectives

1.	To introduce the principles, properties, and types of LiDAR and space borne radar altimeters.
2.	To familiarize students with airborne laser scanning techniques, components, and flight planning for accurate data acquisition.
3.	To provide knowledge on post-processing methods for LiDAR data to generate DSM, DEM, and other geospatial products.
4.	To expose students to terrestrial laser scanning methods for indoor mapping, asset management, and 3D modeling.
5.	To develop the ability to apply LiDAR and TLS data in practical applications such as forestry, corridor mapping, tunnel surveying, and BIM-based studies.

III - Course Content

Preamble:

This course introduces the principles and applications of space-borne, air-borne, terrestrial, and bathymetric laser scanning technologies, emphasizing data acquisition, processing, and integration for topographic and bathymetric mapping to support engineering and environmental studies.

Unit –I	SPACE BORNE RADAR AND LIDAR ALTIMETER	9 Periods

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Principle and Properties of LASER- Production of Laser – Components of LASER – LiDAR – Types of Lidar: Range Finder, DIAL and Doppler LiDAR - Platforms: Terrestrial, Airborne and Space borne LiDAR – Space Borne LiDAR Missions – Space Borne Radar Altimeter for mapping Sea Surface Topography , Moon Topography - Merits of ALS in comparison to Levelling, echo sounding, GPS leveling, Photogrammetry and Interferometry-Application of LIDAR		
Unit –II	**AIRBORNE LASER SCANNERS**	**9 Periods**
Airborne Topographic Laser Scanner – Ranging Principle – Pulse Laser and Continuous Wave Laser –First Return and Last Return – Ellipsoidal and Geoidal Height - Typical parameters of Airborne Laser Scanner (ALS) – Specifications of Commercial ALS –- Components of ALS - GPS, IMU, LASER Scanner, Imaging Device, Hardware and Software - Various Scanning Mechanisms: Oscillating Mirror, Rotating Polygon, Nutating Mirror, Fibre Optic		
Unit –III	**DATA ACQUISITION AND PRE-PROCESSING**	**9 Periods**
Laser Classification – Class I to Class IV Laser – Eye Safety - Synchronization of GPS, IMU and ALS Data -Reflectivity of terrain objects –- Flight Planning – Determination of various data acquisition parameters – Optical, Thermal and Microwave; Resolutions - spatial, spectral, radiometric and temporal, signal to noise ratio, LiDAR data acquisition and processing. -Swath Width, Point Density, No. of Strips, Area Covered, Point Spacing - Data Processing – Determination of optimal flight trajectory- Quality Assurance		
Unit –IV	**POST PROCESSING of LiDAR Data**	**9 Periods**
Post Processing – Geo location of Laser Foot Prints – Various Co-ordinate Transformations involved Filtering - Ground Point filtering – Digital Surface Model and Digital Elevation Model - LIDAR data file formats – LAS File format and other proprietary file formats – Post Processing Software: Open Source and COTS Software – Quality Control Measures – Error Budget - Overview of LIDAR Applications in various domains - 3D city models – Corridor Mapping Applications – Forestry Applications		
Unit –V	**TERRESTRIAL LASER SCANNERS**	**9 Periods**
Terrestrial Laser Scanners (TLS) – Working Principle – Static TLS – Dynamic TLS –- Commercial TLS Specifications – Mobile Mapping Lasers :Vehicle Mounted TLS, Back Pack Wearable Laser Scanners – Asset Management Studies – Highways and Railway Asset Management – Indoor Mapping : Laser Scanning of interior of buildings/monuments – Immersive Applications - BIM Model – Applications in Tunnel Surveying, Forest Inventory, Open Cast Mine Surveying		

Total Periods: 45

Text Books:	1. Jie Shan, Charles K. Toth, "Topographic Laser Ranging and Scanning – Principles and Processing", 2nd Edition, CRC Press Publication, March 2018. ISBN: 9781498772273.
Reference Books:	1.George Vosselman and Hans-Gerd Maas, Airborne and Terrestrial Laser Scanning, Whittles Publishing, 2010 2. Matti Maltamo, Erik Næsset, JariVauhkonen, Forestry Applications of Airborne Laser Scanning-Concepts and Case Studies, Springer, Dordrecht, 2016, Reprint Edition. ISBN 978-94- 017-8662-1 3.Michael Renslow, Manual of Airborne Topographic LiDAR, The American Society for Photogrammetry and Remote Sensing, 2013

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MOOC/Web Platforms:	https://onlinecourses.nptel.ac.in/noc24_ce67/preview

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the components of laser and various platforms of laser scanning.	Understand (K2)
CO2	Apply the components of Airborne Laser Scanner and concept of ranging principles.	Apply (K3)
CO3	Understand the flight planning parameters and pre-processing of acquired data.	Understand (K2)
CO4	Apply process the data to derive DSM and DEM and its applications.	Apply (K3)
CO5	Understand the components of TLS and its 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	2	1	1	1	2	3	-	-	1	-	2	3	2
CO2	3	3	2	2	2	2	3	-	-	2	-	3	3	3
CO3	2	3	3	2	2	2	3	-	-	2	1	3	3	3
CO4	2	2	3	2	2	2	3	-	-	2	1	3	3	2
CO5	3	2	3	2	2	2	3	-	-	2	-	3	3	3

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

VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓	✓	-	-	✓	-	-	-	✓	-

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VERTICAL 5: TRANSPORTATION INFRASTRUCTURE

I- Course Code & Name: 23PCE25 Airports and Harbours

Prerequisite	Program Name	Sem	Category	L	T	P	C
Nil	B.E. -Civil Engineering	V/VI/VII	PEC	3	0	0	3

II - Course Objectives

1.	To introduce the principles of airport planning, including site selection, layout design, and circulation systems.
2.	To develop the ability to design and assess key airfield components such as runways, taxiways, aprons, and terminals.
3.	To understand how wind data affects runway orientation and to learn the standards for runway markings, lighting, and landing systems.
4.	To provide knowledge on seaport planning, including harbor layouts, docks, coastal protection structures, and navigational aids.
5.	To familiarize students with Environmental Impact Assessment (EIA) processes and modern technologies like drones and AI for coastal zone monitoring.

III - Course Content

Preamble:
This course provides foundational knowledge in planning and designing airports and seaports, with a focus on their layout, components, and operational aspects. It also introduces modern tools like GIS, drones, and AI for efficient infrastructure management and environmental assessment

Unit – I	AIRPORT PLANNING	9 Periods

Air transport characteristics – Airport classification – ICAO – Airport Planning: Site selection – Typical Airport Layouts – Case Studies – Parking and Circulation Area.

Unit – II	AIRPORT COMPONENTS	9 Periods

Airport Classification – Planning of Airfield Components: Runway, Taxiway, Apron, Hangar, Passenger Terminals – Geometric Design of Runways and Taxiways – Runway Pavement Design – Differences Between Highway and Airport Pavements – Overview of Pavement Design Methods – Airport Drainage – Sustainable Runway Materials and Green Apron Concept

Unit – III	AIRPORT DESIGN	9 Periods

Runway Orientation – Wind Rose Diagram – Problems on Basic And Actual Runway Length – Geometric Design Elements of Runways and Taxiways – Airport Zoning – Passenger Facilities and Services Planning – Runway and Taxiway Markings and Lighting – Air Traffic Control Tower Siting and Design – Instrument Landing System (ILS) Categories

Unit – IV	SEAPORTS COMPONENTS AND CONSTRUCTION	9 Periods

Definition of Basic Terms: Harbor, Port, Satellite Port, Docks- Dry and Floating Dock, Waves and Tides – Planning and Design of Harbors: Harbour Layout and Terminal Facilities – Coastal

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Structures: Piers, Breakwaters, Wharves, Jetties, Quays, Spring Fenders, Dolphins Floating Landing Stage – Navigational Aids-Inland Water Transport		
Unit – V	**SEAPORT REGULATIONS AND EIA**	**9 Periods**
Wave action on Coastal Structures and Shore Protection and Reclamation – Coastal Regulation Zone, 2011-EIA – methods of impact analysis and its process		

Total Periods: 45

Text Books:	1. Khanna.S.K. Arora.M.G and Jain.S.S, Airport Planning and Design, Nemachand and Bros, Roorkee,1994 2. Robert Honjeff and Francis X.Mckelvey, "Planning and Design of Airports", McGraw Hill, New York,1996 2. Richard De Neufille and Amedeo Odoni, "Airport Systems Planning and Design", McGraw Hill, New York,2003 3. Subramanian K.P., Highways, Railways, Airport and Harbour Engineering,Scitech Publications (India), Chennai, 2010
Reference Books:	1. Venkatramaiah. C., Transportation Engineering-Vol.2 Railways, Airports, Docks and Harbours, Bridges and Tunnels.,Universities Press (India) Private Limited, Hyderabad, 2015. 2. Mundrey J S, Railway Track Engineering, McGraw Hill Education (India) Private Ltd, New Delhi, 2013.
MOOC/Web Platforms:	-

IV - Course Outcomes

On completion of the course, the students will be able to		**Bloom's Level Mapped**
CO1	Understand how to plan an airport's site, layout, and circulation.	Understand (K2)
CO2	Design and evaluate airfield components like runways, taxiways, and aprons.	Apply (K3)
CO3	Use wind data to orient runways and specify markings, lighting, and ILS needs.	Understand (K2)
CO4	Describe seaport layouts, docks, coastal structures, and navigational aids.	Understand (K2)
CO5	Apply basic EIA steps and modern tools (drones, AI) for coastal zone management.	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	1	1	1	-	-	-	-	1	2	2
CO2	3	1	-	1	1	1	1	-	-	-	-	1	2	2
CO3	3	1	-	1	1	1	1	-	-	-	-	1	2	2

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CO4	3	1	-	1	1	1	1	-	-	-	-	1	2	2
CO5	3	1	-	1	1	1	1	-	-	-	-	1	2	2

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

VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓	-	-	✓	-	-	✓	✓	✓	✓

I Course Code & Name: 23PCE26 Traffic Engineering and Management

Prerequisite	Program Name	Sem	Category	L	T	P	C
Nil	B.E. -Civil Engineering	V/VI/VII	PEC	3	0	0	3

II - Course Objectives

1.	To introduce traffic characteristics and teach students how to collect and analyze traffic data using traditional surveys and modern tools like GPS and IoT-based sensors.
2.	To explain traffic flow theory, including speed–flow–density relationships, and teach students how to evaluate roadway capacity using Passenger Car Unit –s (PCU).
3.	To familiarize students with practical and cost-effective traffic management techniques such as signal control, road signs, traffic calming, and road pricing.
4.	To enable students to design various types of road intersections, both at-grade and grade-separated, and introduce basic traffic simulation tools.
5.	To provide knowledge on planning and designing parking facilities, pedestrian walkways, and cycle tracks following standard design principles and safety guidelines.

III - Course Content

Preamble:
This course introduces the principles of traffic engineering, focusing on data collection, traffic flow analysis, and road capacity evaluation.

Unit – I	TRAFFIC SURVEYS AND ANALYSES	9 Periods

Traffic characteristics: Human, vehicular, and pavement characteristics – Presentation of traffic volume data – AADT, ADT, DHV – Spot speed and speed delay studies – Methods of survey – O-D survey, parking surveys, accident studies, and data analysis – Problems.

Unit – II	TRAFFIC FLOW AND ROADWAY CAPACITY	9 Periods

Traffic Flow Characteristics – Basic traffic manoeuvres, Traffic stream flow characteristics, Speed Flow- Density Relations; Passenger Car Unit –s – Mixed traffic flow and related issues – Concept of PCU value- Factors affecting PCU values- Recommended PCU values for different conditions; Capacity and Level of Service – Factors affecting practical capacity – Design Service Volumes

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Unit – III	COST-EFFECTIVE TRAFFIC MANAGEMENT TECHNIQUES	9 Periods
Traffic system management: One-way streets, reversible lanes, turning restrictions, traffic control devices – Road signs, markings, signals – Bus priority techniques – Traffic segregation – Parking management – TDM techniques – Road pricing, tolls, staggering timings.		
Unit – IV	**DESIGN OF ROAD INTERSECTIONS**	**9 Periods**
Importance and classification of intersections – At-grade: uncontrolled, channelised, rotaries, signalised – Grade-separated intersections: types, merits/demerits – Capacity calculations – Concept diagrams – Intersection design problems -Basic use of traffic simulation software		
Unit – V	**DESIGN OF PARKING, PEDESTRIAN FACILITIES, AND CYCLE TRACKS**	**9 Periods**
Need for parking studies – Parking types and standards – Conceptual parking layout – Pedestrian characteristics and design principles – Level of Service (LoS) for pedestrian facilities – Cycle track design for rural and urban areas.		

Total Periods: 45

Text Books:	1. Kadiyali. L.R. Traffic Engineering and Transport Planning, Khanna Publishers, Delhi, 2019. 2. Khanna .K and Justo C.E.G. and Veeraragavan, A Highway Engineering, Nem Chand Bros., Roorkee, Revised 10th Edition, 2014. 3. Srinivasa Kumar, "Introduction to Traffic Engineering", Universities Press, 2018 4. Partha Chakroborty and Animesh Das Principles of Transportation Engineering, PHI Learning Pvt. Ltd., 2011. 5. Papacosta.P.S and Prevedouros.P.D, " Transportation Engineering and Planning, third edition, 2015
Reference Books:	1. Indian Roads Congress (IRC) Specifications: Guidelines and special publications on Traffic Planning and Management. 2. Khanna S. K, and others, Highway Engineering, Nam Chand & Bros, Roorkee, 2014, Pages 177 – 308. 3. C. JotinKhisty, Kent Lall, Transportation Engineering: An Introduction, Prentice Hall, 1998 4. Taylor MAP and Young W, Traffic Analysis – New Technology and New Solutions, Hargreen Publishing Company , 1998.
MOOC/Web Platforms:	

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Collect and analyze traffic data using surveys and modern tools like GPS and sensors.	Apply (K3)
CO2	Understand traffic flow and calculate road capacity using PCU and speed-density concepts.	Understand (K2)
CO3	Use cost-effective methods to manage traffic with signs, signals, and control techniques.	Understand (K2)

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CO4	Design different types of road intersections and use basic traffic simulation tools.	Apply (K3)
CO5	Plan and design parking areas, pedestrian paths, and cycle tracks using standard guidelines.	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	1	1	1	-	-	-	-	1	2	2
CO2	3	1	-	1	1	1	1	-	-	-	-	1	2	2
CO3	3	1	-	1	1	1	1	-	-	-	-	1	2	2
CO4	3	1	-	1	1	1	1	-	-	-	-	1	2	2
CO5	3	1	-	1	1	1	1	-	-	-	-	1	2	2

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

VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓	-	-	✓	-	-	✓	✓	✓	✓

I Course Code & Name: 23PCE27 Urban Planning and Development

Prerequisite	Program Name	Sem	Category	L	T	P	C
Nil	B.E. -Civil Engineering	V/VI/VII	PEC	3	0	0	3

II - Course Objectives

1.	To introduce the basic concepts and definitions related to human settlements, urbanization, and current urban development programs like AMRUT.
2.	To understand the stages and principles of the urban planning process and explore major planning theories, including their relevance to Sustainable Development Goals (SDGs).
3.	To gain knowledge about various types of development plans and their formulation, with an introduction to the use of GIS in planning and monitoring.
4.	To learn the standards and procedures for plan implementation, including project preparation, evaluation, and addressing legal, financial, and institutional challenges.
5.	To familiarize students with urban and regional planning laws, building rules, and design guidelines for sites, layouts, and buildings.

III - Course Content

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Preamble: This course introduces the principles of traffic engineering, focusing on data collection, traffic flow analysis, and road capacity evaluation.		
Unit – I	**U INTRODUCTION**	**9 Periods**
Definition of Human settlement, Urban area, Town, City, Metropolitan City, Megalopolis, Urbanization, Urbanism, Suburbanization, Urban sprawl, Peri-urban areas, Central Business District (CBD), Urban Agglomeration, Census definition of urban settlements, Classification of urban areas – Positive and negative impacts of urbanization – Atal Mission for Rejuvenation and Urban Transformation (AMRUT) - Introduction to digital census mapping and real-time urban data usage.		
Unit – II	**PLANNING PROCESS AND THEORIES**	**9 Periods**
Principles of Planning – Stages in Planning Process – Goals, Objectives, Delineation of Planning Areas, Draft Plans, Evaluation, Final Plan. Planning Theories - Garden City Concept, Geddesian Triad by Patrick Geddes, Modernism Concept by Le-Corbusier, Radburn Concept, Neighbourhoods, Theories of Ekistics, Bid-rent Theory by William Alonso, Green Belt Concept - Role of Sustainable Development Goals (SDGs) in modern urban planning theories		
Unit – III	**DEVELOPMENT PLANS, PLAN FORMULATION AND EVALUATION**	**9 Periods**
Types of plans – Regional Plan, Master Plan, Structure Plan, Detailed Development Plan, New Town/ Satellite town – Development Plan, Urban Nodes, Smart City Plan – Scope and Content of RP, MP, DDP – Methodologies for preparation – Case Studies - Basic use of GIS in plan formulation and monitoring		
Unit – IV	**PLAN IMPLEMENTATION**	**9 Periods**
Planning Standards, Project Formulation and evaluation; Project Report preparation and presentation; Legal, Financial and Institutional constraints – Problems due to multiple laws, rules and institutions; Financing of Urban Development Projects; Urban planning agencies and their functions in the plan formulation and implementation.		
Unit – V	**URBAN AND REGIONAL PLANNING LEGISLATIONS, REGULATIONS AND DESIGNS**	**9 Periods**
Town and Country Planning, Local Bodies and Land Acquisition Acts, Development and Building Rules, Site analyses, Layouts and Buildings Design.		

Total Periods: 45

Text Books:	1. Goel, S.L Urban Development and Management, Deep and Deep publications, New Delhi 2002 2. George Chadwick, A Systems view of planning, Pergamon press, Oxford 1978 3. Singh V.B, Revitalised Urban Administration in India, Kalpaz publication, Delhi, 2001 4. Edwin S.Mills and Charles M.Becker, Studies in Urban development, A World Bank publication, 1986
Reference Books:	1. Tamil Nadu Town and Country Planning Act 1971, and Rules made thereunder, Government of Tamil Nadu, Chennai 2. Thooyavan, K.R., Human Settlements – A Planning Guide to Beginners, M.A Publications, Chennai, 2005 3. Chennai City Municipal Corporation Act, 1919 and Tamil Nadu District Municipalities Act, 1920 4. The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013 5. The Tamil Nadu Combined

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	Development and Building Rules, 2019
MOOC/Web Platforms:	-

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the meaning of urban areas, types of settlements, urban growth, and government schemes like AMRUT.	Understand (K2)
CO2	Understand how planning is done and know the ideas behind different urban planning theories.	Understand (K2)
CO3	Apply your knowledge to prepare basic city plans using different types of planning methods and simple GIS tools.	Apply (K3)
CO4	Apply the steps to make and manage urban development projects, including handling rules, money, and planning bodies.	Apply (K3)
CO5	Understand the laws and rules used in planning cities and designing buildings and layouts.	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	-	2	1	1	2	-	-	-	-	2	2	2
CO2	3	1	-	2	1	1	2	-	-	-	-	2	2	2
CO3	3	1	-	2	1	1	2	-	-	-	-	2	2	2
CO4	3	1	-	2	1	1	2	-	-	-	-	2	2	2
CO5	3	1	-	2	1	1	2	-	-	-	-	2	2	2

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

VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓	-	-	✓	-	-	✓	✓	✓	✓

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I Course Code & Name: 23PCE28 Smart Cities

Prerequisite	Program Name	Sem	Category	L	T	P	C
Nil	B.E. -Civil Engineering	V/V/VII	PEC	3	0	0	3

II - Course Objectives

1.	To introduce the concept of smart cities, the need for focused urban development, and the role of authorities and missions like Smart Cities Mission in India.
2.	To understand the components of smart physical infrastructure including land use planning, public transport, green infrastructure, and smart governance.
3.	To explore the integration of sustainability principles with smart urban planning, including climate-smart strategies and intelligent urban systems.
4.	To familiarize students with key technologies used in smart cities such as ICCC, GIS, surveillance systems, and data-driven urban management.
5.	To provide knowledge on smart city project management covering planning, cost analysis, risk management, PPP models, and monitoring with real-life case studies.

III - Course Content

Preamble:
This course introduces the concept of smart cities, focusing on sustainable urban development, smart infrastructure, and technology-driven governance.

Unit – I	**INTRODUCTION TO SMART CITIES**	**9 Periods**
Urbanization – Need for focused development – Role of authorities – Smart city concept – Opportunities and challenges – Smart infrastructures for cities – Smart Cities Mission in India.		
Unit – II	**SMART PHYSICAL INFRASTRUCTURE**	**9 Periods**
Smart infrastructure development – Land use and planning – Compact/mixed-use development – Transit Oriented Development (TOD) – Smart City Management – Smart public transportation – Intelligent traffic systems – Electric mobility – Smart governance structures – Green infrastructure and climate-resilient urban systems.		
Unit – III	**SUSTAINABILITY AND SMART PLANNING**	**9 Periods**
Relationship between sustainability and smart planning – Place making and urban design – Smart Street lighting – Intelligent emergency services – GIS-based spatial decision systems – Surveillance systems		
Unit – IV	**APPLICATION OF TECHNOLOGIES IN SMART CITIES**	**9 Periods**
Role of Technologies in Smart Cities - Integrated Command and Control Center (ICCC), Data Analytics, Data-driven strategies implementation in smart cities		
Unit – V	**SMART CITIES PROJECT MANAGEMENT**	**9 Periods**
Need for project management, Philosophy and concepts; Project phasing and stages; Project organizational structuring: Planning and Scheduling: Project cost analysis; Procurement and Contracting: PPP: Project Monitoring and Evaluation: Risk Management; Case studies.		

Total Periods: 45

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Text Books:	1.Global Warming and Climate Change by Agarwal S.K., First Edition, A P H Publishing Corporation, 2004 2. Foundations of Climatology by E.T. Stringer, Surjeet Publications, Delhi,1989 3. Understanding carbon credits by Gurmit Singh, Aditya Book Pvt. Ltd, New Delhi, 2009
Reference Books:	1. P Sharma , "Sustainable Smart cities in India, Challenges and Future Perspectives", Springer Link, 2017 2. Sameer Sharma,"Smart Cities Unbounded- Ideas and Practice of Smart Cities in India", Bloomsbury India, 2018. 3. Binti Singh, Manoj Parmar, "Smart City in India Urban Laboratory, Paradigm or Trajectory? Routledge India,2019
MOOC/Web Platforms:	

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Apply basic ideas about smart cities, urban growth, and how technology helps manage modern cities.	Apply (K3)
CO2	Apply concepts to plan and manage smart infrastructure like transport, land use, and eco-friendly systems.	Apply (K3)
CO3	Apply planning methods to create sustainable, safe, and climate-friendly cities.	Apply (K3)
CO4	Apply smart technologies like data analytics and control centers to improve city services.	Apply (K3)
CO5	Apply project management steps to plan, monitor, and manage smart city projects successfully.	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	1	1	1	-	-	-	-	1	2	2
CO2	3	1	-	1	1	1	1	-	-	-	-	1	2	2
CO3	3	1	-	1	1	1	1	-	-	-	-	1	2	2
CO4	3	1	-	1	1	1	1	-	-	-	-	1	2	2
CO5	3	1	-	1	1	1	1	-	-	-	-	1	2	2

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

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I Course Code& Name: 23PCE29 Intelligent Transport Systems

Prerequisite	Program Name	Sem	Category	L	T	P	C
Transportation Engineering	B.E. – Civil Engineering	V/VI/VII	PEC	3	0	0	3

II - Course Objectives

1.	To introduce the concept, purpose, and benefits of Intelligent Transportation Systems (ITS).
2.	To understand data collection methods used in ITS, including sensors, AVL, RFID, and IoT technologies.
3.	To familiarize students with the various ITS applications in traffic management systems and user services.
4.	To analyze the role of ITS in transportation planning, safety, security, demand management, and tolling systems.
5.	To explore ITS applications in logistics, including fleet management, e-commerce, and freight systems.

III - Course Content

Preamble:

This course introduces the principles and technologies involved in Intelligent Transportation Systems (ITS), focusing on their role in modernizing transport infrastructure. Students will learn about ITS data collection methods, applications in traffic management, transportation planning, safety, and logistics. The course bridges civil engineering and digital technologies to equip students for smart mobility solutions.

Unit –-I	INTRODUCTION TO ITS	7 Periods
Introduction to Intelligent Transportation Systems (ITS) - Definition of ITS Purpose of ITS Deployment- Benefits of ITS- Overview of application of ITS in Transportation Planning		
Unit –-II	**DATA COLLECTION THROUGH ITS**	**9 Periods**
Historical Background, Benefits of ITS - ITS Data collection techniques. Guidance concepts; ITS Data collection techniques – vehicle Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), GIS, RFID, video data collection, Internet of Things (IOT)		
Unit –-III	**ITS IN TRAFFIC MANAGEMENT**	**10 Periods**
ITS User Needs and Services and Functional areas –Introduction, Advanced Traffic Management systems (ATMS), Advanced Traveler Information systems (ATIS), Commercial Vehicle Operations (CVO), Advanced Vehicle Control Systems (AVCS), Advanced Public Transportation Systems (APTS), Advanced Rural Transportation Systems (ARTS).		
Unit –-IV	**ITS IN TRANSPORTATION PLANNING**	**10 Periods**
ITS and safety, ITS and security- Traffic and incident management systems; ITS and sustainable mobility, travel demand management, electronic toll collection, ITS and road-pricing.; Transportation network operations – public transportation applications- Weight –in Motion		
Unit –-V	**ITS APPLICATION IN LOGISTICS**	**9 Periods**
Commercial vehicle operations and intermodal freight-Fleet Management- IT application in freight logistics-E commerce		

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Total Periods: 45

Text Books:	1. R. Srinivasa Kumar,"Intelligent Transportation Systems", Universities Press P Ltd, Telangana, 2022.
Reference Books:	1. Intelligent Transport Systems, Intelligent Transportation Primer, Washington, US,2001. 2. Henry F.Korth, and Abraham Siberschatz, Data Base System Concepts, McGraw Hill,1992. 3. TurbanE.,"Decision Support and Export Systems Management Support Systems", Maxwell Macmillan,1998.
MOOC/Web Platforms:	https://nptel.ac.in/courses/105105204 https://onlinecourses.nptel.ac.in/noc22_ce70/preview

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the fundamentals of ITS and its benefits.	Understand (K2)
CO2	Understand knowledge on data collection using sensors and its applications.	Understand (K2)
CO3	Understand the performance and design of piles subjected to lateral and uplift loads using case studies and codal provisions.	Understand (K2)
CO4	Understand principles to design piles and pile caps, accounting for wind and seismic loads.	Understand (K2)
CO5	Apply the significance of caisson foundations and check their stability using codal provisions.	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	3	2
CO2	3	2	-	2	3	-	-	-	-	-	-	2	2	3
CO3	3	3	2	2	3	1	-	-	-	-	-	2	3	3
CO4	3	3	2	2	2	3	2	-	-	-	1	2	2	3
CO5	3	2	2	1	3	1	-	-	-	-	2	2	2	2

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

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VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓	✓			✓				✓	

I Course Code & Name: 23PCE30 Pavement Engineering.

Prerequisite	Program Name	Sem	Category	L	T	P	C
Nil	B.E. -Civil Engineering	V/VI/VII	PEC	3	0	0	3

II - Course Objectives

1.	To introduce the types of pavements, subgrade behavior, and pavement materials, including stress analysis and sustainable material applications.
2.	To provide knowledge on the design principles and methods for flexible pavements, including IRC 37 and Superpave mix design techniques.
3.	To understand the design of rigid pavements using IRC 58 guidelines and Modified Westergaard analysis, incorporating recycled concrete use.
4.	To study pavement construction techniques, surface and structural evaluation methods, and maintenance practices based on IRC standards.
5.	To explore pavement layer stabilization using various materials and techniques, including the use of geosynthetics and industrial waste.

III - Course Content

Preamble:
This course covers the design, construction, evaluation, and maintenance of flexible and rigid pavements, focusing on material behavior and structural performance.

Unit – I	PAVEMENT MATERIALS AND SUBGRADE ANALYSIS	9 Periods

Introduction – Pavement as layered structure – Pavement types: rigid, flexible, and composite – Subgrade analysis and classification – Stress and deflections in pavements using Boussinesq and Burmister theories – Pavement materials: aggregates, bitumen, cement.

Unit – II	DESIGN OF FLEXIBLE PAVEMENTS	9 Periods

Design principles of flexible pavements – Advantages and disadvantages – Factors influencing design– Design methods– IRC 37 method of design – Design of rural roads.

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Unit – III	DESIGN OF RIGID PAVEMENTS	9 Periods
Cement concrete pavements – Factors influencing design– IRC 58 method and Modified Westergaard analysis – Concrete roads and their scope in India.		
Unit – IV	**PAVEMENT CONSTRUCTION, EVALUATION AND MAINTENANCE**	**9 Periods**
Construction methods for flexible and rigid pavements – Pavement distress types: cracks, rutting, potholes, raveling – Surface evaluation: skid resistance, roughness, present serviceability index – Structural evaluation: Benkelman Beam Deflection.		
Unit – V	**STABILIZATION OF PAVEMENTS**	**9 Periods**
Concepts of stabilization for pavement layers – Choice of stabilizers: lime, cement, fly ash, bitumen – Testing and field control methods – Stabilization for rural roads – Geocomposites– Application of industrial wastes as stabilization techniques.		

Total Periods: 45

Text Books:	1. Khanna, S.K. and Justo C.E.G.and Veeraragavan, A, "Highway Engineering", New Chand and Brothers, Revised 10th Edition,2014. 2. Kadiyali, L.R., "Principles and Practice of Highway Engineering", Khannatech. Publications, New Delhi,2015. .
Reference Books:	1. Yoder, R.J. and Witchak M.W. "Principles of Pavement Design", John Wiley 2000. 2. Guidelines for the Design of Flexible Pavements, IRC-37–2018, The Indian roads Congress, New Delhi. 3. Guideline for the Design of Rigid Pavements for Highways, IRC 58-2015, The Indian Road Congress, New Delhi.
MOOC/Web Platforms:	-

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Apply basic ideas about types of roads, layers, soil strength, and road materials.	Apply (K3)
CO2	Apply methods to design flexible (bitumen) roads using Indian standards.	Apply (K3)
CO3	Apply methods to design concrete roads using Indian standards.	Apply (K3)
CO4	Apply ways to check road problems and suggest how to fix and maintain them.	Apply (K3)
CO5	Apply soil improvement methods using lime, cement, plastic sheets, and waste materials.	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	1	1	1	-	-	-	-	1	2	2
CO2	3	1	2	1	1	1	1	-	-	-	-	1	2	2
CO3	3	1	2	1	1	1	1	-	-	-	-	1	2	2
CO4	3	1	-	1	1	1	1	-	-	-	-	1	2	2
CO5	3	1	-	1	1	1	1	-	-	-	-	1	2	2

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

VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓	-	-	✓	-	-	✓	✓	✓	

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VERTICAL 6: ENVIRONMENT

I -Course Code & Name: 23PCE31 Air and Noise Pollution Control Engineering

Prerequisite	Program Name	Sem	Category	L	T	P	C
Nil	B.E. -Civil Engineering	V/VI/VII	PEC	3	0	0	3

II - Course Objectives

1.	To understand the types, sources, and effects of air and noise pollutants on the environment and human health.
2.	To gain knowledge on meteorological factors influencing pollutant dispersion and the use of modeling tools.
3.	To analyze sampling techniques and monitoring strategies for ambient and indoor air quality.
4.	To explore various technologies for controlling particulate and gaseous pollutants from industrial sources
5.	To evaluate noise pollution parameters and propose control measures, with special emphasis on occupational safety and industrial emission management.

III - Course Content

Preamble:
This course provides knowledge on the sources, effects, sampling, and modeling of air and noise pollution, along with control technologies.

Unit – I	INTRODUCTION	9 Periods

Atmosphere as a place of disposal of pollutants – Air Pollution – Definition - Air Pollution and Global Climate - Unit –s of measurements of pollutants - Air quality criteria - emission standards - National ambient air quality standards - Air pollution indices and emission standards - Air quality management in India.

Unit – II	SOURCES, CLASSIFICATION AND EFFECTS	9 Periods

Sources and classification of air pollutants - Man made - Natural sources - Type of air pollutants - Pollution due to automobiles - Analysis of air pollutants - Chemical, Instrumental and biological methods. Air pollution and its effects on human beings, plants and animals - Economic effects of air pollution - Effect of air pollution on meteorological conditions - Changes on the Meso scale, Micro scale and Macro scale.

Unit – III	SAMPLING, METEOROLOGY AND AIR QUALITY MODELLING	9 Periods

Sampling and measurement of particulate and gaseous pollutants - Ambient air sampling - Stack sampling. Environmental factors - Meteorology - temperature lapse rate and stability – Adiabatic lapse rate - Wind Rose - Inversion – Wind velocity and turbulence - Plume behavior - Dispersion of air pollutants- Air Quality Modeling.

Unit – IV	AIR POLLUTION CONTROL MEASURES	9 Periods

Control - Source correction methods - Control equipments - Particulate control methods – Bag house filter - Settling chamber - cyclone separators - inertial devices - Electrostatic precipitator - scrubbers - Control of gaseous emissions - Absorption - Absorption equipments - adsorption and combustion devices (Theory and working of equipments only).

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Unit – V	NOISE POLLUTION AND INDUSTRIAL AIR POLLUTION STRATEGIES	9 Periods
Noise pollution: Sources (construction, mining, transport, industry) - Unit –s and measurement (dB scale, equivalent sound level) - Effects: auditory and non-auditory - Control methods: source reduction, transmission barriers, personal protection Industrial air pollution: Control strategies and philosophies - Case studies: thermal power plants, cement, petroleum, steel, fertilizer industries.		

Total Periods: 45

Text Books:	1. C. S. Rao, "Environmental Pollution Control Engineering", Wiley Eastern Limited, 2006. 2. M. N. Rao, H. V. N. Rao, Air pollution, Tata McGraw Hill Pvt Ltd, New Delhi, 2017 3. Dr. Y. Anjaneyulu, "Air Pollution and Control Technologies", Allied publishers Pvt. Ltd., 2019.
Reference Books:	1. Noel De Nevers, "Air pollution control Engineering", McGraw Hill International Edition, McGraw Hill Inc, New Delhi, 2000. 2. Kenneth wark, Cecil F.Warner, "Air Pollution its Origin and Control", Harper and Row Publishers, New York, 1998. 3. C. D. Cooper and F. C. Alley, Air Pollution Control Engineering , Waveland Press, 2019. 4. C. E. Davis, Industrial Air Pollution Control Routledge, 2018. 5. Antony Milne, "Noise Pollution: Impact and Counter Measures", David & Charles PLC, 1979.
MOOC/Web Platforms:	--

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Explain air quality standards, global environmental concerns, and atmospheric dispersion principles.	Understand (K2)
CO2	Understand the sources, types, and effects of air pollutants,	Understand (K2)
CO3	Understand air pollutant sampling techniques and utilize air quality models for dispersion prediction under varying meteorological conditions	Understand (K2)
CO4	Understand the air pollution control measures.	Understand (K2)
CO5	Identify noise pollution sources and evaluate noise control strategies along with industry-specific air pollution control practices	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	2				2							3	2
CO2	3	3	2	2									3	3
CO3	3	3	3	2									3	3
CO4	3	2	3										3	3
CO5	3	2	2			2							2	3

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

VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓		✓	✓					✓	

I Course Code & Name: 23PCE32 Environmental Impact Assessment

Prerequisite	Program Name	Semester	Category	L	T	P	C
Nil	B.E. -Civil Engineering	V/VI/VII	PEC	3	0	0	3

II - Course Objectives

6.	To introduce the fundamentals, historical development, and legal aspects of Environmental Impact Assessment (EIA).
7.	To apply methodologies and analytical tools for environmental impact prediction and evaluation.
8.	To assess socio-economic impacts of developmental projects on individuals, families, and communities.
9.	To analyze and propose mitigation measures for impacts on natural, cultural, and economic environments.
10.	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		

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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.		
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 Periods: 45

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:	6. Canter, L.W., Environmental Impact Assessment, 2nd Edition, McGraw-Hill, New York, 1996. 7. Lawrence, D.P., Impact Assessment – Practical Solutions to Recurrent Problems and Contemporary Challenges, 2nd Edition, Wiley, New Jersey, 2014. 8. Kolluru, R., Bartell, S., Pitblado, R. and Stricoff, R., Risk Assessment and Management Handbook, McGraw-Hill Inc., New York, 1996.
MOOC/Web Platforms:	4. https://onlinecourses.nptel.ac.in/noc22_ar07/preview 5. https://www.futurelearn.com/courses/environmental-impact-assessment 6. https://cursos.iadb.org/en/topics/management-social-and-environmental-risk/principles-reviewing-environmental-impact-assessments

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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 principles, process, and regulatory framework of Environmental Impact Assessment.	Apply (K3)
CO2	Apply analytical methods and prediction tools for assessing environmental impacts.	Apply (K3)
CO3	Apply 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.	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	3	–	–	–	–	2	2	–	–	2	–	–	3	–
CO2	3	2	3	3	2	–	–	–	–	–	–	2	3	3
CO3	–	2	–	–	–	3	2	2	–	2	–	–	–	3
CO4	–	–	3	–	–	3	3	3	–	3	2	–	3	3
CO5	3	–	3	2	–	2	3	–	2	3	–	2	3	3

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

VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓			✓	✓		✓	✓	✓	

I Course Code& Name: 23PCE33 Industrial Waste Water Management

Prerequisite	Program Name	Sem	Category	L	T	P	C
Environmental Engineering	B.E. – Civil Engineering	V/VI/VII	PEC	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

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	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 – 1	**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 – 2	**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 – 3	**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 – 4	**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.		
Unit – 5	**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 Periods: 45

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

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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

IV - Course Outcomes

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	Apply (K3)
CO4	Analyze environmental performance of industries to internal, external client, regulatory bodies and design water reuse management techniques	Analyze (K4)
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	3	3

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CO2	3	2	3	2	2	2	2	-	-	-	-	2	3	3
CO3	3	3	3	3	2	3	-	-	-	-	-	3	3	3
CO4	3	2	3	3	3	3	2	-	-	-	-	3	2	3
CO5	3	3	3	3	3	3	2	-	-	-	-	3	3	3

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

VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓	✓			✓				✓	

I Course Code& Name: 23PCE34 Solid and Hazardous waste Management

Prerequisite	Program Name	Sem	Category	L	T	P	C
Environmental Science and Sustainability	B.E. – Civil Engineering	V/VI/VII	PEC	3	0	0	3

II - Course Objectives

1.	To impart knowledge on the sources, characteristics, and impacts of solid and hazardous wastes.
2.	To develop skills in planning and designing systems for storage, collection, and transport of wastes.
3.	To provide understanding of methods for recycling, processing, treatment, and energy recovery from wastes.
4.	To familiarize students with engineering principles, design criteria, and equipment used in waste management.
5.	To create awareness of environmental regulations, standards, and sustainable practices in solid and hazardous waste management.

III - Course Content

Preamble:

The rapid growth of population, urbanization, and industrialization has led to a significant increase in the generation of solid and hazardous wastes. Proper management of these wastes is essential to protect public health, preserve environmental quality, and ensure sustainable development.

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Unit –-I	WASTE CLASSIFICATION AND REGULATORY REQUIREMENTS	9 Periods
Sources and types of solid and hazardous wastes - need for solid and hazardous waste management – salient features of latest Indian legislations on management and handling of solid wastes, hazardous wastes, biomedical wastes, electronic wastes, construction and demolition wastes, plastics and discarded lead acid batteries – elements of integrated waste management and roles of stakeholders - seven elements and seven step approach to integrated solid waste management planning.		
Unit –II	**WASTE CHARACTERIZATION SOURCE REDUCTION AND RECYCLING**	**9 Periods**
Waste sampling and characterization plan - waste generation rates and variation – physical composition, chemical and biological properties – hazardous characteristics – ignitability, corrosivity and TCLP tests –source reduction, segregation and onsite storage of wastes – waste exchange - extended producer responsibility - recycling of plastics, C&D wastes and E wastes		
Unit –III	**WASTE COLLECTION TRANSPORT AND MATERIAL RECOVERY**	**9 Periods**
Door to door collection of segregated solid wastes - analysis of hauled container and stationery container collection systems - compatibility, storage, labeling and handling of hazardous wastes – principles and design of transfer and transport facilities - hazardous waste transport and manifests - mechanical processing and material separation technologies – Size reduction – size separation - density separation - magenetic separation – compaction – principles and design of material recovery facilities – physico chemical treatment of hazardous wastes - solidification and stabilization – case studies on waste collection and material recovery		
Unit –IV	**BIOLOGICAL AND THERMAL PROCESSING OF WASTES**	**9 Periods**
Biological and thermos-chemical conversion technologies – composting – biomethanation – incineration – pyrolysis- plasma arc gasification –principles and design of biological and thermal treatment facilities - MSW processes to energy with high-value products and specialty By-products - operation of facilities and environmental controls - treatment of biomedical wastes – case studies and emerging waste processing technologies.		
Unit –V	**WASTE DISPOSAL**	**9 Periods**
Sanitary and secure landfills - components and configuration– site selection - liner and cover systems - geo synthetic clay liners and geo membranes - design of sanitary landfills and secure landfills- leachate collection, treatment and landfill gas management – landfill construction and operational controls - landfill closure and environmental monitoring – landfill bioreactors – rehabilitation of open dumps and biomining of dumpsites-remediation of contaminated sites-Case studies		

Total Periods: 45

Text Books:	1. George Tchobanoglous, Hilary Theisen and Samuel A, Vigil, "Integrated Solid Waste Management, Mc-Graw Hill India, First edition, 2015. 2. CPHEEO, "Manual on Municipal Solid waste management,Vol I, II and III, Central Public Health and Environmental Engineering Organisation , Government of India, New Delhi, 2016.
Reference Books:	1. William A. Worrell, P. Aarne Vesilind, Christian Ludwig, Solid Waste Engineering – A Global erspective, 3rd Edition, Cengage Learning, 2017. 2. Michael D. LaGrega, Philip L Buckingham, Jeffrey C. E vans and

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	"Environmental Resources Management, Hazardous waste Management", Mc-Graw Hill International edition, New York,2010. 3. John Pitchtel,Waste Management Practices, CRC Press,Taylor and Francis Group,2014. 4. Gary C. Young, Municipal Solid Waste to Energy Conversion Processes: Economic, Technical, and Renewable Comparisons, Wiley, 2010
MOOC/Web Platforms:	https://onlinecourses.swayam2.ac.in/cec20_ge34/preview

IV - Course Outcomes

On completion of the course, the students will be able to		**Bloom's Level Mapped**
CO1	Explain the various functional elements of solid and hazardous waste management including the associated legal, health, safety, and cultural issues as well as responsibilities of different stakeholders.	Understand (K2)
CO2	Apply the knowledge of science and engineering fundamentals to characterize different types of solid and hazardous wastes, assess the factors affecting variation and assess performance of waste treatment and disposal systems.	Apply (K3)
CO3	Apply the knowledge of science and engineering fundamentals to characterize different types of solid and hazardous wastes, assess the factors affecting variation and assess performance of waste treatment and disposal systems	Understand (K2)
CO4	Understand methods for processing and disposal of solid and hazardous wastes, taking into account the impact of the solutions in a sustainability context	Understand (K2)
CO5	Apply solid and hazardous waste management and communicate effectively to different stakeholders as well as engage in independent lifelong learning.	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	-	-	2	2
CO2	3	3	2	2	-	2	2	-	-	-	-	2	3	2
CO3	3	2	2	2	-	2	2	-	-	-	-	2	3	2
CO4	2	2	3	-	-	3	3	-	-	-	-	2	2	3
CO5	2	-	2	-	-	2	2	2	2	3	2	3	2	3

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

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VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓	✓			✓				✓	

I – Course Code & Name: 23CE35 Environmental policy and Legislations

Prerequisite	Program Name	Semester	Category	L	T	P	C
Water supply and Wastewater Engineering	B.E. -Civil Engineering	V/VI/VII	PEC	3	0	0	3

II - Course Objectives

1.	To introduce international and national environmental legislations and conventions.
2.	To familiarize students with environmental policies, ethics, and regulatory frameworks.
3.	To analyze legal remedies available for environmental protection in India.
4.	To study major Indian legislations and waste management rules.
5.	To examine landmark case laws linking environment, law, and sustainable development.

III - Course Content

Preamble: This course provides an in-depth understanding of international and national environmental legislations, conventions, and judicial frameworks. It enables students to analyze legal principles, policies, and case laws that balance environmental protection with sustainable development.

Unit – I	INTRODUCTION TO ENVIRONMENTAL LEGISLATIONS AND INTERNATIONAL SCENARIO	9 Periods

Significance of Environmental Law -International Environmental Law -Development of International Environmental Law -Source and General principals of International Environmental Law –General rights and obligations of States -General Issues of the international law related to environmental protection -Stockholm Declaration-Rio Declaration on Environment and Development-Basel Convention on the Control of Trans boundary Movement of Hazardous Wastes and their disposal- Convention of Biological Diversity-U.N Frame Work Convention on Climate Change-Montreal Protocol on Substances that deplete Ozone Layer-Kyoto Protocol.

Unit – II	ENVIRONMENTAL POLICY AND LAW	9 Periods

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Environmental Philosophy and ethics- Social & Civil Society movements to protect environment National Environmental Policy, Land-use policy& Common Property Resources Regulations on EIA, Pollution Control regulations: Environment Protection Act, Water Act, Air Act, NGT Waste management rules: Solid waste, E Waste, C&D Waste, Plastic Waste, Biomedical waste, Hazardous waste .		
Unit – III	**REMEDIES FOR ENVIRONMENTAL POLLUTION**	**9 Periods**
Common Law Remedies/Remedies under Law of Tort – Penal Remedies – Indian Penal Code and Code of Criminal Procedure – Remedies under Constitutional Law –Writs – Public Interest Litigation - Public Liability Insurance Act, 1991 – The National Green Tribunal Act 2010.		
Unit – IV	**MAJOR INDIAN LEGISLATIONS**	**9 Periods**
Water Act (1974) Air Act (1981) Environmental Protection Act (1986) Major Notifications, The Municipal solid Wastes (Management and Handling) Rules 2000-Bio Medical Wastes (Management and Handling) Rules 1998- Hazardous Wastes (Management and Handling Rules 1989- Environment Impact Assessment Notifications- Coastal Regulation Zone Notification- Public Hearing.		
Unit – V	**ENVIRONMENT AND DEVELOPMENT CASE LAWS**	**9 Periods**
Meaning and concept of development - Its impact on environment; conflict between environment and development, Concept of Sustainable Development., Polluter Pay Principle, Precautionary Principle, Public Trust Doctrine. Landmark Judgments - Olium gas leakage case, Rural Litigation and Entitlement Kendra, Dehradun, (1985) Supp SCC 487) Vellore Citizen Welfare Forum v. Union of India, (1996) 5SCC 647) Ganga Pollution case (1988) I SCC) S. Jagannath v. UOI (1997) SCC867) Vellore Citizens welfare forum case M.C. Mehta V. Kamalnath (1997) I SCC 388)		

Total Periods: 45

Text Books:	1. Shastri, S.C., Environmental Law, 6th Edition, Eastern Book Company, 2021. 2. Divan, S. and Rosencranz, A., Environmental Law and Policy in India: Cases, Materials and Statutes, 3rd Edition, Oxford University Press, 2022. 3. Birnie, P.W., Boyle, A.E., and Redgwell, C., International Law and the Environment, 4th Edition, Oxford University Press, 2021. 4. Leelakrishnan, P., Environmental Law in India, 6th Edition, Lexis Nexis, 2020. 5. Sands, P. and Peel, J., Principles of International Environmental Law, 4th Edition, Cambridge University Press, 2018.
Reference Books:	1. Kailash Thakur, Environmental Protection Law and Policy in India, Deep and Deep Publications, 2019. 2. C.M. Abraham, Environmental Jurisprudence in India, Kluwer Law International, 2018. 3. Armin Rosencranz, The Oxford Handbook of Environmental Law in India, OUP, 2020. 4. Shyam Divan & Armin Rosencranz, Cases and Materials on Environmental Law in India, 2nd Edition, OUP, 2019.

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MOOC/Web Platforms:	1. https://nptel.ac.in/courses/127106148 2. https://swayam.gov.in/nd2_ugc19_en14 3. https://www.unep.org/resources/environmental-law

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Explain the significance and evolution of international and national environmental legislations.	Apply (K3)
CO2	Interpret environmental policies, ethics, and statutory regulations in India.	Apply (K3)
CO3	Analyze the legal remedies available under constitutional, statutory, and common law provisions.	Apply (K3)
CO4	Apply knowledge of major environmental legislations and waste management rules in practical contexts.	Apply (K3)
CO5	Evaluate landmark case laws and principles governing environmental protection and sustainable development	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	–	–	–	–	–	2	–	–	2	–	–	–	–
CO2	2	–	–	–	–	2	3	–	–	2	–	–	–	–
CO3	3	–	–	–	–	2	2	–	–	3	–	–	–	–
CO4	2	–	–	–	–	2	3	–	–	2	–	–	–	2
CO5	3	–	–	–	–	3	3	–	–	3	–	–	–	2

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

VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓			✓	✓		✓	✓	✓	

I Course Code & Name: 23PCE36 Environment, Health and Safety

Prerequisite	Program Name	Semester	Category	L	T	P	C
Nil	B.E. -Civil Engineering	V/VI/VII	PEC	3	0	0	3

II - Course Objectives

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1.	explain the need for EHS systems in workplaces and interpret international and national EHS regulations, policies, and ergonomics principles
2.	identify occupational health hazards, exposure pathways, and apply appropriate control measures including personal protective equipment.
3.	analyze safety features in workplace design and implement safety systems for physical, chemical, and construction-related hazards.
4.	assess workplace hazards, conduct job safety analyses, and develop effective risk management and emergency response plans.
5.	understand and apply the components of an EHS management system based on national and international standards like BIS and ISO 45001.

III - Course Content

Preamble:

Environment, Health, and Safety (EHS) is an integrated discipline dedicated to protecting the well-being of people, the planet, and operational integrity. It establishes a holistic framework for identifying and mitigating risks in the workplace and the broader environment, ensuring legal and ethical compliance. Ultimately, EHS is a commitment to fostering a sustainable and responsible culture where safety and environmental stewardship are fundamental to all operations.

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.

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.

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Total Periods: 45

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 Outcomes

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)

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	-	-	-	-	-	-	-

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

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓							✓		✓	

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VERTICAL 7: WATER RESOURCES

Course Code & Name: 23PCE37 Participatory Water Resources Management

Prerequisite	Program Name	Semester	Category	L	T	P	C
Nil	B.E. -Civil Engineering	V/VI/VII	PEC	3	0	0	3

II - Course Objectives

1.	To introduce the concept and objectives of participatory approaches in water resource systems for sustainable water management.
2.	To understand the need, types, and benefits of farmers' participation and the role of institutions in participatory irrigation management.
3.	To analyze key issues in water allocation and management across sectors and explore modernization and rehabilitation strategies.
4.	To examine global challenges and participatory solutions for water conservation, including success stories and policy frameworks.
5.	To understand the principles and practices of participatory watershed development and evaluate its implementation in government programs.

III - Course Content

Preamble: Participatory water resources management emphasizes active involvement of farmers, communities, and institutions in water planning, irrigation, conservation, and watershed development, supported by case studies and policy frameworks for sustainable governance.

Unit – I	PARTICIPATORY APPROACH	9 Periods

Technology for meeting water needs; Water resources systems - Participatory concepts– Objectives of participatory approach.

Unit – II	UNDERSTANDING FARMERS PARTICIPATION	9 Periods

Farmers participation –need and benefits – Comparison of cost and benefit -Sustained system performance - Kinds of participation – Context of participation, factors in the environment – WUA - Constraints in organizing FA – Role of Community Organizer – Case Studies.- Water resources information system.

Unit – III	ISSUES IN WATER MANAGEMENT	9 Periods

Multiple use of water – Issues in Intersectoral Water Allocation - domestic, irrigation, industrial sectors - modernization techniques – Rehabilitation – Command Area Development – Water delivery systems.

Unit – IV	PARTICIPATORY WATER CONSERVATION	9 Periods

Global Challenges -Social – Economic – Environmental - Solutions –Political - Water Marketing – Water Rights -Consumer education – Success Stories Case Studies

Unit – V	PARTICIPATORY WATERSHED DEVELOPMENT	9 Periods

Concept and significance of watershed - Basic factors influencing watershed development –- Principles of watershed management - Definition of watershed management – Identification of

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problems - Watershed approach in Government programmes –- People's participation – Entry point activities - Evaluation of watershed management measures.

Total Periods: 45

Text Books:	1. Sivasubramaniyan, K. Water Management, SIMRES Publication, Chennai, 2011 2. Uphoff.N., Improving International Irrigation management with Farmer Participation – Getting the process Right – Studies in water Policy and management, No.11, Westview press, Boulder,CO, 1986.
Reference Books:	1. Chambers Robert, Managing canal irrigation, Cambridge University Press, 1989. 2. Tideman, E.M., "Watershed Management", Omega Scientific Publishers, New Delhi, 1996.
MOOC/Web Platforms:	https://onlinecourses.swayam2.ac.in/cec21_ge14/preview https://www.mooc-list.com/tags/water-resources

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand participatory concepts and appropriate technologies to meet water resource needs in a sustainable manner.	Understand (K2)
CO2	Apply suitable participatory strategies to enhance farmers' involvement through Water User Associations (WUAs) and community organizers	Apply (K3)
CO3	Get knowledge in modernization and rehabilitation techniques to resolve intersectoral water allocation issues and improve water delivery systems.	Understand (K2)
CO4	Understand participatory approaches to address socio-economic and environmental challenges in water conservation through consumer involvement and water rights.	Understand (K2)
CO5	Apply watershed management principles and participatory methods for planning and implementing effective watershed development programs.	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	3	-	-	-	-	-	2	2
CO2	3	-	-	-	2	2	3	-	-	-	-	-	2	2
CO3	3	-	-	-	2	2	3	-	-	-	-	-	2	2
CO4	3	-	-	-	2	2	3	-	-	-	-	-	2	2

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CO5	3	-	-	-	2	2	3	-	-	-	-	-	2	2

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

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓		✓	✓					✓	

I - Course Name: 23PCE38 Ground Water Engineering

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Civil Engineering	V/VI/VII	PCC	3	0	0	3

II - Course Objectives

1.	To understand the basics of groundwater systems and aquifer types.
2.	To analyze groundwater flow under steady and unsteady conditions using well hydraulics.
3.	To develop skills in groundwater modeling and database management.
4.	To explore artificial recharge techniques and assess groundwater quality.
5.	To promote innovative and sustainable practices for groundwater conservation and management.

III - Course Content

Preamble:

This course provides fundamental knowledge on groundwater systems, aquifer characteristics, and flow dynamics. It emphasizes the techniques of well hydraulics, groundwater modeling, artificial recharge, and quality assessment. It aims to equip students with practical skills to manage and conserve groundwater resources effectively and sustainably.

UNIT- I	HYDROGEOLOGICAL PARAMETERS	8 Periods
Groundwater in hydrological cycle, Properties of rocks and water bearing formations – Type of aquifers - Aquifer properties – permeability, specific yield, transmissivity and storage coefficient – Methods of Estimation – GEC norms - Steady state flow - Darcy's Law - Groundwater Velocity – Dupuit Forchheimer assumption – Steady Radial Flow into a Well		
UNIT-II	**WELL HYDRAULICS**	**8 Periods**
Steady groundwater flow Dupuit assumptions, Storage coefficient - Unsteady State and Radial Flow equations, – Law of Times – Theis Recovery – Bailer method – Slug method - tests - Image well theory – Partial penetrations of wells - Well losses – Specific Capacity and Safe yield -		

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Collector well and Infiltration gallery		
UNIT -III	**GROUND WATER MANAGEMENT**	**10 Periods**
Need for Management Model – Database for Groundwater Management – Groundwater balance study – Introduction to Mathematical model – Model Conceptualization – Initial and Boundary Condition – Calibration – Validation – Future Prediction – Geophysical exploration, Electric resistivity method, Seismic method, Gravity and magnetic methods		
UNIT -IV	**GROUND WATER QUALITY**	**9 Periods**
Ground water chemistry - Quality of Ground Water, Physical and Chemical properties; Quality criteria for domestic,– Drinking water Industrial water – Irrigation water - Groundwater Pollution and legislation - Environmental Regulatory requirements		
UNIT -V	**GROUNDWATER CONSERVATION**	**10 Periods**
Concept of artificial recharge: Methods of artificial recharge-water spreading, Waste water recharge for reuse, Recharge mounds – Soil aquifer treatment (SAT) – Aquifer Storage and Recovery (ASR) Seawater Intrusion and Remediation – Ground water Basin management and Conjunctive use – Protection zone delineation,		
		Total Periods: 45

Text Books:	1. Raghunath H.M., "Ground Water Hydrology", New Age International (P) Limited, New Delhi,2010. 2. Todd D.K., "Ground Water Hydrology", John Wiley and Sons, New York,2000.
Reference Books:	1. Fitts R Charles, "Groundwater Science". Elsevier, Academic Press,2002. 2. Ramakrishnan, S, Ground Water, K.J. Graph arts, Chennai, 1998. 3. Chahar BR, Groundwater hydrology, McGraw Hill Education (India) Pvt Ltd, New Delhi, 2015. 4. RastogiA.K. , Numerical Groundwater Hydrology,2011

MOOC/Web Platforms:	//nptel.ac.in/courses/105107473
	//onlinecourses.nptel.ac.in/noc24_ce83/preview
	//nptel.ac.in/courses/105103026

IV - Course Outcomes

On completion of the course, the students will be able to		**Bloom's Level Mapped**
CO1	Define the groundwater system basics, aquifer types, parameters, and movement.	Understand (K)
CO2	Apply the knowledge of groundwater flow in steady/unsteady conditions and well hydraulics.	Apply (K3)
CO3	Explain groundwater model development and manage relevant data.	Understand (K2)
CO4	Describe artificial recharge and groundwater quality concepts.	Understand (K2)
CO5	Apply creative techniques for groundwater conservation.	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	3	-	-	-	-	1	3	2
CO2	3	3	2	2	-	-	2	-	-	-	-	2	3	3
CO3	2	2	3	3	3	-	2	-	-	-	-	3	3	2
CO4	2	1	1	2	1	2	3	2	-	-	-	2	2	3
CO5	3	2	3	3	3	3	3	-	2	1	1	3	2	3

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

VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓	✓			✓				✓	

I-Course Code & Name: 23PCE39 Water Resources Systems Engineering

Prerequisite	Program Name	Semester	Category	L	T	P	C
Water supply and Wastewater Engineering	B.E. -Civil Engineering	V/VI/VII	PEC	3	0	0	3

II - Course Objectives

1.	Understand the fundamentals of systems engineering, modelling philosophy, and system analysis concepts in water resources.
2.	Formulate and solve linear programming problems for water resources planning and reservoir operations.
3.	Apply dynamic programming and decision-making techniques under certainty and uncertainty in water allocation problems.
4.	Gain knowledge of multi-objective and multi-criteria decision-making tools, including simulation and evolutionary algorithms.
5.	Perform economic evaluation and optimization of water resources systems for sustainable and efficient management.

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III - Course Content

Preamble: This course introduces the concepts of systems engineering, modelling, and optimization techniques applied to water resources engineering. It equips students with tools like linear programming, dynamic programming, and evolutionary algorithms for efficient planning, design, and operation of water resources systems.		
Unit – I	**SYSTEM APPROACH**	**9 Periods**
Definition, classification, and characteristics of systems – Philosophy of modelling – Goals and Objective Basics of system analysis concept – steps in systems engineering.		
Unit – II	**LINEAR PROGRAMMING**	**9 Periods**
Introduction to Operation research –Linear programming Problem Formulation-graphical solution Simplex method Sensitivity analysis application to operation of single purpose reservoir.		
Unit – III	**DYNAMICPROGRAMMING**	**9 Periods**
Bellman's optimality criteria, problem formulation and solutions – Water Allocation for three state (user), Forward and Backward Recursion techniques- dynamic programming, decision making Under uncertainty, fuzzy optimization. Overview of multi objective optimization		
Unit – IV	**SIMULATION**	**9 Periods**
Multi criteria decision making, Simulation- optimizations overview of Genetic Algorithm and other evolutionary algorithms Economic analysis, discounting techniques, benefit cost evaluation. River basin modelling, storage-yield relation, reservoir design and operation		
Unit – V	**ADVANCED OPTIMIZATION TECHNIQUES**	**9 Periods**
Integer and parametric linear programming – Goal programming types – Applications to reservoir release optimization – application of evolutionary algorithms like Genetic algorithm, Particle swarm, Simulated Annealing to reservoir release optimization.		

Total Periods: 45

Text Books:	1. H.A. Taha, *Operations Research: An Introduction*, 10th Edition, Pearson Education, 2019. 2. D.E. Goldberg, *Genetic Algorithms in Search, Optimization and Machine Learning*, 1st Edition, Addison Wesley, 1989 (classic reference, still standard). 3. S.S. Rao, *Engineering Optimization: Theory and Practice*, 5th Edition, Wiley, 2019. 4. Vedula, S. and Mujumdar, P.P., *Water Resources Systems – Modelling Techniques and Analysis*, 1st Edition, Tata McGraw Hill, 2005. 5. Loucks, D.P., Stedinger, J.R. and Haith, D.A., *Water Resource Systems Planning and Analysis*, Prentice Hall, 1981
Reference Books:	1. *Wagner, H.M.,* Principles of Operations Research with Applications to Managerial Decisions*, 2nd Edition, Prentice Hall, 1975.* 2. *R. Panneerselvam,* Operations Research*, 3rd Edition, PHI Learning, 2017.* 3. *Mays, L.W. and Tung, Y.K.,* Hydrosystems Engineering and Management*, McGraw Hill, 1992.* 4. *Deb, Kalyanmoy,* Optimization for Engineering Design: Algorithms and

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	Examples, *2nd Edition, PHI Learning, 2012.*
MOOC/Web Platforms:	1. https://nptel.ac.in/courses/105/107/105107155/ 2. https://nptel.ac.in/courses/105/107/105107156/ 3. https://nptel.ac.in/courses/110/106/110106062/ 4. https://www.coursera.org/learn/water-resources-management

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Define and classify systems, explain the philosophy of modelling, and outline the steps in systems engineering.	Apply (K3)
CO2	Formulate and solve linear programming problems using graphical and simplex methods for water resources applications.	Apply (K3)
CO3	Apply dynamic programming and Bellman's optimality principle for water allocation and decision-making under uncertainty.	Apply (K3)
CO4	Analyze and evaluate multi-criteria decision-making, simulation, and evolutionary optimization methods for reservoir planning.	Analyze (K4)
CO5	Develop optimization models (linear, integer, goal programming, evolutionary algorithms) for reservoir design and operation.	Create (K6)

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	–	2	3	2
CO2	3	3	2	2	–	–	–	–	–	–	–	2	3	3
CO3	3	2	2	3	1	–	–	–	–	–	–	3	3	3
CO4	2	3	2	3	2	–	1	–	–	1	–	3	2	3
CO5	3	3	3	3	3	–	1	–	–	–	2	3	3	3

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

VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓			✓	✓		✓	✓	✓	

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I- Course Code & Name: 23PCE40 Integrated Water Resources Management

Prerequisite	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Civil Engineering	V/VI/VII	PCE	3	0	0	3

II - Course Objectives

1.	To introduce students to the economic aspects of Integrated Water Resources Management (IWRM).
2.	To familiarize students with public–private partnership models in water resource management.
3.	To examine the interrelationship between water and health.
4.	To analyze the role of water in ensuring food security.
5.	To understand the legal and regulatory frameworks governing water resources.

III - Course Content

Preamble: Integrated Water Resources Management (IWRM) is an emerging framework that addresses water issues by linking economic, social, health, agricultural, and legal aspects. This course equips students with the knowledge to evaluate complex water challenges and contribute to sustainable development.

Unit – I	CONTEXT FOR IWRM	9 Periods

Water as a global issue: Key challenges – Definition of IWRM within the broader context of development – Global and national perspectives of water crisis - Key elements of IWRM - Principles – Paradigm shift in water management - Complexity of the IWRM process – UN World Water Assessment - SDGs.

Unit – II	WATER ECONOMICS	9 Periods

Economic view of water issues: Economic characteristics of water good and services – Non-market monetary valuation – Water economic instruments – Private sector involvement in water resources management: PPP objectives, PPP models, PPP processes, PPP experiences through case studies.

Unit – III	LEGAL AND REGULATORY SETTINGS	9 Periods

Basic notion of law and governance: Principles of International and National law in the area of water management - Understanding UN law on non-navigable uses of International water courses - International law for groundwater management – World Water Forums – Global Water Partnerships - Development of IWRM in line with legal and regulatory framework: Case Studies

Unit – IV	WATER AND HEALTH WITHIN THE IWRM CONTEXT	9 Periods

Links between water and health: Options to include water management interventions for health – Health protection and promotion in the context of IWRM – Global burden of Diseases - Health impact assessment of water resources development projects – Case studies.

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Unit – V	AGRICULTURE IN THE CONCEPT OF IWRM	9 Periods
Water for food production: 'blue' versus 'green' water debate – Water foot print - Virtual water trade for achieving global water and food security - Climate Smart Agriculture - Current water pricing policy– Scope to relook pricing		

Total Periods: 45

Text Books:	1. Cech Thomas V., Principles of water resources: history, development, management and policy. John Wiley and Sons Inc., New York. 2003. 2. Mollinga .P. etal " Integrated Water Resources Management", Water in South Asia Volume I, Sage Publications, 2006
Reference Books:	1. Technical Advisory Committee, Integrated Water Resources management, Technical Advisory Committee Background Paper No: 4. Global water partnership, Stockholm, Sweden. 2002. 2.. Technical Advisory Committee, Dublin principles for water as reflected in comparative assessment of institutional and legal arrangements for Integrated Water Resources Management, Technical Advisory Committee Background paper Global water partnership, Stockholm, Sweden. 1999. 3. Technical Advisory Committee, Effective Water Governance". Technical Advisory Committee Background paper No: 7. Global water partnership, Stockholm, Sweden, 2003.
MOOC/Web Platforms:	https://nptel.ac.in/courses/105105214

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Describe the context and principles of IWRM; Compare the conventional and integrated ways of water management.	Understand (K2)
CO2	Select the best economic option among the alternatives; illustrate the pros and cons of PPP through case studies.	Understand (K2)
CO3	Apply law and governance in the context of IWRM	Apply (K3)
CO4	Discuss the linkages between water-health; develop a HIA framework	Understand (K2)
CO5	Analyze how the virtual water concept pave way to alternate policy options	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	3	–	2	2	3	3	3	2
CO2	2	2	2	2	2	2	3	2	3	3	3	3	2	3

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CO3	2	–	2	2	–	3	3	2	3	3	3	3	2	2
CO4	2	2	2	2	–	3	3	2	3	3	3	3	2	2
CO5	2	2	2	2	1	3	3	2	3	3	3	3	2	3
	2	1	2	2	1	3	3	2	3	3	3	3	2	2

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

VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓	✓	✓						✓	✓

I - Course Code & Name: 23PCE41 Urban Water Infrastructure

Prerequisite	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Civil Engineering	V/VI/VII	PCE	3	0	0	3

II - Course Objectives

1.	To impart knowledge on the fundamentals of water management in the context of urbanization.
2.	To develop skills in applying engineering principles to water supply systems.
3.	To provide an understanding of storm water management practices.
4.	To familiarize students with wastewater management methods and technologies.
5.	To expose students to regulations and best management practices in water management from around the world.

III - Course Content

Preamble: To impart knowledge and skills relevant to water management in the context of urbanization and relate engineering principles to water supply, storm water and wastewater management, along with related regulations and best management practices from around the world.

Unit – I	URBAN ECOSYSTEM	9 Periods
Cities as Ecological system – hybrid ecosystem – Resilience in urban ecosystem. Human components of Ecosystem – Urban pattern and Ecosystem function. Population and Community dynamics, functions of Urban Ecosystem		

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Unit – II	URBAN HYDROLOGY	9 Periods
The urban hydrological cycle – Function – Human induced changes in urban watershed – Hydrological calculation – design considerations, sanitary sewer design, design rainfall, frequency analysis, rational method, NRCS curve number method, Unit – hydrographs Runoff – Infiltration – hydrograph.		
Unit – III	**URBAN STORM WATERMANAGEMENT**	**9 Periods**
Design of Drainage System – Roadway Drainage Analysis – Types of inlet – inlet design – Design of storm drain - Storm water management regulations - structural storm management systems – Newer trends in storm water management (Green infrastructure) – installation – operation and maintenance		
Unit – IV	**WATER CONSERVATION AND REUSE**	**9 Periods**
Trends in supply and demand – indoor conservation – outdoor conservation – water reuse – Rainwater harvesting – public education		
Unit – V	**WATER GOVERNANCE**	**9 Periods**
Challenges in water sector - Institutional setting, Supply Management, Demand Management, Waste water management – Private sector participation, urban service delivery, customer satisfaction, financial resource management – case studies of best practices in cities across the world.		

Total Periods: 45

Text Books:	1. AnandChiplunkar, K Seetharam and CheonKheong (ed) (2012), "Good Practices in urban water management" ADB, National University Singapore. 2. Marina Alberti (2008), "Advances in Urban Ecology", SpringeR 3. Mohammad Karamouz, Ali Moridi, Sara Nazif (2010), Urban Water Engineering and Management, 1st Edition, CRC Press 4. Monzur A. Imteaz , (2019), Urban Water Resources, CRC Press
Reference Books:	1. HormozPazwash (2016), "Urban storm water management", CRC Press 2. Larry W. Mays, (2004), Urban Stormwater Management Tools, McGraw-Hill Companies 3. J Parkinson, O Mark (2005) Urban Stormwater Management in Developing Countries, IWA Publishing
MOOC/Web Platforms:	https://onlinecourses.nptel.ac.in/noc21_ar13/preview

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Explain various functional elements of urban ecosystem.	Understand (K2)

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CO2	Calculate urban runoff, compute supply and demand of water, draw hydrograph	Understand (K2)
CO3	Compare advantages of Newer techniques of green infrastructure and illustrate benefits	Apply (K3)
CO4	Assess the Operation and Maintenance needs of urban water systems	Understand (K2)
CO5	Propose best management practices for Indian context	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	3	1	3	–	–	–	–
CO2	3	3	3	–	–	–	–	3	1	3	–	–	3	–
CO3	3	3	2	–	2	–	–	3	2	3	–	–	3	–
CO4	2	2	2	3	–	2	2	3	1	3	2	2	3	2
CO5	2	1	1	3	–	2	2	3	–	3	2	2	3	2

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

VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓	✓	✓						✓	✓

I – Course Code & Name: 23PCE42 Water Quality and Management

Prerequisite	Program Name	Semester	Category	L	T	P	C
Water supply and Wastewater Engineering	B.E. -Civil Engineering	V/VI/VII	PEC	3	0	0	3

II - Course Objectives

1.	Understand the fundamentals of water quality models, their development, calibration, and verification.
2.	Analyze contaminant transport in surface and groundwater using advection, diffusion, and dispersion principles.
3.	Apply water quality modeling techniques for streams, lakes, and estuaries, including DO, BOD, COD, and pathogen modeling.

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4.	Develop and validate numerical groundwater flow and solute transport models, including seawater intrusion and organic compound degradation.
5.	Utilize modeling software (MIKE 21, WASP, QUAL2E, MODFLOW) for simulation, management, and restoration of water quality systems.

III - Course Content

Preamble: This course introduces students to the theoretical and practical aspects of water quality modeling. It integrates transport phenomena with surface and groundwater quality studies and exposes students to state-of-the-art modeling software for effective water resource management.

Unit – I	**MODELLING INSIGHTS MODELLING INSIGHTS**	**9 Periods**
Engineers and Mathematical models-Water quality models – historical development – different types of models— steps in model development – importance of model building.- calibration and verification of models- finite element, finite difference and finite volume methods		
Unit – II	**POLLUTION TRANSPORT**	**9 Periods**
Transport phenomena – advection, diffusion, dispersion- contamination transport in surface and subsurface water - Simple transport models –steady state and time variable solutions-conservation of mass, momentum and energy balance, governing equation for contaminant fate and transport		
Unit – III	**SURFACE WATER QUALITY MODELLING**	**9 Periods**
Water quality modeling of streams, lakes and estuaries – water quality– model sensitivity – assessing model performance; Models for dissolved oxygen, pathogens and COD, BOD-Streeter Phelp's model for point and distributed sources – modified streeter Phelp's equation.		
Unit – IV	**GROUNDWATER QUALITY MODELLING**	**9 Periods**
Groundwater flow and mass transport of solutes – groundwater quality modelling using numerical methods – Parameters, Input-output stresses, Initial and Boundary conditions- degradation of organic compounds in subsurface – Model calibration : steady state and unsteady state – sensitivity analysis – Model validation –seawater intrusion – basic concepts and modelling.		
Unit – V	**WATER QUALITY MANAGEMENT MODELS**	**9 Periods**
Exposure to surface water and groundwater quality modelling software's – MIKE 21, WASP, QUAL2E and MODFLOW – demonstration – case studies – Modeling multilayer groundwater flow system – Artificial recharge feasibility through modeling – Groundwater contamination, restoration and management.		

Total Periods: 45

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Text Books:	1. Chapra, S.C., Surface Water-Quality Modeling, 2nd Edition, Waveland Press, 2008. 2. Thomann, R.V. and Mueller, J.A., Principles of Surface Water Quality Modeling and Control, 2nd Edition, Harper & Row, 1987. 3. Chapra, S.C., Applied Water Quality Modeling, 2nd Edition, McGraw Hill, 2008. 4. Anderson, M.P., Woessner, W.W., Applied Groundwater Modeling: Simulation of Flow and Advective Transport, 2nd Edition, Academic Press, 1992. 5. Bennett, R. and Calver, A., Water Quality Modelling in the 21st Century, 1st Edition, CRC Press, 2016.
Reference Books:	1. Fetter, C.W., *Contaminant Hydrogeology*, 3rd Edition, Waveland Press, 2018. 2. Wang, L.K., Shammas, N.K., Hung, Y.T., *Handbook of Environmental Engineering Calculations*, 2nd Edition, McGraw Hill, 2004. 3. Zheng, C. and Bennett, G.D., *Applied Contaminant Transport Modeling*, 2nd Edition, Wiley-Interscience, 2002. 4. Chapra, S.C. and Pelletier, G.J., *Modeling Water Quality in Lakes and Reservoirs*, 1st Edition, Wiley, 2003.
MOOC/Web Platforms:	1. https://www.my-mooc.com/en/mooc/modelling-watershed-processes-for-water-resource-management 2. https://pacleanwateracademy.remotelearner.net/course/view.php?id=450&utm

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Explain the fundamentals of water quality models and the steps in model development.	Apply (K3)
CO2	Analyze contaminant transport in surface and groundwater using advection, diffusion, and dispersion concepts.	Apply (K3)
CO3	Apply modeling techniques for streams, lakes, and estuaries, including DO, BOD, COD, and pathogen dynamics.	Apply (K3)
CO4	Develop and calibrate groundwater flow and solute transport models using numerical methods.	Apply (K3)
CO5	Utilize software tools (MIKE 21, WASP, QUAL2E, MODFLOW) for simulation, case studies, and management of water quality 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	–	–	2	–	–	3	–
CO2	3	2	2	–	–	2	2	–	–	2	–	–	3	2
CO3	3	3	2	–	–	2	3	–	–	2	–	–	3	3
CO4	2	3	3	–	2	2	2	–	–	2	–	–	3	3
CO5	3	3	3	–	2	2	3	–	–	2	–	–	3	3

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

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VI – Teaching Pedagogies

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓			✓	✓		✓	✓	✓	

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OPEN ELECTIVES

I - Course Name: 23OCS01 Artificial Intelligence and Machine Learning Fundamentals

Prerequisite	Programme Name	Semester	Category	L	T	P	C
Basic Computer Knowledge	B.E – Common to ECE, EEE, Mech, Civil	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	To understand the fundamental concepts, history, and problem-solving strategies of Artificial Intelligence and Machine Learning, along with their real-world applications.
2.	To learn knowledge representation, logical inference, and probabilistic reasoning techniques for handling uncertainty in intelligent systems.
3.	To explore and apply various supervised machine learning algorithms for predictive modeling and data classification.
4.	To analyze and implement unsupervised learning techniques for clustering, dimensionality reduction, and anomaly detection.
5.	To examine real-world applications of AI and ML across domains and understand ethical, explainable, and operational aspects of intelligent systems.

III - Course Content

Unit – I	**Introduction to AI and ML**	**10 Periods**
Introduction to AI and ML – History and foundations of AI – Intelligent agents – Problem solving – Search strategies – Uninformed and informed search – Heuristic functions-Introduction to ML types (Supervised, Unsupervised, Reinforcement), Applications of AI in real-world domains.		
Unit – II	**Probabilistic Reasoning**	**8 Periods**
Knowledge representation and reasoning – Logic and inference – Propositional and predicate logic – Uncertainty – Bayes Theorem – Rule-based systems-Probabilistic graphical models (Bayesian networks), Fuzzy logic for reasoning.		
Unit – III	**Supervised Learning**	**9 Periods**
Machine Learning Algorithms – Linear regression, Logistic regression, KNN, Decision trees, Naive Bayes. Support Vector Machines, Ensemble methods (Bagging, Boosting)		
Unit – IV	**Unsupervised Learning**	**9 Periods**
Unsupervised Learning – Clustering techniques: K-means, Hierarchical, DBSCAN – Dimensionality reduction: PCA, LDA-Anomaly detection, Auto encoders.		
Unit – V	**AI and ML Applications**	**9 Periods**
AI and ML Applications – Natural Language Processing – Computer Vision – Robotics – Expert systems-AI ethics and governance, Explainable AI (XAI), ML Ops and deployment.		

TOTAL: 45 Periods

Text Books:	1. Stuart Russell and Peter Norvig, "Artificial Intelligence – A Modern Approach", Fourth Edition, Pearson Education, 2021. 2. Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, Fourth

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	Edition, 2020.
Reference Books:	1. Tom M. Mitchell, Machine Learning, McGraw Hill, 2022 2. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, O'Reilly, 2023 3. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press, 2021 4. Michael Negnevitsky, AI: A Guide to Intelligent Systems, Pearson, 2020 5. Ankur Taly et al., Explainable AI: Interpreting, Explaining and Visualizing Deep Learning, Springer, 2023
MOOC/Web Platforms:	https://nptel.ac.in/courses/106/106/106106126/

IV - Course Outcomes

On completion of the course, the students will be able to		**Bloom's Level Mapped**
CO1	Understand the principles and history of Artificial Intelligence and Machine Learning.	Understand (K2)
CO2	Apply logic and probabilistic reasoning for knowledge representation.	Apply (K3)
CO3	Apply machine learning algorithms for classification and regression.	Apply (K3)
CO4	Analyze unsupervised learning methods and dimensionality reduction.	Analyze (K4)
CO5	Apply AI/ML techniques in real-world applications and understand responsible AI practices.	Apply (K3)

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

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

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

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I - Course Name: 23OCS02 Fundamentals of Augmented Reality/Virtual Reality

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Basic Computer Knowledge	B.E – Common to ECE, EEE, Mech, Civil	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	To introduce the fundamental principles of Augmented Reality (AR) and Virtual Reality (VR).
2.	To understand the components, devices, and working mechanisms of immersive technologies.
3.	To gain basic knowledge of 3D visualization, modeling, and simulation concepts.
4.	To explore common toolkits, applications, and interaction techniques used in AR/VR.
5.	To study various applications, challenges, and future trends in AR/VR across engineering fields.

III - Course Content

Unit – I	**Introduction to AR and VR Technologies**	**9 Periods**
Overview of Virtual Reality (VR) and Augmented Reality (AR)-Concept of Immersion, Interaction, and Imagination-Difference between VR and 3D Computer Graphics-Benefits and Components of a VR System-Introduction to Immersive Technologies: AR, VR, MR, and XR-Basic Display Systems: Graphics Displays, 3D Trackers, and Sound Displays-Applications of AR/VR in Various Fields		
Unit – II	**Basics of 3D Visualization and Modeling**	**9 Periods**
Fundamentals of 3D Object Modeling-Transformation and Kinematics Basics-Overview of 3D Graphics and Game Engines-Object Hierarchies and Viewing the 3D World-Introduction to Physical Modeling and Collision Detection-Force Computation and Interaction Basics		
Unit – III	**AR/VR Tools and Interaction Methods**	**9 Periods**
Introduction to VR Programming and Toolkits-WorldToolKit and Java 3D Overview-Basics of Augmented Reality and Computer Vision Concepts-Interaction and Navigation in AR/VR Environments-Gesture Interfaces and Wearable Devices		
Unit – IV	**Case Studies and Emerging Trends**	**9 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		
Unit – V	**Applications and Future Scope**	**9 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.		

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TOTAL: 45 Periods

Text Books:	1. Grigore C. Burdea & Philippe Coiffet, *Virtual Reality Technology*, Wiley-IEEE Press, 2nd Edition, 2003. 2. Alan B. Craig, *Understanding Augmented Reality: Concepts and Applications*, Morgan Kaufmann, 2013
Reference Books:	1.Steven M. LaValle, Virtual Reality, Cambridge University Press, 2017. 2.Dieter Schmalstieg and Tobias Hollerer, Augmented Reality: Principles and Practice, Addison-Wesley, 2016. 3.Jason Jerald, The VR Book: Human-Centered Design for Virtual Reality, ACM Books, 2016
MOOC/Web Platforms:	https://nptel.ac.in/courses/106/106/106106138 https://onlinecourses.nptel.ac.in/noc25_cs87

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the fundamental concepts, principles, and scope of AR and VR technologies.	Understand (K2)
CO2	Identify and describe the key components, devices, and working mechanisms of AR/VR systems.	Apply (K3)
CO3	Explain the basics of 3D visualization, transformation, and object modeling in virtual environments.	Understand (K2)
CO4	Utilize AR/VR toolkits and interaction methods to explore immersive technologies and user interfaces.	Apply (K3)
CO5	Analyze real-world applications, ethical issues, and emerging trends of AR/VR across different engineering domains.	Analyze (K4)

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

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

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

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I - Course Name: 23OCS03 Data Science Fundamentals

Prerequisite	Programme Name	Semester	Category	L	T	P	C
Basic Computer Knowledge	B.E – Common to ECE, EEE, Mech, Civil	V/VI/VII	OEC	3	0	0	3

II – Course Objectives

1.	Apply core Python and data manipulation libraries to clean, preprocess, and transform data.
2.	Analyze and visualize data using statistical and graphical methods to derive insights.
3.	Develop machine learning models for classification, regression, and clustering tasks.
4.	Handle large-scale datasets efficiently using distributed tools like PySpark and cloud platforms.
5.	Present analytical findings through dashboards, reports, and interactive visualizations

III – Course Content

Unit – I	**Introduction**	**9 Periods**
Data Science: Benefits and uses – facets of data – Data Science Process: Overview – Defining research goals – Retrieving data – data preparation – Exploratory Data analysis – build the model – presenting findings and building applications – Data Mining – Data Warehousing – Basic statistical descriptions of Data.		
Unit – II	**Data Manipulation**	**9 Periods**
Python Shell – Jupyter Notebook – NumPy Arrays – Universal Functions – Aggregations – Computation on Arrays – Fancy Indexing – Sorting arrays – Structured data – Data manipulation with Pandas – Data Indexing and Selection – Handling missing data – Hierarchical indexing – Combining datasets – Aggregation and Grouping – String operations – Working with time series – Data cleaning pipelines – Introduction to Polars.		
Unit – III	**Machine Learning**	**9 Periods**
The modeling process – Types of machine learning – Supervised learning – Unsupervised learning – Semi-supervised learning – Classification – Regression – Clustering – Outliers and Outlier Analysis – Feature engineering and selection – Model evaluation metrics.		
Unit – IV	**Data Visualization**	**9 Periods**
Importing Matplotlib – Simple line plots – Scatter plots – Density and contour plots – Histograms – Legends – Colors – Subplots – Text and annotation – Customization – Three-dimensional plotting – Geographic visualization with Plotly – Visualization with Seaborn – Interactive dashboards with Plotly and Streamlit.		
Unit – V	**Handling Large Data**	**9 Periods**
Problems with large data – Techniques for handling large datasets – Programming tips for large data – Predicting malicious URLs (case study) – Recommender system (case study) – Tools and techniques needed – Research question – Data preparation – Model building – Model monitoring and automation – Scalable ML using PySpark – Working with cloud-based data platforms (e.g., AWS, BigQuery).		

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TOTAL: 45 Periods

Text Books:	1.David Cielen, Arno D. B. Meysman, and Mohamed Ali, "Introducing Data Science", Manning Publications, 2016. (Unit I)
Reference Books:	1. Robert S. Witte and John S. Witte, "Statistics", Eleventh Edition, Wiley Publications, 2017. (Units II and III)69 2. Jake VanderPlas, "Python Data Science Handbook", O'Reilly, 2016. (Units IV and V)
MOOC/Web Platforms:	https://nptel.ac.in/courses/106/106/106106179/

IV – Course Outcomes

On completion of the course, the students will be able to		**Bloom's Level Mapped**
CO1	Apply core Python and data manipulation libraries to clean, preprocess, and transform data.	Apply (K3)
CO2	Analyze and visualize data using statistical and graphical methods to derive insights.	Analyze (K4)
CO3	Apply machine learning models for classification, regression, and clustering tasks.	Apply (K3)
CO4	Handle large-scale datasets efficiently using distributed tools like PySpark and cloud platforms.	Apply (K3)
CO5	Present analytical findings through dashboards, reports, and interactive visualizations	Apply (K3)

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

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

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

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I – Course Name: 23OCS04 Introduction to Data Structures using Python

Prerequisite	Programme Name	Semester	Category	L	T	P	C
Basic Computer Knowledge	B.E – Common to ECE, EEE, Mech, Civil	V/VI/VII	OEC	3	0	0	3

II – Course Objectives

1.	Apply core Python and data manipulation libraries to clean, preprocess, and transform data.
2.	Analyze and visualize data using statistical and graphical methods to derive insights.
3.	Develop machine learning models for classification, regression, and clustering tasks.
4.	Handle large-scale datasets efficiently using distributed tools like PySpark and cloud platforms.
5.	Present analytical findings through dashboards, reports, and interactive visualizations

III – Course Content

Unit – I	Abstract Data Types	9 Periods
Data Abstraction: Data Representation – Types of Data Structures – Abstract Data Type ADTs and classes – introduction to OOP – classes in Python – inheritance – namespaces – shallow and deep copying Introduction to analysis of algorithms – asymptotic notations-The Big-O, Omega and Theta notation- Optimizing for optimistic scenarios – Trade- offs between Time and Space		
Unit – II	**Linear Structures**	**9 Periods**
Linear ADTs: List – Stack – Queue – Circular Queue – Linked List – Singly Linked List, Doubly Linked List, Circular Linked List -Applications- Expression evaluation, Scheduling Algorithms, Polynomial Evaluation, Josephus Problem		
Unit – III	**Sorting and Searching**	**9 Periods**
Bubble sort – selection sort – insertion sort – merge sort – quick sort- Radix sort, Bitonic sort, Cocktail sort, Medians and Order Statistics- Minimum and maximum, Selection in expected linear time, Selection in worst-case linear time, linear search, Interpolation search, Exponential search.		
Unit – IV	**Tree Structures**	**9 Periods**
Binary trees- Properties of Binary trees, B-tree, B-Tree definition- Operations on B-Tree: Searching a B-tree, Creating, Splitting, Inserting and Deleting, B+-tree. Threaded binary trees, Leftist trees, Tournament trees, 2-3 tree, Splay tree, Red-black trees, Range trees. Heaps as priority queues, Binary heaps, binomial and Fibonacci heaps, Heaps in Huffman coding, Extendible hashing.		
Unit – V	**Graph Structures**	**9 Periods**
Representation of graphs, Topological sorting, Shortest path algorithms- Dijkstra's algorithm, Floyd-Warshall algorithm, Minimum spanning trees – Reverse delete algorithm, Boruvka's algorithm.		

TOTAL: 45 Periods

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Text Books:	1.Michael T. Goodrich, Roberto Tamassia, and Michael H. Goldwasser, "Data Structures & Algorithms in Python", An Indian Adaptation, John Wiley & Sons Inc., 2021
Reference Books:	1.Lee, Kent D., Hubbard, Steve, "Data Structures and Algorithms with Python" Springer Edition 2015 2.Rance D. Necaise, "Data Structures and Algorithms Using Python", John Wiley & Sons, 2011 3.Aho, Hopcroft, and Ullman, "Data Structures and Algorithms", Pearson Education, 1983. 4.Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, "Introduction to Algorithms", Second Edition, McGraw Hill, 2002.
MOOC/Web Platforms:	https://nptel.ac.in/courses/106106145/

IV – Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Apply core Python and data manipulation libraries to clean, preprocess, and transform data.	Apply (K3)
CO2	Analyze and visualize data using statistical and graphical methods to derive insights.	Analyze (K4)
CO3	Apply machine learning models for classification, regression, and clustering tasks.	Apply (K3)
CO4	Handle large-scale datasets efficiently using distributed tools like PySpark and cloud platforms.	Apply (K3)
CO5	Present analytical findings through dashboards, reports, and interactive visualizations	Apply (K3)

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

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

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

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I – Course Name: 23OCS05 IoT Concepts and Applications

Prerequisite	Programme Name	Semester	Category	L	T	P	C
Basic Computer Knowledge	B.E – Common to ECE, EEE, Mech, Civil	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	Understand IoT fundamentals, ecosystem, and evolution.
2.	Understand IoT communication protocols, standards, and middleware.
3.	Learn about IoT network topologies, communication technologies, and cloud integration.
4.	Explore data analytics and AI in IoT applications.
5.	Understand security, ethics, and real-world IoT applications.

III - Course Content

Unit – I	**Foundations of IoT History and Evolution of IoT**	**10 Periods**
IoT Ecosystem & Layers: Perception, Network, Middleware, Application - IoT Design Goals, Challenges, and Future Directions - Architectures: oneM2M, IoT World Forum (IoTWF), Fog & Edge Computing - Functional Blocks of IoT Systems - Smart Objects: Sensors, Actuators, Embedded Systems Mini Project Idea: Build a "Thing" using basic sensors and Arduino to demonstrate environmental data collection.		
Unit – II	**Protocols, Standards and Middleware**	**8 Periods**
Need for Middleware in IoT - RFID, WSN, SCADA, M2M Middleware Architectures - IoT Access Technologies: IEEE 802.15.4, LoRaWAN, NB-IoT - Communication Protocols: MQTT, CoAP, HTTP vs CoAP - Protocol Stack Overview: 6LoWPAN, RPL, 6TiSCH - Interoperability and Resource Management		
Unit – III	**Communication and Networking for IoT**	**9 Periods**
IoT Network Topologies: Star, Mesh, Cluster - LPWAN vs WPAN: LoRa, Sigfox, Zigbee, BLE - IPv6, 6LoWPAN, and addressing in Constrained Devices - Routing in IoT: RPL, Mobility Support - Application Layer Communication: Data Aggregation, Dissemination - Cloud Platforms: AWS IoT Core, ThingSpeak Hackathon Task: Design a networked system for smart traffic control using simulated nodes.		
Unit – IV	**Data Analytics and AI in IoT**	**9 Periods**
Data Lifecycle in IoT: Collection to Visualization - Real-time Analytics and Edge AI - Data Cleaning, Storage (Cloud vs Edge), and Processing - Machine Learning in IoT: Supervised vs Unsupervised - AI Tools: TensorFlow Lite, TinyML - Big Data Tools: Apache Kafka, Spark Streaming Lab Task: Train a TinyML model on microcontroller to detect gestures or anomalies in sensor data.		
Unit – V	**Security, Ethics and Applications**	**9 Periods**
Cybersecurity Challenges in IoT - Secure Communication, Authentication, and Data Privacy - Legal, Ethical, and Environmental Concerns - Real-World Applications: - Smart Cities & Grids - Precision Agriculture - Healthcare Monitoring - Industrial IoT- Smart Retail		

TOTAL: 45 Periods

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Text 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
Reference Books:	1. Pethuru Raj, "The Internet of Things: Enabling Technologies..." 2. Arshdeep Bahga, Vijay Madisetti, "IoT: A Hands-on Approach"
MOOC/Web Platforms:	**Online tools:** Blynk, Node-RED, Firebase, Azure IoT Hub **Hardware:** ESP32, NodeMCU, Raspberry Pi, DHT11, PIR sensors

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand IoT fundamentals, ecosystem, and evolution.	Understand (K2)
CO2	Understand IoT communication protocols, standards, and middleware.	Understand (K2)
CO3	Apply IoT network topologies, communication technologies, and cloud integration.	Apply (K3)
CO4	Explore data analytics and AI in IoT applications.	Analyze (K4)
CO5	Understand security, ethics, and real-world IoT applications.	Understand (K2)

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

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

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

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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 Outcomes

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 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	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

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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 Outcomes

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)

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	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

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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 Outcomes

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 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	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

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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 Outcomes

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 microcontroller's 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 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	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

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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

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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 Outcomes

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 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	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		

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Compression Techniques (JPEG, Transform Coding), Basics of Video Compression (MPEG) Feature Extraction (SIFT, SURF, HOG), Pattern Recognition Basics

TOTAL: 45 Periods

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 Outcomes

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 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	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

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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 Outcomes

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 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	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

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I - Course Name: 223OEC08 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 Inductance 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 Outcomes

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 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	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

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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:		

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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

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 Outcomes

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 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	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

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I - Course Name: 23OEC10 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 to Wireless Sensor Networks	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 –		

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Power-aware MAC and Routing, Battery and Transmission Management Trade-offs Between QoS and Energy Efficiency.

TOTAL: 45 Periods

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 Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Design solutions for WSNs applications.	Apply (K3)
CO2	Develop efficient MAC and Routing Protocols.	Analyze (K4)
CO3	Design solutions for 6LOWPAN applications.	Apply (K3)
CO4	Develop efficient layered protocols in 6LOWPAN.	Analyze (K4)
CO5	Use Tiny OS and Contiki OS in WSNs and 6LOWPAN applications.	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	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

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I- Course Name: 23OEE01 AI with MATLAB

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

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

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

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	and Artificial Intelligence: A practical guide for AI and deep learning with MATLAB, Apress, 2017.
MOOC/Web Platforms:	1. MATLAB Official Documentation (AI & ML Toolboxes) https://www.mathworks.com/products/artificial-intelligence.html 2. MATLAB Tutorials and Examples (MathWorks) https://www.mathworks.com/learn/tutorials/matlab-onramp.html 3. AI Projects in MATLAB – File Exchange https://www.mathworks.com/matlabcentral/fileexchange/ 4. Coursera – Introduction to AI with MATLAB https://www.coursera.org/learn/ai-for-everyone 5. MATLAB and Simulink Training – MathWorks https://www.mathworks.com/services/training.html

IV-Course Outcomes

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 Vs POs/ PSOs	PO1	PO2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
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

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I - Course Name: 23OEE02 Applied Soft Computing

Prerequisite	Programme Name	Semester	Category	L	T	P	C
Basic Programming	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 Outcomes

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 Vs POs/ PSOs	PO1	PO2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
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

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I - Course Name: 23OEE03 Electric Vehicle Technology

Prerequisite	Programme Name	Semester	Category	L	T	P	C
Basic Programming	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**

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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

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 Outcomes

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 ar inverters.	Analyze (K4)
CO5	Apply the fundamentals of vehicle mechanics to evaluate energy requirements and hybrid electric vehicles.	Apply (K3)

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

COs Vs POs/ PSOs	PO1	PO2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
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

I- Course Name: 23OEE04 Electrical Safety

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		

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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

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 Outcomes

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)

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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 Vs POs/ PSOs	PO1	PO2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
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

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,

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	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

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 and Gregory K. Krumdick, "Recycling of Electronic Waste II", Wiley 2011. 5. Fowler B, Electronic Waste – 1st Edition (Toxicology and Public Health Issues), 2017Elsevier
MOOC/Web Platforms:	https://news.mit.edu/2013/ewaste-mit

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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 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 Vs POs/ PSOs	PO1	PO2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
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

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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		

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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

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, Newness, New Delhi, "Industrial Control Handbook",3rd Edition, 2000.

IV - Course Outcomes

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 usir timers, counters, arithmetic, and logic instructions.	Analyze (K4)
CO5	Analyze the advanced PLC logic solutions for real- world industrial automation problems	Analyze (K4)

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

COs Vs POs/ PSOs	PO1	PO2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
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

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,		

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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

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:	1. NPTEL (National Programme on Technology Enhanced Learning) 2. Coursera (e.g., Energy Production, Distribution & Safety) 3. edX (e.g., Smart Grids, Control Systems)

IV - Course Outcomes

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)

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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 Vs POs/ PSOs	PO1	PO2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
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

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.

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III- Course Content

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.		
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,

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	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:	1. https://archive.nptel.ac.in/courses/112/104/112104298/ 2. Introduction to Robotics IIT Kanpur Prof. T.Asokan

IV-Course Outcomes

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.	Analyse (K4)
CO5	Design and implement trajectory planning and control schemes for robotic manipulators in both joint and Cartesian spaces.	Analyse (K4)

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

COs Vs POs/ PSOs	PO1	PO2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
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

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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

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 Inductance 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 Outcomes

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)

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

COs Vs POs/ PSOs	PO1	PO2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
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

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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

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.		

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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

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.
References	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 Outcomes

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)

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V-Mapping Table Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO1	PO2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
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

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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 analyze 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 utilize 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 & Usage: 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.
REFERENCES	[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 Outcomes

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 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	-	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	-	-

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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	8 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**	**8 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**	**10 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**	**10 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.		

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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

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 Outcomes

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)

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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	-	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

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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
REFERENCES	[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 Outcomes

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 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	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

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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		

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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 – 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:	NPTEL Videos: https://onlinecourses.nptel.ac.in/noc20_me92/preview https://nptel.ac.in/courses/107106090

IV - Course Outcomes

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)

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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)

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	-	-
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

I–Course Name: 23OME05 Industrial Design & Rapid Proto Typing 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.

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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

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. Schmid Pearson Education
MOOC/Web Platforms:	NPTEL Videos: https:// nptel/courses/video/112105126/L01.html

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IV - Course Outcomes

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 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	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

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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	**FUNCTIONS OF MANAGEMENT**	**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,		

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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 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
References	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 Outcomes

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)

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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	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

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		

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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

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: ONLINE RESOURCES	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

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	https://law.resource.org/pub/in/bis/S02/is.15656.2006.pdf

IV - Course Outcomes

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)

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	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

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I–Course Name: 23OME08 Introduction to Industrial Automation Systems

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 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**

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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

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 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	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

I–Course Name: 23OME09 Introduction to Non- Destructive Testing

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.	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		

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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 – 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.

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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:	NPTEL Videos: 1. https://nptel.ac.in/courses/113106070 2. https://onlinecourses.nptel.ac.in/noc25_mm29/preview

IV - Course Outcomes

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)

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	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

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I–Course Name: 23OME10 Mechatronics

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 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- Overview, Siemens PLC, Allen Bradley PLC, Schneider electric PLC, Omron PLC, Mitsubishi PLC. Their comparison of various instructions. PLC Applications.		
Unit – V	**Actuators and Mechatronics System Design**	**9 Periods**

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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

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:	1. nptel.ac.in/courses/112107298

IV - Course Outcomes

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 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	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

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I – Course Name: 23OME11 Nanomaterials and applications

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.	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 characterization techniques employed to characterize 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

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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.
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/

IV - Course Outcomes

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 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	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

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I–Course Name: 23OME12 Nano 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 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**	**8 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**	**8 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**	**10 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**	**10 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		

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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

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 Outcomes

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 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	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

I–Course Name: 23OME13 Operation 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.	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.

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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

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,

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	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:	1. nptel.ac.in/courses/108102191

IV - Course Outcomes

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)

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	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

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I–Course Name: 23OME14 Production Planning and Control

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 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**

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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.		
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:	NPTEL Videos: https:// nptel/courses/video/112105126/L01.html

IV - Course Outcomes

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)

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CO5	Plan Manufacturing Requirement Planning (MRP II) and Enterprise Resource Planning (ERP).	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	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

I–Course Name: 23OME15 Quality Engineering

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, 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.

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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 Process Control**	**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
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:	NPTELVideos: https://www.mooc-list.com/course/quality-engineering-management-edx / https://onlinecourses.nptel.ac.in/noc21_mg24

IV - Course Outcomes

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)

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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 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	-	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

I–Course Name: 23OME16 Sustainable Manufacturing

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.	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

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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

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

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	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:	NPTEL Videos: https:// nptel/courses/video/112105126/L01.html

IV - Course Outcomes

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)

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	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

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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	9 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**	**9 Periods**
Rings - Polynomial rings - Irreducible polynomials over finite fields - Factorization of polynomials over finite fields.		
Unit III	**Divisibility Theory and Canonical Decompositions**	**9 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**	**9 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**	**9 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 Outcomes

On completion of the course, the students will be able to		Blooms 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 (K2)
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)

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	3	2	2	-	-	-	-	2	-	-	2	-	-
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	-	-

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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	9 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**	**9 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**	**9 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**	**9 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**	**9 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 Outcomes

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 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	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

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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

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	1. Bernard Kolman, David R. Hill, Introductory Linear Algebra, Pearson

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Books	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 Outcomes

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)

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	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

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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 o 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, Pearsor 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?utm_source=chatgpt.com https://www.youtube.com/watch?v=Q31jKiEXxdc&utm_source=chatgpt.com www.digimat.in/nptel/courses/video/110104073/L21.html?utm_source=chatgpt.com https://nptel.ac.in/courses/117103017?utm_source=chatgpt.com https://onlinecourses.nptel.ac.in/noc19_ge32/preview?utm_source=chatgpt.com

IV - Course Outcomes

Upon 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 (K 3)
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)

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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	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

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.		

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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

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 Publishing Company Ltd., New Delhi, 1983.
MOOC/Web Platforms:	1. https://www.classcentral.com/course/youtube-electronics-probability-random-variables-47668?utm_source=chatgpt.com 2. https://onlinecourses.nptel.ac.in/noc21_ee93/preview?utm_source=chatgpt.com 3. https://onlinecourses.nptel.ac.in/noc21_ee93/preview?utm_source=chatgpt.com 4. https://onlinecourses.nptel.ac.in/noc21_ce58/preview?utm_source 5. https://onlinecourses.nptel.ac.in/noc21_ce58/preview?utm_source

IV - Course Outcomes

Upon 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 (K 3)
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)

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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	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

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 understand and solve project management problems.

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		

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Unit – V	Object Scheduling	9 Periods
Network diagram representation – Critical path method – Time charts and resource leveling – PERT.		

TOTAL:45 Periods

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 Outcomes

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 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	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

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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		

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oral presentation Telling a story or a personal anecdote - Talking about oneself Utterance Speech acts- Brainstorming ideas - Group discussion.

TOTAL:45 Periods

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.
Web Source	http://www.examenglish.com/, 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 Outcomes

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 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
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CO2	-	-	-	-	-	-	-	-	2	3	-	2	-	-
CO3	-	-	-	-	-	-	-	-	2	3	-	2	-	-
CO4	-	-	-	-	-	-	-	-	2	3	-	2	-	-
CO5	-	-	-	-	-	-	-	-	2	3	-	2	-	-

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

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**

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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
Books for study & Reference:	• Gerson and Gerson-Technical Communication: Process and Product, 7th Edition, Prentice Hall (2012) • Virendra K. Pamecha - Guide to Project Reports, Project Appraisals and Project Finance (2012) • Daniel Riordan - Technical Report Writing Today (1998) • 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	

IV - Course Outcomes

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 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
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CO2	-	-	-	-	-	-	-	-	2	3	-	2	-	-
CO3	-	-	-	-	-	-	-	-	2	3	-	2	-	-
CO4	-	-	-	-	-	-	-	-	2	3	-	2	-	-
CO5	-	-	-	-	-	-	-	-	2	3	-	2	-	-

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

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