NATIONAL ENGINEERING COLLEGE

(An Autonomous Institution Affiliated to Anna University Chennai)

K.R. NAGAR, KOVILPATTI

www.nec.edu.in

REGULATIONS – 2023

CURRICULUM & SYLLABUS

B. E. CIVIL ENGINEERING

(Outcome Based Education & Choice Based Credit System)

DEPARTMENT OF CIVIL ENGINEERING

I. VISION

Producing outstanding civil engineering professionals with human values to face future challenges

II. MISSION

- To provide with excellent teaching and research ambience.
- To prepare student for leadership roles in civil engineering.
- To facilitate student with lifetime skills and human values.
- To collaborate with industries to meet the ever-challenging environment

III. PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO 1: Apply Civil engineering knowledge for sustainable practices

PEO 2: Exhibit leadership skills to solve societal problems through teamwork.

PEO 3: Pursue lifelong learning and professional development to address emerging challenges.

IV. PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO 1: Apply technical Skills learnt through professional society events, certification programs, projects and/or lab exercise to provide sustainable solutions to civil engineering and business systems related to society and environment.

PSO 2: Apply their fundamental knowledge to crack state and national level competitive Examinations to have a successful career in public sectors.

V. PROGRAM OUTCOMES (POs)

PO 1: **Apply knowledge of mathematics, natural science, computing and engineering fundamentals**, and an engineering specialization to develop solutions to complex engineering problems

PO 2: Identify, formulate, research literature and analyze **complex engineering problems** reaching substantiated conclusions using **first principles** of mathematics, natural sciences and engineering sciences with holistic considerations for sustainable development

PO 3: **Design creative solutions** for **complex engineering problems** and design systems, components or processes to meet identified needs with appropriate consideration for public health and safety, whole-life cost, net zero carbon as well as resource, cultural, societal, and environmental considerations as required

PO 4: Conduct **investigations** of **complex engineering problems** using research methods including **research-based knowledge, design of experiments, analysis and interpretation of data, and synthesis of information** to provide valid conclusions

PO 5: **Create, select and apply, and recognize** limitations of appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to **complex engineering problems**

PO 6: When solving complex engineering problems, analyze and evaluate sustainable development impacts to: society, the economy, sustainability, health and safety, legal frameworks, and the environment

PO 7: Apply ethical principles and commit to professional ethics and norms of engineering practice and adhere to relevant national and international laws. Demonstrate an understanding of the need for diversity and inclusion

PO 8: Function effectively as an individual, and as a member or leader in diverse and inclusive teams and in multi-disciplinary, face-to-face, remote and distributed settings

PO 9: Communicate effectively and inclusively 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, taking into account cultural, language, and learning differences

PO10: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments

PO11: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change

REGULATIONS 2023

CURRICULUM AND SYLLABUS

SEMESTER - I

S. No	Course Code	Course Title	Category	Periods Per Week				Total Contact Periods	Credits
				L	T	P	E		
Induction Programme – 2 weeks									**0**
Theory Courses									
1.	23SH11C	தமிழர்மரபு/ Heritage of Tamils	HSMC	1	0	0	0	1	1
2.	23SH12C	Mathematical Foundation for Engineers	BSC	3	1	0	0	4	4
3.	23SH13C	Introduction to Engineering	ESC	1	0	0	0	1	1
Integrated Courses									
4.	23SH14C	Technical English	HSMC	1	0	2	0	3	2
5.	23SH15C	Engineering Physics	BSC	2	0	2	0	4	3
6.	23SH16C	Engineering Chemistry	BSC	2	0	2	0	4	3
7.	23ME11C	Engineering Graphics	ESC	2	0	4	0	6	4
8.	23EE13C	Fundamentals of Electrical and Electronics Engineering	ESC	3	0	2	0	5	4
			TOTAL	**15**	**1**	**12**	**0**	**28**	**22**

SEMESTER – II

S. No	Course Code	Course Title	Category	Periods Per Week				Total Contact Periods	Credits
				L	T	P	E		
Theory Courses									
1.	23SH21C	தமிழரும்தொழில்நுட்பமும்/ Tamils & Technology	HSMC	1	0	0	0	1	1
2.	23GN01C	Aptitude Essentials	EEC	1	0	0	0	1	1
3.	23CE21C	Fourier Series, Complex Analysis and Calculus	BSC	3	1	0	0	4	4
4.	23CE22C	Environmental Science and sustainability	BSC	2	0	0	0	2	2
5.	23CE23C	Engineering Mechanics	ESC	3	1	0	0	4	4
Integrated Courses									
6.	23SH22C	Professional English	HSMC	1	0	2	0	3	2
7.	23CS11C	Problem solving Techniques	ESC	3	0	2	0	5	4
8.	23CE24C	Building Materials	PCC	3	0	0	2	5	4
Practical Courses									
9.	23GN02C	Innovation through Design Thinking	EEC	0	0	0	4	4	2
			TOTAL	**17**	**2**	**4**	**6**	**29**	**24**

SEMESTER – III

S. No	Course Code	Course Title	Category	Periods Per Week				Total Contact Periods	Credits
				L	T	P	E		
Theory Courses									
1.	23CE31C	Fluid Mechanics	ESC	3	1	0	0	4	4
2.	23CE32C	Biology for Engineers	BSC	3	0	0	0	3	3
3.	23CE33C	Statistics and Numerical methods	BSC	3	1	0	0	4	4
4.	23GN05C	Professional Ethics and Human values	HSMC	2	0	0	0	2	2
Integrated Courses									
5.	23CE34C	Solid Mechanics	PCC	3	0	2	0	5	4
6.	23CE35C	Surveying	PCC	3	0	2	0	5	4
7.	23CE36C	Building planning and Drawing	PCC	1	0	0	2	3	2
Practical Courses									
8.	23GN03C	Intellectual property Rights study	EEC	0	0	2	2	4	2
9.	23GN04C	Aptitude Excellence	EEC	0	0	2	0	2	1
			TOTAL	**18**	**2**	**8**	**4**	**32**	**26**

SEMESTER – IV

S. No	Course Code	Course Title	Category	Periods Per Week				Total Contact Periods	Credits
				L	T	P	E		
Theory Courses									
1.	23CE41C	Strength of Materials	PCC	3	0	0	0	3	3
2.	23CE42C	Water Supply Engineering	PCC	3	0	0	0	3	3
3.	-	Program Elective Course - I	PEC	3	0	0	0	3	3
4.	-	Open Elective Course – I	OEC	3	0	0	0	3	3
Integrated Courses									
5.	23CE43C	Hydraulics and Hydraulic machines	PCC	3	0	2	0	5	4
6.	23CE44C	Concrete Technology	PCC	3	0	2	0	5	4
7.	23CE45C	Soil Mechanics	PCC	3	0	2	0	5	4
Practical Courses									
8.	23CE46C	System Modeling Projects	PCC	0	0	2	2	4	2
Mandatory courses									
9.	23MC01C	Constitution of India	MAC	2	0	0	0	2	0
			TOTAL	**23**	**0**	**8**	**2**	**33**	**26**

SEMESTER – V

S. No	Course Code	Course Title	Category	Periods Per Week				Total Contact Periods	Credits
				L	T	P	E		
Theory Courses									
1.	23CE51C	Structural Analysis	PCC	3	1	0	0	4	4
2.	23CE52C	Design of Reinforced Concrete Elements	PCC	3	0	0	0	3	3
3.	23CE53C	Foundation Engineering	PCC	3	0	0	0	3	3
4.	-	Program Elective Course - II	PEC	3	0	0	0	3	3
Integrated Courses									
5.	23CE54C	Wastewater Engineering	PCC	3	0	2	0	5	4
6.	23CE55C	Highway Engineering	PCC	3	0	2	0	5	4
Practical Courses									
7.	23CE56C	Design and Detailing Laboratory	EEC	0	0	2	2	4	2
8.	23CE57C	Simulation using modern tools	EEC	0	0	2	2	4	2
			TOTAL	**18**	**1**	**8**	**4**	**31**	**25**

SEMESTER –VI

S. No	Course Code	Course Title	Category	Periods Per Week				Total Contact Periods	Credits
				L	T	P	E		
Theory Courses									
1.	23CE61C	Construction Engineering and Management	PCC	3	0	0	0	3	3
2.	23CE62C	Design of Steel Structures	PCC	3	0	0	0	3	3
3.	23CE63C	Water Resources and Irrigation Engineering	PCC	3	0	0	0	3	3
4.	-	Program Elective Course - III	PEC	3	0	0	0	3	3
5.	-	Program Elective Course - IV	PEC	3	0	0	0	3	3
6.	-	Open Elective Course - II	OEC	3	0	0	0	3	3
Practical Courses									
7.	23CE64C	Estimation and costing Lab		1	0	2	0	3	2
8.	23CE65C	Product Development Practice	EEC	0	0	2	2	4	2
Mandatory courses									
9.	23MC03C	Indian Culture and Heritage	MAC	2	0	0	0	2	0
			TOTAL	**21**	**0**	**4**	**2**	**27**	**22**

SEMESTER –VII

S. No	Course Code	Course Title	Category	Periods Per Week				Total Contact Periods	Credits
				L	T	P	E		
Theory Courses									
1.	23GN06C	Project management and Finance	HSMC	2	0	0	0	2	2
2.	-	Program Elective Course - V	PEC	3	0	0	0	3	3
3.	-	Program Elective Course - VI	PEC	3	0	0	0	3	3
4.	-	Open Elective Course - III	OEC	3	0	0	0	3	3
Practical Courses									
5.	23CE71C	Mini Project	EEC	0	0	0	6	6	3
6.	23CE72C	Internship	EEC	-	-	-	-	-	2
			TOTAL	**11**	**0**	**0**	**6**	**17**	**16**

SEMESTER –VIII

S. No	Course Code	Course Title	Category	Periods Per Week				Total Contact Periods	Credits
				L	T	P	E		
Practical Courses									
1.	23CE81C	Capstone Project / Industry Practice	EEC	0	0	0	12	12	6
			TOTAL	**0**	**0**	**0**	**12**	**12**	**6**

Total No. of Credits: 167

CATEGORY OF COURSES

Category	I Sem.	II Sem.	III Sem.	IV Sem.	V Sem.	VI Sem.	VII Sem.	VIII Sem.	Credits	Percentage of credits
HSMC	3	3	2				2		**10**	**6**
BSC	10	6	7						**23**	**14**
ESC	9	8	4						**21**	**13**
PCC		4	10	18	19	12			**63**	**38**
PEC				3	3	6	6		**18**	**11**
OEC				3		3	3		**9**	**5**
EEC		3	3		4	2	5	6	**23**	**14**
Total	**22**	**24**	**26**	**24**	**26**	**23**	**16**	**6**	**167**	

Verticals
(Program Electives to be opted under the Verticals)

Vertical I (Structures)	Vertical II (Environment)	Vertical III (Geotechnical and Transportation)	Vertical IV (Diversified)
Pre-stressed Concrete Structures	Municipal Solid Waste Management	Ground Improvement Techniques	Digital Surveying & Photogrammetry
Prefabricated structures	Industrial Waste Management	Earthquake Geotechnical Engineering	Smart Cities
Design of Reinforced concrete and Brick Masonry structures	Air and Noise pollution control Engineering	Geo-Environmental Engineering	Energy Efficient Buildings
Finite Element Techniques	Environment policy and legislations	Earth and Earth Retaining Structures	Sustainable Construction Management
Computer Aided Design of structures	Hydrology	Traffic Engineering and Management	Remote Sensing and GIS
Advanced Structural Analysis	Environment Impact Assessment	Pavement Engineering	Sustainable Construction and Lean Construction
Design of steel concrete composite structures	Climate change Adaptation mitigation and management	Transportation planning process	Repair and Rehabilitation of structures
Advanced steel structures	Soil Pollution Engineering	Urban Planning and Development	BIM and 3D Printing Application
Basics of Dynamics and Aseismic design	Environment, health and safety	Intelligent Transport Systems	Railways, Airports and Harbour Engineering

Program Elective Courses

S. No	Course Code	Course Title	Category	Periods Per Week				Total Contact Periods	Credits
				L	T	P	E		
Vertical - Structures									
1.	23CE01E	Prestressed Concrete Structures	PEC	3	0	0	0	3	3
2.	23CE02E	Prefabricated structures	PEC	3	0	0	0	3	3
3.	23CE03E	Design of Reinforced concrete and Brick Masonry structures	PEC	3	0	0	0	3	3
4.	23CE04E	Finite Element Techniques	PEC	3	0	0	0	3	3
5.	23CE05E	Computer Aided Design of structures	PEC	3	0	0	0	3	3
6.	23CE06E	Advanced Structural Analysis	PEC	3	0	0	0	3	3
7.	23CE07E	Design of steel concrete composite structures	PEC	3	0	0	0	3	3
8.	23CE08E	Advanced steel structures	PEC	3	0	0	0	3	3
9.	23CE09E	Basics of Dynamics and Aseismic design	PEC	3	0	0	0	3	3
Vertical - Environment									
10.	23CE10E	Municipal Solid Waste Management	PEC	3	0	0	0	3	3
11.	23CE11E	Industrial Waste	PEC	3	0	0	0	3	3

		Management							
12.	23CE12E	Air and Noise pollution control Engineering	PEC	3	0	0	0	3	3
13.	23CE13E	Environment policy and legislations	PEC	3	0	0	0	3	3
14.	23CE14E	Hydrology	PEC	3	0	0	0	3	3
15.	23CE15E	Environment Impact Assessment	PEC	3	0	0	0	3	3
16.	23CE16E	Climate change Adaptation mitigation and management	PEC	3	0	0	0	3	3
17.	23CE17E	Soil Pollution Engineering	PEC	3	0	0	0	3	3
18.	23CE18E	Environment, Health and safety	PEC	3	0	0	0	3	3
Vertical - Geotechnical and Transportation									
19.	23CE19E	Ground Improvement Techniques	PEC	3	0	0	0	3	3
20.	23CE20E	Earthquake Geotechnical Engineering	PEC	3	0	0	0	3	3
21.	23CE21E	Geo-Environmental Engineering	PEC	3	0	0	0	3	3
22.	23CE22E	Earth Retaining Structures	PEC	3	0	0	0	3	3
23.	23CE23E	Traffic Engineering and Management	PEC	3	0	0	0	3	3
24.	23CE24E	Pavement Engineering	PEC	3	0	0	0	3	3
25.	23CE25E	Transportation planning process	PEC	3	0	0	0	3	3
26.	23CE26E	Urban Planning and Development	PEC	3	0	0	0	3	3
27.	23CE27E	Intelligent Transport Systems	PEC	3	0	0	0	3	3
Vertical - Diversified									
28.	23CE28E	Digital Surveying & Photogrammetry	PEC	3	0	0	0	3	3
29.	23CE29E	Smart Cities	PEC	3	0	0	0	3	3
30.	23CE30E	Energy Efficient Buildings	PEC	3	0	0	0	3	3
31.	23CE31E	Sustainable Construction Management	PEC	3	0	0	0	3	3
32.	23CE32E	Remote Sensing and GIS	PEC	3	0	0	0	3	3
33.	23CE33E	Sustainable Construction and Lean Construction	PEC	3	0	0	0	3	3
34.	23CE34E	Repair and Rehabilitation of structures	PEC	3	0	0	0	3	3
35.	23CE35E	BIM and 3D Printing Application	PEC	3	0	0	0	3	3
36.	23CE36E	Railways, Airports and Harbour Engineering	PEC	3	0	0	0	3	3

Open Elective Course

S. No	Course Code	Course Title	Category	Periods Per Week				Total Contact Periods	Credits
				L	T	P	E		
1.	23CE01N	Disaster Management	OEC	3	0	0	0	3	3

One Credit Courses

S. No	Course Code	Course Title	Category	Periods Per Week				Total Contact Periods	Credits
				L	T	P	E		
1.	23CE01L	Structural Health Monitoring	OCC	1	0	0	0	1	1
2.	23CE02L	Drone Applications in Civil Engineering	OCC	1	0	0	0	1	1
3.	23CE03L	Building Marking	OCC	0	0	2	0	2	1
4.	23CE04L	Earthquake Risk Mitigation and Retrofitting	OCC	1	0	0	0	1	1
5.	23CE05L	Building Bye Laws	OCC	1	0	0	0	1	1
6.	23CE06L	E-Waste Management	OCC	1	0	0	0	1	1

Course Code	**தமிழர் மரபு (HERITAGE OF TAMILS)**	**L**	**T**	**P**	**E**	**C**
23SH11C	(Common to all B.E. / B.Tech. Degree Programmes)	**1**	**0**	**0**	**0**	**1**

COURSE OUTCOMES

இப்பாடம் முடிந்ததும் மாணவர்களிடம் வளரும் திறன்

CO1:தமிழ் மொழியின் இலக்கிய வளம், ஓவிய, சிற்பக் கலையின் பரிணாம வளர்ச்சி நாட்டுப்புறக் கலை மற்றும் வீர விளையாட்டுக்கள் பற்றிய அறிவு மற்றும் விளக்கும் திறன்

CO2:தமிழர்களின் திணை சார் கோட்பாடுகள் மற்றும் இந்திய பண்பாட்டில் தமிழர்களின் பங்கு பற்றிய அறிவு மற்றும் விளக்கும் திறன்

Upon the successful completion of the course, the student will be able to

Theory Component

CO1:know andexplain about Tamil literary resources, Dimensional growth of painting and sculpture arts, folk art and martial arts.

CO2: know andexplain about Tamils Thinai concepts, contribution of Tamils in Indian National Movements and Indian Culture

CO1:தமிழ் மொழியின் இலக்கிய வளம், ஓவிய, சிற்பக் கலையின் பரிணாம வளர்ச்சி நாட்டுப்புறக்கலை மற்றும் வீர விளையாட்டுக்கள் பற்றிய அறிவு மற்றும் விளக்கும் திறன் **L:9**

இந்திய மொழிக்குடும்பங்கள் - திராவிட மொழிகள் - தமிழ் ஒரு செம்மொழி – தமிழ் செவ்விலக்கியங்கள் - சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை – சங்க இலக்கியத்தில் பகிர்தல் அறம் - திருக்குறளில் மேலாண்மைக் கருத்துக்கள் - தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் - பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் - சிற்றிலக்கியங்கள் - தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி - தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு - நடுகல் முதல் நவீன சிற்பங்கள் வரை – ஐம்பொன் சிலைகள் - பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் - தேர் செய்யும் கலை - சுடுமண் சிற்பங்கள் - நாட்டுப்புறத் தெய்வங்கள் - குமரிமுனையில் திருவள்ளுவர் சிலை - இசைக் கருவிகள் - மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் - தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு - தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.

CO1:know andexplain about Tamil literary resources, Dimensional growth of painting and sculpture arts, folk art and martial arts.

Language Families in India - Dravidian Languages – Tamil as a Classical Language – ClassicalLiterature 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 Modernliterature in Tamil - Contribution of Bharathiyar and Bharathidhasan - Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple carmaking - - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari,Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role ofTemples in Social and Economic Life of Tamils - Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leather puppetry, Silambattam,Valari, Tiger dance - Sports and Games of Tamils.

CO2:தமிழர்களின் திணை சார் கோட்பாடுகள் மற்றும் இந்திய பண்பாட்டில் தமிழர்களின் பங்கு பற்றிய அறிவு மற்றும் விளக்கும் திறன் **L:6**

தமிழகத்தின் தாவரங்களும், விலங்குகளும் - தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் - தமிழர்கள் போற்றிய அறக்கோட்பாடு – சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் - சங்ககால நகரங்களும் துறை முகங்களும் - சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி - இந்திய விடுதலைப் போரில் தமிழர்களின் பங்கு - இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் - சுயமரியாதை இயக்கம் - இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு – கல்வெட்டுகள், கையெழுத்துப் படிகள் - தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

CO2: know andexplain about Tamils Thinai concepts, contribution of Tamils in Indian National Movements and Indian Culture

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 ofSangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas - Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the otherparts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems ofMedicine – Inscriptions & Manuscripts – Print History of Tamil Books.

REFERENCES:

1. தமிழக வரலாறு –மக்களும் பண்பாடும் - கே.கே.பிள்ளை (வெளியீடு:தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2. கணினித் தமிழ் - முனைவர்.இல.சுந்தரம் (விகடன் பிரசுரம்)
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரீகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை –ஆற்றங்கரை நாகரீகம். (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 C ivilization 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.

L: 15; TOTAL: 15 PERIODS

Course Code	MATHEMATICAL FOUNDATIONS FOR ENGINEERS	L	T	P	E	C
23SH12C	(Common to all B.E. / B.Tech. Degree Programmes)	**3**	**1**	**0**	**0**	**4**

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Component

CO1: interpret the nature of quadratic form by orthogonal transformation.
CO2: identify the maxima and minima of functions.
CO3: solve ordinary differential equations.
CO4: find the solution of partial differential equations.
CO5: evaluate integrals of multivariate calculus.

Soft skill Component

CO6 :develop communication, problem solving and interpersonal skills

CO1: interpret the nature of quadratic form by orthogonal transformation. **L:9, T:3**

Characteristic equation – Eigen values and Eigen vectors of a real matrix – Properties of Eigen values and Eigen vectors – Diagonalisation of a matrix by orthogonal transformation – Quadratic forms – Reduction of quadratic form to canonical form by orthogonal transformation and its nature; Cayley – Hamilton theorem (excluding proof) - Application: Stretching of a elastic membrane.

CO2: identify the maxima and minima of functions. **L:9, T:3**

Functions of two variables: Limit, continuity and partial derivatives; Total derivative, Jacobian, Taylor series- Application:Linearization of Non-Linear systems using Taylor Series - Maxima and minima - Method of Lagrange multipliers.

CO3: solve ordinary differential equations. **L:9, T:3**

Solutions of first order ordinary differential equations - Equations solvable for ‘p’, equations solvable for ‘y’, equations solvable for ‘x’ - Solutions of higher order linear differential equations with constant coefficients – Cauchy’s and Legendre’s linear equations - Method of variation of parameters – Solution of simultaneous linear differential equation. Application RCL – circuit and Mass Spring System.

CO4: find the solution of partial differential equations. **L:9, T:3**

Formation of partial differential equations – Solutions of standard types of first order partial differential equations - Lagrange’s linear equations - Solutions of homogeneous and Non homogeneous linear partial differential equations of second and higher order with constant coefficient – Application - Shallow wave equations of first order PDE.

CO5 : evaluate integrals of multivariate calculus **L:9, T:3**

Double integration – Cartesian and polar coordinates - Change of order of integration - Change of variables - Cartesian to polar coordinates - Area as double integral - Triple integration - Cartesian and polar coordinates – Change of Variables- Cartesian to spherical and cylindrical coordinates. Application – Moments and centers of mass.

TEXT BOOKS:

1. Grewal.B.S., Higher Engineering Mathematics, Khanna Publications, 44th Edition, 2021.
2. James E. Gentle, Matrix Algebra, Springer International Publishing, 2nd Edition, 2017
3. Shanker Rao.G., Linear Albebra, WileyIndia, 1st Edition , 2017

REFERENCES:

1. Bali.N.P. and Manish Goyal, A Textbook of Engineering Mathematics, Laxmi Publications Private Limited, 10th Edition, 2016.
2. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley India, 10th Edition, 2017.
3. Kenneth B. Howell, Ordinary Differential Equations, CRC Press, 2020.
4. James Strewart, Daniel Clegg, Saleem Watson, Essential Calculus Early Trancendentals, Cengage Learning, 9th Edition, 2021.
5. Nanda Kumar A.K, P.S.Datti: Raju.K.George , Ordinary Differential Equations, Cambridge University press, 2017.

L: 45; T: 15; TOTAL: 60 PERIODS

Course Code	INTRODUCTION TO ENGINEERING	L	T	P	E	C
23SH13C	(Common to all B.E. / B.Tech. Degree Programmes)	**1**	**0**	**0**	**0**	**1**

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Component

CO1: articulate the importance of Engineering and its role in society through OBE framework
CO2: identify and describe academic pathways towards career settlement

CO1: articulate the importance of Engineering and its role in society through OBE framework **L:9**

Engineering – An introduction, Classification of different Engineering Disciplines, Role of Engineers in Society. Graduate Attributes (GA), Program Specific Criteria (PSC)- Program Educational Objectives (PEO), Program Outcomes (PO), Course Outcomes (CO), Choice Based Credit System (CBCS), course categories, teaching and learning process, active and passive learning, project / problem based learning, different assessments process.

CO2: identify and describe academic pathways towards career settlement **L:6**

Curriculum, cafeteria curriculum and self learning big picture of the Program and the significance of each course in the undergraduate Engineering Program, Discuss the different career paths for an engineering graduate. Career objective, competency requirement.

Case study: Each student has to interact with alumni mentors/seniors/faculty members/surf the internet and present a career path that inspires him/her at the end of the course

REFERENCES:

1. Quamrul H. Mazumder Introduction to Engineering, An Assessment and Problem Solving Approach, CRC Press, 1st Edition, 2016.
2. Saeed Moaveni, "Engineering Fundamentals an Introduction to Engineering", Cengage Learning, USA, 4th Edition, 2011.

L: 15; TOTAL: 15 PERIODS

Course Code	TECHNICAL ENGLISH	L	T	P	E	C
23SH14C	(Common to all B.E. / B.Tech. Degree Programmes)	**1**	**0**	**2**	**0**	**2**

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Component

CO1: apply the fundamental grammar rules in writing

CO2: utilizing phonetic transcription for pronunciation

Practical Component

CO3: apply the basic language skills in various aspects of communication

CO4: utilize technical terms and phrases in specific contexts

CO5: develop the pronunciation skill through various language components

CO6: distinguish different writing forms and interpret text through divergent thinking

CO7: develop effective reports with grammatical and language components

Soft skill Component

CO8: develop communication, team spirit, creativity and time management

CO1: apply the fundamental grammar rules in writing **L:13, P:26**

Parts of Speech - Word Formation using Prefix and Suffix - Sentence formation (Kinds of Sentences) - Tenses (Present, Past & Future tense) – Concord

CO3: apply the basic language skills in various aspects of communication

Diary Writing - Greeting and Self Introduction

CO4: utilize technical terms and phrases in specific contexts

Technical terms and extended definition - Essay Writing (Argumentative Essay and Analytical Essay) - Situational phrases & Conversation - Formal Letter Writing (Permission & Requisition letters)

CO6: distinguish different writing forms and interpret text through divergent thinking

Picture Description, Introduction to Reading Techniques (Skimming, scanning, inferring, predicting, Reading and Reviewing a book (Sci – Fi), E Mail Writing

CO7: develop effective reports with grammatical and language components
Listening and responding to general information (Business context) - Report Writing (Types, Structure, and Stages of report writing) - Checklist

CO2:utilizing phonetic transcription for pronunciation **L:2, P:4**

Phonetics (Vowels & Consonants)

CO5: develop the pronunciation skill through various language components

Word Transformation from one form to another - Letter Writing (Informal) - Listening and responding to general information (General context)

TEXT BOOKS:

1. Paul V. Anderson, Technical Communication: A Reader - Centered Approach, Cengage Learning, 9th Edition, 2017.
2. Ravindra Nath Tiwari, Technical English-II, Shashwat Publication, 1st Edition, 2020.
3. Stephen D. Krashen, Principles and Practice in Second LanguageAcquisition. Pergamon, 1987.
4. Lester Kaufman and Jane Straus, The Blue Book of Grammar and Punctuation: An Easy-to Use Guide with Clear Rules, Real-World Examples, and Reproducible Quizzes, Wiley, 2021.
5. Wells H. G., The Time Machine, Penguin Classics, 2012.

REFERENCES:

1. Michael McCarthy, English Grammar: The Basics, Taylor & Francis, 2021.
2. Peter Lucantoni and Lydia Kellas, Cambridge IGCSE(TM) English as a Second Language Workbook, Cambridge University Press, 6th Edition, 2022.

L: 15; P: 30; L:45; TOTAL: 45 PERIODS

Course Code	ENGINEERING PHYSICS	L	T	P	E	C
23SH15C	(Common to all B.E. / B.Tech. Degree Programmes)	**2**	**0**	**2**	**0**	**3**

COURSE OUTCOMES:

Upon successful completion of the course the students will be able to:

Theory Components:

CO1: identify the structural properties of crystalline materials

CO2: comprehend and apply the concepts of centre of mass and elasticity

CO3: explain thermodynamic parameters and fundamental laws and their application in various processes

CO4: illustrate the applications of different lasers and optical fibers

CO5:interpret the quantum concepts, to illustrate the quantization of energy, and computation

Practical Components:

CO6: compare the mechanical properties of the materials due to bending and torsion

CO7: analyze thermal conductivity of different bad conducting materials

CO8: explore the light-matter interaction by the phenomenon of interferenceand diffraction and photoelectric effect

Soft skill Component:

CO9: develop the team spirit and communication skill through group activities

CO1: identify the structural properties of crystalline materials **L:10**

Crystalline and amorphous materials - unit cell - primitive cell - crystal systems, Bravais lattices - Miller indices – interplanar distance – Characteristics of SC, BCC, FCC, HCP structures - Bragg's law - X-ray diffraction and its applications - Synthesis of crystalline materials

CO2: comprehend and apply the concepts of centre of mass and elasticity **L:6,**
CO6: compare the mechanical properties of the materials due to bendingand torsion **P:10**

Multi-particle dynamics - Introduction - Center of mass (CM) – CM of continuous bodies - Introduction to rigid bodies - translation - rotation – moment of inertia – theorems of moment of inertia – Torsional pendulum.

Elasticity – Stress - strain diagram and its applications - Moduli of elasticity and its relation - bending of beams - Bending moment – cantilever - theory and experiment - Uniform bending - theory and experiment – Non Uniform bending - I-shaped girders

CO3: explain thermodynamic parameters and fundamental laws and their application in various processes **L:6, P:8**

CO7: analyse thermal conductivity of different bad conducting materials.

Laws of thermodynamics –Thermo dynamical processes – Introduction to heat transfer – conduction - convection and radiation – thermal conductivity of good conductor –Radial flow of heat - Spherical shell method and cylindrical shell method – Thermal conductivity of poor conductor- Lee's disc method– Applications - heat exchangers - refrigerators and ovens

CO4: illustrate the applications of different lasers and optical fibers **L:6, P:6**

CO8: explore the light-matter interaction by the phenomenon of Interference and diffraction and photoelectric effect

Lasers: Interaction of light with matter - Einstein coefficients and their relations – characteristics of laser - components of laser – Lasing action – Pumping methods – Types of Laser - Nd-YAG laser -semiconductor laser- Applications

Fiber optics: principle and classification of optical fibers – propagation of light in optical fiber - Numerical aperture and Acceptance angle – losses associated with optical fibers (Qualitative) – Fiber optic communication system - Applications - Displacement and pressure sensors – Endoscopy

CO5: interpret the quantum concepts, to illustrate the quantization of energy, and computation **L:6, P:2**

CO8: explore the light-matter interaction by the phenomenon of interference and diffraction and photoelectric effect

Planck's radiation law - de-Broglie hypothesis – Matter waves - Heisenberg's uncertainty principle – elementary proof – applications – Schrödinger's time-dependent and time-independent wave equation – physical significance of wave function – Introduction to quantum tunneling - applications - particle in a one-dimensional box – tunneling microscope – quantum confinement in 0D, 1D, 2D systems - quantum computation

TEXT BOOKS:

1. Avadhanulu M.N., Kshirsagar P.G and Arun Murthy T.V.S, A Text book of Engineering Physics, S.Chand&Co, 11th Edition, 2018.
2. Kleppner D and Kolenkow R. An Introduction to Mechanics. McGraw Hill Education (Indian Edition), 2017.
3. Kenneth S Krane, Modern Physics, Wiley, 4thEdition, 2021.

REFERENCES:

1. Wolfson R., Essential University Physics, Volume 1 & 2, Pearson Education, 2nd Indian Edition, 2009.
2. Hitendra K. Malik, A.K.Singh, Engineering Physics, McGraw Hill Education, 2nd Edition, 2017.
3. Kyungwon An, Fundamentals of Laser Physics, World Scientific Publishing Company, 2023
4. Halliday D, Resnick R and Walker J, Principles of Physics, Wiley, 12thEdition, 2021.

L: 30; P: 30; TOTAL: 60 PERIODS

Course Code	ENGINEERING CHEMISTRY	L	T	P	E	C
23SH16C	(Common to all B.E. / B.Tech. Degree Programmes)	**2**	**0**	**2**	**0**	**3**

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Component

CO1: explain the suitable water treatment technologies for domestic and industrial applications

CO2: apply the knowledge of corrosion to solve the industrial problems

CO3: describe the preparation, properties and their applications of smart materials in various sectors

CO4: describe the basic components and performance analysis of batteries

CO5: predict the mechanical, electrical and electronics properties of materials using various instrumentation techniques

Practical Component

CO6: estimate the amount of Ca^{2+}/ Mg^{2+}, alkalinity and Chloride ion present in the water sample.

CO7: quantify the amount of acid and metal ion in the given samples by different analytical techniques

Soft skill Component

CO8: develop interpersonal, work ethics and communications skills for career settlement

CO1: explain the suitable water treatment technologies for domestic andindustrial applications

CO6: estimate the amount of Ca^{2+}/ Mg^{2+}, alkalinity and Chloride ion present in the water sample.

Introduction, sources and impurities in water, potable water specifications (as per WHO and BIS) - hardness-types-estimation of $Ca^{2+}$and Mg^{2+} ion in water by EDTA method. Alkalinity-types-determination of alkalinity of water -chronic daily intake - incremental life time risk - hazard quotient, hazard index, contamination factor - determination of chloride ion in water using Argentometric method-municipal water treatment- physical methods and chemical methods. Disinfection-internal conditioning - calgon and carbonate conditioning. Desalination-types-Reverse Osmosis (RO) process- Forward osmosis (FO) - electro dialysis - demineralization. **L:6, P:12**

CO2: apply the knowledge of corrosion to solve the industrial problems.

CO7: quantify the amount of acid and metal ion in the given samples by different analytical techniques

Corrosion – mechanism of dry and wet corrosion-forms of corrosion– galvanic corrosion and differential aeration corrosion, crevice corrosion, pitting corrosion, microbial corrosion-stress corrosion, intergranular corrosion - determination of rate of corrosion by weight loss method. **L:6, P:6**

Protection: cathodic protection, surface coatings, corrosion inhibitors. Corrosion of industrial components: corrosion and its control in power industries, automotive industries, chemical processing industries and marine industries.

CO3: describe the preparation, properties and their applications of smart materials in various sectors **L:6**

Polymers: introduction - classification - functional polymers: electroluminescence

polymer, biodegradable polymers, fire retardant polymer, thermo responsive polymer - piezo, ferro and pyroelectric polymer - nanocomposites: introduction, synthesis, properties & applications- synthesis of nanocomposites using sol -gel process

CO4: describe the basic components and performance analysis of batteries

Introduction - components - operation principle - Lead acid – Nickel metal hydride batteries- Lithium ions batteries: Lithium polymer battery, Lithium sulphur battery - fabrication and performance evaluation- safety issues - battery management system - recycling of lithium batteries. **L:6**

CO5:predict the mechanical, electrical and electronics properties of materials using various instrumentation techniques

CO7: quantify the amount of acid and metal ion in the given samples by different analytical techniques.

Spectroscopy methods: Beer-Lambert's law and its limitations– UV-visible spectroscopy and IR spectroscopy – principle - instrumentation– applications. Estimation of copper. Electro analytical methods: potentiometric titration - Estimation of Fe^{2+} ion by potentiotometric method. Conductometric method- estimation of HCl by conductometric titration- pH metric method-Estimation of HCl by pH metric titration-applications. Thermal analytical methods: Thermal Gravimetric Analysis (TGA) and Differential Thermal Analysis (DTA)- Thermo Mechanical Analysis (TMA) –principle - instrumentation - Thermo gravimetric analysis of $CuSO_4.5H_2O$- applications. **L:6, P:12**

TEXT BOOKS:

1. Jain P.C. and Jain M, Engineering Chemistry, Dhanpat Rai Publishing Company, New Delhi, 17th Edition, 2021.
2. Dara S.S and Umare S.S, A Text Book of Engineering Chemistry, S.Chand & Company Limited, 20th Edition, 2018.
3. Agarwal S, Engineering Chemistry, Cambridge Publishing Company, 2nd Edition, 2019

REFERENCES:

1. Benjamin M. M, Water Chemistry, Waveland Press, 2nd Edition, 2019.
2. Cicek V, Corrosion Engineering, Springer Publishing, 1st Edition, 2021.
3. Shahinpoor. M, Fundamentals of Smart Materials, Publisher: Royal Society of Chemistry, 1st Edition, 2020.
4. Berg H, Bernhardsson S, and Johansson P, Electric Vehicle Batteries: Moving from Research towards Innovation, Publisher: Springer, 1st Edition, 2019.
5. Crouch S, Skoog D, Holler F, Principles of Instrumental Analysis, 2017.

L: 30; P: 30; TOTAL: 60 PERIODS

Course Code	ENGINEERING GRAPHICS	L	T	P	E	C
23ME11C	(Common to MECH,CIVIL,AIDS,EEE,IT)	**2**	**0**	**4**	**0**	**4**

COURSE OUTCOMES:

Upon the successful completion of the course, the student will be able to

CO1: Construct the Engineering Curves and Perform Freehand Sketching.

CO2: Construct the Orthographic Projections of Points, Straight Lines and Lamina

CO3: Draw the Projections of Simple Solids in Different Positions.

CO4: Visualize the Sectional Views and Surface of Various Solids.

CO5: Draw the Isometric and Perspective Projections of Various Solids.

CO1: Construct the Engineering Curves and Perform Freehand Sketching. **L:6, P:12**

Principles of Engineering Graphics – significance. Usage of Drawing Instruments. Lettering and dimensioning exercise Construction of ellipse, parabola and hyperbola using eccentricity method– Construction of cycloids, Epi and Hypo-cycloids. Orthographic views of simple components by Free hand drawing - Transferring measurement from the given object to the free hand sketches.

CO2: Construct the Orthographic Projections of Points, Straight Lines and Lamina **L:6, P:12**

Principle of orthographic projections – Conventions - First angle and third angle projections. Projections of points placed in all quadrants – projections of straight lines – inclined to both reference planes - determination of true length and inclinations. Projections of regular polygonal surfaces and circular lamina inclined to both reference planes.

CO3: Draw the Projections of Simple Solids in Different Positions. **L:6, P:12**

Projections of simple solids like prisms, pyramids, cylinder and cone - axis inclined to one reference plane - change of position method.

CO4: Visualize the Sectional Views and Surface of Various Solids. **L:6, P:12**

Sectioning of simple solids – Axis perpendicular to horizontal plane- Drawing sectional views with true shape of the section. Development of lateral surfaces of truncated solids – Prisms, pyramids, cylinder and cone.

CO5: Draw the Isometric and Perspective Projections of Various Solids. **L:6, P:12**

Principles of isometric projection – Isometric scale – Isometric projections of simple solids like prism, pyramid, cone and cylinder – Combination of solids. Perspective projections of simple solids by visual-ray method

TEXT BOOKS:

1. Bhatt N.D, "Engineering Drawing", 54th Edition, Charotar Publishing House, 2023.
2. Shah M.B and Rana B.C, "Engineering Drawing", Pearson Education, 2nd Edition, 2009.

REFERENCES:

1. Natrajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2009.
2. Agrawal B. & Agrawal C.M., "Engineering Graphics", TMH Publication,2nd Edition, 2013
3. Narayana K.L. & Kannaiah P, "Text book on Engineering Drawing", Scitech Publishers, 2011.
4. Gopalakrishna K.R, "Engineering Drawing", Subhas Publications, 32nd Edition, 2017.

L: 30; P: 60; TOTAL: 90 PERIODS

Course Code	FUNDAMENTALS OF ELECTRICAL AND	L	T	P	E	C
23EE13C	ELECTRONICS ENGINEERING	3	0	2	0	4

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Component

CO1: Demonstrate the characteristic parameters of DC and AC circuits.

CO2: Explain the working of AC and DC machines.

CO3: Describe the analog and digital instruments for monitoring and control.
CO4: Demonstrate the operation of electronic and digital devices for applications.
CO5: Infer the purpose of wiring and safety.

Practical Component

CO6: Analyze basic electric circuits and characteristics of electrical machines.
CO7: Demonstrate the functionality of instruments and characteristics of electronics devices.
CO8: Perform residential wiring and measure earth resistance.

CO1: Demonstrate the characteristic parameters of DC and AC circuits. **L:9, P:6**

Sources - Passive Elements – Electrical Quantities: Voltage, Current, Power and Energy – DC circuits: Ohms Law – Kirchhoff's Laws – Mesh analysis - AC Circuits: Waveforms, RMS, Peak, real power, reactive power and apparent power, power factor.

CO6: Analyze basic electric circuits and characteristics of electrical machines

1. Verification of Ohms Law and Kirchhoff law.
2. Measurement of AC signal parameter (Peak-Peak, RMS, Period and Frequency)

CO2: Explain the working of AC and DC machines. **L:9, P:8**

Construction, Types of DC motors – Working Principles – Need for Starters - AC Motors: Construction and Working of Single Phase and Three Phase Induction Motor– Servomotor -Stepper motor.

CO6: Analyze basic electric circuits and characteristics of electrical machines.

1. Analyse the characteristics of DC Shunt Motor and DC series motor
2. Load test on single phase and three phase induction motor

CO3: Describe the analog and digital instruments for monitoring and control. **L:9, P:2**

Analog instruments: Functional Elements, Principles: PMMC, MI, And Electrodynamometer wattmeter – Digital voltmeter – energy meter - multimeter – DSO – Multifunction meter.

CO7: Demonstrate the functionality of instruments and characteristics of electronics devices.

1. Calibration of single phase energy meter using wattmeter

CO4: Demonstrate the operation of electronic and digital devices for applications. **L:9, P:6**

Characteristics and applications: Diode – Rectifiers, Zener Diode – Regulators, BJT - LEDs – Photo Diodes, Opto-Isolators- Binary Number System – Logic Gates: Basic gates, Universal gates – Boolean Algebra –ADC and DAC.

CO7: Demonstrate the functionality of instruments and characteristics of electronics devices.

1. Experimental Verification of PN Junction diode as rectifiers.
2. Experimental Verification of Zener Diode as Voltage Regulators.
3. Verify the truth table of logic gates.

CO5: Infer the purpose of wiring and safety. **L:9, P:8**

Diagrams & Symbols used in basic Electrical wiring -Electric shock -Protection: PPE, Switches, Plug and Socket, Fuse, MCB, ELCB, MCCB and Earthing- Wiring & installations- Inverters – UPS- Energy Consumptions –Electrical safety and standards– Schematic Electrical Layout for building.

CO8: Perform residential wiring and measure earth resistance.

1. Measurement of Earth Resistance using Electrical Equipment.
2. Residential house wiring, Staircase wiring and selection of fuse.

TEXT BOOKS:

1. D.P. Kothari and I J Nagrath, "Basic Electrical and Electronics Engineering", Tata McGraw Hill, 4th Edition, 2019.
2. R.K.Rajput, "Basic Electrical and Electronics Engineering", University Science Press, 2017.

REFERENCES:

1. Lionel Warnes, "Electrical and electronics engineering: Principles and practice, Palgrave Macmillan publication, 3rd Edition, 2003.
2. D.C. Kulshreshtha, "Basic Electrical Engineering", Tata McGraw Hill, Revision 1st Edition, 2011.
3. David Bell, "Electronic Devices and Circuits", Oxford university press, 5th Edition, 2008.
4. Mohamed A. El-Sharkawi, "Electric Safety Practice and Standards", Taylor & Francis, 2013.

L: 45; P: 30; TOTAL: 75 PERIODS

Course Code	தமிழரும் தொழில்நுட்பமும் (TAMILS AND TECHNOLOGY)	L	T	P	E	C
23SH21C	(Common to all B.E. / B.Tech. Degree Programmes)	1	0	0	0	1

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

CO1:தமிழர்களின் நெசவு மற்றும் பானைத் தொழில்நுட்பம், வடிவமைப்பு மற்றும் தொழில் நுட்பம், உற்பத்தித் தொழில்நுட்பம் பற்றிய அறிவு மற்றும் விளக்கும் திறன்.

CO2: தமிழர்களின் வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில்நுட்பம், அறிவியல் தமிழ் மற்றும் கணினித் தொழில்நுட்பம் பற்றிய அறிவு மற்றும் விளக்கும் திறன்.

Upon the successful completion of the course, the student will be able to

CO1: Know and explain about Tamils weaving and Pottery technology, Design and construction Technology and Manufacturing Technology.

CO2: Know and explain about Tamils Agriculture and irrigation technology, Scientific Tamil and Tamil computing

CO1:தமிழர்களின் நெசவு மற்றும் பானைத் தொழில்நுட்பம், வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம் மற்றும் உற்பத்தித் தொழில்நுட்பம் பற்றிய அறிவு மற்றும் விளக்கும் திறன் **L:9**

சங்ககாலத்தில் நெசவுத்தொழில் - பானைத் தொழில்நுட்பம் - கருப்பு சிகப்பு பாண்டங்கள் - பாண்டங்களில் கீறல் குறியீடுகள்- சங்ககாலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்ககாலத்தில் வீட்டுப்பொருட்களில் வடிவமைப்பு - சங்ககாலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் - சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் - மாமல்ல புரச்சிற்பங்களும் கோவில்களும் - மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் - செட்டிநாடு வீடுகள் - பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ-சாரோசெனிக் கட்டிடக்கலை- கப்பல்கட்டும்கலை - உலோகவியல் - இரும்புத்தொழிற்சாலை - இரும்பை உருக்குதல், எஃகு - வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்கநாணயங்கள் - நாணயங்கள் அச்சடித்தல் - மணி உருவாக்கும் தொழிற்சாலைகள் - கல்மணிகள், கண்ணாடி மணிகள் - சுடுமண் மணிகள் - சங்குமணிகள் - எலும்புத்துண்டுகள் - தொல்லியல் சான்றுகள் - சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.

CO1:KNOW AND EXPLAIN ABOUT WEAVING AND CERAMIC TECHNOLOGY, DESIGN AND CONSTRUCTION TECHNOLOGY, MANUFACTURING TECHNOLOGY

Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware

Potteries (BRW)– Graffiti on Potteries- Designing and Structural construction House & Designs in household materials duringSangam 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- 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 – Gemstone types described in Silappathikaram.

CO2:தமிழர்களின் வேளாண்மை, நீர்ப்பாசனத் தொழில்நுட்பம், அறிவியல் தமிழ் மற்றும் கணினித் தமிழ் பற்றிய அறிவு மற்றும் விளக்கும் திறன். **L:6**

அணை, ஏரி, குளங்கள், மதகு - சோழர்காலக்கு முழித்தூம்பின் முக்கியத்துவம் - கால்நடை பராமரிப்பு - கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் - வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் - கடல்சார் அறிவு - மீன்வளம் - முத்து மற்றும் முத்துக்குளித்தல் - பெருங்கடல் குறித்த பண்டைய அறிவு - அறிவுசார்சமூகம்- அறிவியல் தமிழின் வளர்ச்சி - கணினித் தமிழ் வளர்ச்சி-தமிழ்நூல்களை மின்பதிப்பு செய்தல் - தமிழ் மென்பொருட்கள் உருவாக்கம் - தமிழ் இணையக் கல்விக்கழகம் - தமிழ் மின்நூலகம் - இணையத்தில் தமிழ் அகராதிகள் - சொற்குவைத் திட்டம்.

CO2: KNOW AND EXPLAIN ABOUT AGRICULTURE TECHNOLOGY, IRRIGATION TECHNOLOGY, SCIENTIFIC TAMIL & TAMIL COMPUTING

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- 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.

REFERENCE BOOKS:

1. தமிழக வரலாறு –மக்களும் பண்பாடும் - கே. கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2. கணினித் தமிழ் - 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
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 InstituteofTamilStudies.)
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 TamilNadu (Dr.K.K.Pillay) (Published by: The Author)

L: 15; TOTAL: 15 PERIODS

Course Code	APTITUDE ESSENTIALS	L	T	P	E	C
23GN01C	(Common to all B.E. / B.Tech. Degree Programmes)	1	0	0	0	1

COURSE OUTCOMES:

Upon the completion of the course the students will be able to

CO1: Recall the fundamentals in quantitative techniques and solve Number series problems quickly
CO2: Develop problem solving skills on Numbers and enhance arithmetic ability
CO3: Infer appropriate comparison and distribution methods using ratio and to form equations
CO4: Improve quantitative skills and solve problems on percentages and profit loss
CO5: Calculate data interpretation and data sufficiency in quantitative aptitude

CO1: Recall the fundamentals in quantitative techniques and solve Number series problems quickly **L : 3**

Numeric series – Finding missing numbers – Odd number out series - Letter series – Symbol series - Alphanumeric series

CO2: Develop problem solving skills on Numbers and enhance arithmetic ability **L : 3**

Number Types - HCF & LCM – Square root- Cubic root - divisibility criteria- Unit digit calculation- Prime factors

CO3: Infer appropriate comparison and distribution methods using ratio and to form equations **L : 3**

Ratio & Proportion: Comparison of Ratios - Variations: Direct and indirect proportion Ages: Present Age, Past Age & Future calculation

CO4: Improve quantitative skills and solve problems on percentage and profit loss **L : 3**

Concept of Percentage – Percentage calculation - Calculation of Percentage on Population Results on Depreciation .Profit and Loss –Percentage of Profit and Loss – Discount

CO5: Calculate data interpretation and data sufficiency in quantitative aptitude **L : 3**

Data Interpretation – Pie Chart – Bar Chart – Table Chart .Data Sufficiency in Logical Reasoning : Numbers, Ratio, Ages, Percentage and Profit Loss

REFERENCES:

1. Dr.R.Aggarwal, " Quantitative Aptitude", S Chand Publishing, Revised Edition 2017
2. R.V.Praveen, "Quantitative Aptitude and Reasoning" , 3rd Edition , Eastern Economy Edition, PHI Learning 2016

Video Materials

Profit Loss
https://youtu.be/PpVO7I8dx6U
https://youtu.be/_cW7_BUDYcw

Number series
https://youtu.be/_4ZJFkFE2XU
https://youtu.be/83nJmniFmNk

Numbers
https://youtu.be/81pwuMJ8OIU
https://youtu.be/VT_N9cacgl4

Square root and Cube root
https://youtu.be/nJSqsaT0AgU
https://youtu.be/_HyhwS8P9KY

Problems on Ages
https://youtu.be/6PCTRVmu-ek
https://youtu.be/eAl3BvO_Ipw

Data Interpretation
https://youtu.be/s99rda8e0vc

L: 15; TOTAL: 15 PERIODS

Course Code	FOURIER SERIES, COMPLEX ANALYSIS AND	L	T	P	E	C
23CE21C	CALCULUS	3	1	0	0	4

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Component

CO1: perform Fourier series expansion of the functions.
CO2: calculate the Fourier series solution of Wave and Heat equation.
CO3: interpret analytic function in transformations.
CO4: evaluate complex integration over contour.
CO5: analyze the concepts related to vector field.

CO 1 : perform Fourier series expansion of functions

Dirichlet's conditions – General Fourier series – Half range series – Complex form of Fourier series – Parseval's identity – Harmonic analysis – Identification of frequencies **L:9,T:3**

CO2 : calculate Fourier series solution of Wave and Heat equation

Fundamentals of Fourier series - Half range Fourier series - Classification of Partial Differential Equations - Fourier series solutions of one dimensional wave equation - One dimensional heat equation - Steady state solution of two dimensional heat equation (Insulated edges excluded). **L:9,T:3**

CO3 : interpret analytic function in transformations

Analytic functions - Necessary and Sufficient conditions (excluding proofs) - Harmonic and orthogonal properties of analytic functions - Harmonic conjugate - Construction of analytic functions - fluid flow problems - Conformal mapping:
w= z+c, cz, 1/z and bilinear transformation. **L:9,T:3**

CO4 : evaluate complex integration over contour

Statement and applications of Cauchy's integral theorem and Cauchy's integral formula (excluding proofs) – Taylor's and Laurent's expansions - Singular points - Residues - Residue theorem (excluding proof) - Application of residue theorem to evaluate real integrals - Unit circle and semi - circular contour (excluding poles on boundaries). **L:9,T:3**

CO5 : analyze the concepts of calculus in vector fields

Differentiation of vectors: Gradient, Divergence, Curl and Directional derivatives – Line, Surface and Volume Integrals - Statement of Green's, Gauss divergence and Stokes' theorem - Simple applications involving rectangular parallelepiped and cubes. **L:9,T:3**

TEXT BOOKS:

1. Grewal.B.S. Higher Engineering Mathematics, 44th Edition, Khanna Publications, Delhi, 2021.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, Wiley India, 2017.

REFERENCES:

1. Bali.N.P. and Manish Goyal, A Textbook of Engineering Mathematics, 10th Edition, Laxmi Publications Private Limited, 2018.
2. Jain.R.K. and Iyengar.S.R.K., Advanced Engineering Mathematics, 5th Edition, Narosa Publishing House Private Limited, 2016
3. Ramana B.V, Higher Engineering Mathematics, Tata Mc-Graw Hill Publishing Company, New

Delhi, 2017.

4. Michael D .Greenberg, Advanced Engineering Mathematics, 2nd Edition, Pearson Education,2021.

L: 45; T: 15; TOTAL: 60 PERIODS

Course Code	ENVIRONMENTAL SCIENCE AND SUSTAINABILITY	L	T	P	E	C
23CE22C		2	0	0	0	2

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

CO1 : Explain the functions of environment, ecosystems and biodiversity and their conservation.

CO2 : Analyze the causes, effects of environmental pollution and natural disasters.

CO3 : Apply the understanding of renewable and non-renewable resources.

CO4 : Apply the goals of sustainable development for technological and societal development.

CO5 : Demonstrate the knowledge of sustainability practices, energy cycles .

CO 1: Explain the functions of environment, ecosystems and biodiversity and their conservation

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. **L:6**

CO 2 Analyze the causes, effects of environmental pollution and natural disasters

Causes, Effects and Preventive measures of Water, Soil, Air and Noise Pollutions. Solid, Hazardous and EWaste management. Case studies on Occupational Health and Safety Management system (OHASMS). Environmental protection, Environmental protection acts. **L:6**

CO 3 Apply the understanding of renewable and non-renewable resources

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. **L:6**

CO 4 Apply the goals of sustainable development for technological and societal development

Development, GDP, Sustainability- concept, needs and challenges-economic, social and aspects of sustainability-from unsustainability to sustainability-millennium development goals, and protocols Sustainable Development Goals-targets, indicators and intervention areas Climate change- Global, Regional and local environmental issues and possible solutions-case studies. Concept of Carbon Credit, Carbon Footprint. Environmental management in industry-A case study. **L:6**

CO 5 Demonstrate the knowledge of sustainability practices, energy cycles

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. **L:6**

TEXT BOOKS:

1. Anubha Kaushik and C.P.Kaushik's "Perspectives in Environmental Studies", 6th Edition, New Age International Publishers,2018.
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi,2016.
3. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd Edition, Pearson Education, 2004.

REFERENCES:

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media. 38thEdition 2010.
2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
3. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT. LTD, New Delhi, 2007.
4. Erach Bharucha "Textbook of Environmental Studies for Undergraduate Courses" Orient Blackswan Pvt. Ltd. 2013.

L:30; TOTAL : 30 PERIODS

Course Code	ENGINEERING MECHANICS	L	T	P	E	C
23CE23C		3	1	0	0	4

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Component

CO1: Analyze equilibrium of particles and solve problems.

CO2: Determine the support reactions, equilibrium of rigid bodies in 2D and 3D.

CO3: Explain the significance of centroid, center of gravity and moment of inertia.

CO4: Explain the effect of friction on equilibrium and its principles to analyze and solve problems

CO5: Apply principles of dynamics, work-energy, impulse momentum, and impact on elastic bodies.

CO1: Analyze equilibrium of particles and solve problems. **L : 9,T : 3**

Introduction–Units and Dimensions–Laws of Mechanics–Force Systems – Basic concepts, System of Forces, Coplanar Concurrent Forces, Resolution and addition of forces, resultant of several concurrent forces-Lame's theorem, Parallelogram and triangular Law of forces–Equilibrium of a particle–Forces in space–Principle of transmissibility.

CO2: Determine the support reactions, equilibrium of rigid bodies in 2D and 3D **L:9,T : 3**

Free body diagram - Types of supports and their reactions – requirements of stable equilibrium – Moments and Couples– Moment of a force about a point and about an axis, Vectorial representation of moments and couples– Scalar components of a moment – Varignon's theorem – Equilibrium of Rigid bodies in two dimensions – Equilibrium of Rigid bodies in three dimensions.

CO3: Explain the significance of centroid, center of gravity and moment of inertia. **L : 9,T : 3**

Determination of Areas and Volumes– First moment of area and the centroid of sections – Rectangle, circle, triangle from integration – T section, I section – Angle section, Hollow section by using standard formula -Second and product moment of rectangle, triangle and circle from integration - Second moment of area for T section, I section, Angle section and Hollow section using standard formula - Polar moment of inertia - Principal moments of inertia of plane areas - Principal axes of inertia - Significance of mass moment of inertia (concept only).

CO4: Explain the effect of friction on equilibrium and its principles to analyze and solve problems **L : 9,T : 3**

Friction: Types of friction, Limiting friction, Laws of friction –simple contact friction–ladder friction – wedge friction– Rolling resistance – Belt friction – Translation and Rotation of Rigid Bodies

CO5: Apply principles of dynamics, work-energy, impulse momentum and impact on elastic bodies. **L : 9,T : 3**

Displacements, Velocity and acceleration, their relationship – Projectile motion – Newton's law of motion - D' Alembert principle - Work Energy Equation of particles - Impulse and Momentum - Impact of elastic bodies Definition – time of compression, restitution, collision – laws of conservation of momentum – coefficient of restitution – types of impact – collision of elastic bodies by direct central impact and oblique impact- Introduction to dynamics of rigid bodies - General Plane motion (Concept only).

TEXTBOOKS:

1. Beer,F.P. and Johnson Jr.E.R., Vector Mechanics for Engineers,Vol.1 Statics and Vol.2 Dynamics, McGraw Hill International,11th Edition, 2017.
2. Palanichamy, M.S., Nagan, S., "Engineering Mechanics – Statics & Dynamics", Tata McGraw–Hill, 2018

REFERENCES:

1. Rajasekaran S and Sankarasubramanian G,Fundamentals of Engineering Mechanics, Vikas Publishing House Private Limited, 3rdEdition, 2017.
2. Hibbeller R.C., Engineering Mechanics, Vol.1 Statics, Vol.2 Dynamics, 12th Edition, Pearson Education Asia Private Limited, 2018.
3. Irving H Shames, Engineering Mechanics Statics and Dynamics, Pearson Education Asia Private Limited, 4th Edition, 2018.
4. Ashok Gupta, "Interactive Engineering Mechanics – Statics – A Virtual Tutor (CDROM)", Pearson Education Asia Pvt., Ltd., 2012.

L:45;T: 15;TOTAL: 60PERIODS

Course Code	PROFESSIONAL ENGLISH	L	T	P	E	C
23SH22C	(Common to all B.E. / B.Tech. Degree Programmes)	2	0	2	0	2

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Component

CO1: extend the primary language skills to develop critical thinking

CO2: build the secondary language skills for professional competence

Practical Component

CO3: apply the vital sub-functions of listening in particular context

CO4: take part in propagating ideas through effective oral communication

CO5: inferring information using various reading techniques

CO6: construct professional content via distinct methods of writing

Soft skill Component

CO7: develop interpersonal, communicational and behavioral attributes

CO1:extend the primary language skills to develop critical thinking
CO3: apply the vital sub-functions of listening in particular context
CO4: take part in propagating ideas through effective oral communication

If Conditionals – Standard Abbreviations –Types of Listening(Comprehensive, Informational, Critical Listening) –One Word Substitution, Components of Speaking Listening for Specific Information –Listening to Speech (Oxford Union Society) – Listening to Science Talks or Theories **L:6, P:16**

Product Description – Chart Description – Process Description – Group Discussion (Uses – Structure – Strategies – Team Work – Positive & Negative Body Languages – Samples – Demo)

CO2:build the secondary language skills for professional competence **L:5,P:18**
CO5: inferring information using various reading techniques
CO6: construct professional content via distinct methods of writing

Synonyms – Intensive and Extensive Reading –Error Spotting (Based on Concord, Pronoun, Articles & Adverb Placement)– Writing Style (Persuasive, Expository & Descriptive)

Newspaper Reading – Reading Comprehension (Fiction & NonFiction)

Business Letters for Quotations and Clarification, Placing Orders and Making Complaints – Proposal Writing – Job Application Letter & Resume Preparation – Paragraph Writing – Content Writing

TEXT BOOKS

1. Lucantoni, Peter & Lydia Kellas. "English as a Second Language Workbook", 6th Edition, Cambridge University Press, 2022.
2. Twain, Mark. "The Adventures of Tom Sawyer", 1st Edition, Pegasus, 2012.
3. Clear, James. "Atomic Habits", 1st Edition, Dreamliners, 2022.
4. Garcia, Hector & Francesc Miralles. Ikigai: The Japanese Secret to a long and Happy Life. 1stEdition, Tuttle Publishing, 2021.
5. Elbow, Peter, "Writing with Power" 2nd Edition, Oxford University Press, 1998.

REFERENCES

1. Butterfield, Jeff. "Soft Skills for Everyone". 2nd Edition, Cengage, 2020
2. Raman, Meenashi & Sangeetha Sharma. Professional English. 1st Edition, Oxford University Press, 2018

L: 11; P: 34; L:45; TOTAL: 45 PERIODS

Course Code	PROBLEM SOLVING TECHNIQUES	L	T	P	E	C
23CS11C	(Common to all B.E. / B.Tech. Degree Programmes)	3	0	2	0	4

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theroy Component

CO1: apply fundamentals of problem solving techniques to develop simple algorithms for arithmetic and logical problems

CO2: apply fundamental, sequential, conditional logic statements and arrays for solving basic problems

CO3: implement modular programming concept using user defined functions

CO4: inscribe programs using pointers and to allocate memory for user defined data types using dynamic memory management functions

CO5: develop file processing application programs

Practical Component

CO6: develop programs for simple algorithms using sequential and Control structures

CO7: inscribe programs using arrays, functions and pointers to work with multiple data items.

CO8: develop application programs using structures and files concept.

CO1: apply fundamentals of problem solving techniques to develop simple algorithms for arithmetic and logical problems **L:6**

Overview of programming: Problem Solving in Everyday Life, Types of Problem, Computer-based problem solving, Algorithms - Building blocks of algorithms (statements, control flow, functions) - Notation (pseudo code, flow chart) – Problem solving aspect – Top down design – Implementation of algorithms – Program Verification – Efficiency of algorithms – Analysis of algorithm.

CO2: apply fundamental, sequential, conditional logic statements and arrays for solving basic problems **L:12, P:10**

Data Types - Constants – Variables - Keywords – Operators– Problem Solving using fundamental algorithms. Control Statements: Branching and Looping - Algorithms Using Selection and Repetition - Summation of a set of numbers, Reversing Digits of an Integer - Implementation of fundamental algorithms and factoring methods - Array Techniques - Array order reversal, Array Counting, Finding maximum and the minimum value in a set

CO6: develop programs for simple algorithms using sequential and Control structures

Solve problems using control statements (Decision making and Looping)

CO7: inscribe programs using arrays, functions and pointers to work with multiple data items.

Problem solving based on Array Handling(1D and 2D, Multi-dimensional arrays, traversal, rotation) - Solve problems to handle strings

CO3: implement modular programming concept using user defined functions **L:10, P:8**

Modular Programming approach: Modularization and recursion - Bubble Sort, Selection Sort, Linear Search, Binary Search, Implementation of sorting and searching

CO7: inscribe programs using arrays, functions and pointers to work with multiple data items.

Solve problems by using modular approach (Functions and Recursion)

CO4: inscribe programs using pointers and to allocate memory for user defined data types using dynamic memory management functions **L:12, P:10**

Pointer Concept – add numbers using call by reference – finding maximum number from list of numbers - permutations of a given string using pointers – Implementation of function returns a pointer;

Structures & Union - finding the largest element of an array using Dynamic Memory Allocation – Implementation of Student database in structure using Dynamic Memory Allocation;

CO7: inscribe programs using arrays, functions and pointers to work with multiple data items.

Build efficient solutions to manage memory efficiently through Pointers.

CO8: develop application programs using structures and files concept.

Develop applications using Structures

CO5: Develop file processing application programs **L:5, P:2**

File Handling: Files - Introduction, Types of file processing: Sequential access, Random access – Implementation of word count, copy file, Voter's age validation, Marks range validation

CO8: Develop application programs using structures and files concept.

Develop applications using Files

TEXT BOOKS:

1. Maureen Sprankle and Jim Hubbard, Problem Solving and Programming Concepts, Prentice Hall, 9th Edition, 2012.
2. R.G Dromey, How to solve it by Compute, Pearson education, Delhi, 2nd Edition, 2021.

REFERENCES:

1. Behrouz A. Forouzan, Richard F.Gilberg, P.Golda Jeyasheeli, G.Priyanka, S.T.Veena , Problem solving Using C A Structured Programming Approach, Volume I & II, 1st Edition, Cengage Publication, 2022
2. Karl Beecher, Computational Thinking: A Beginner's Guide to Problem Solving and Programming, BCS Learning & Development Limited, 1st Edition, 2017.
3. Byron S. Gottfried, Jitendar Kumar Chhabra, Programming with C, Tata McGraw Hill Publishing Company, New Delhi, 4th Edition, 2018.
4. Kernighan B.W., Ritchie D.M., C Programming Language (ANSI C), Prentice Hall of India Private Limited., New Delhi, 2nd Edition, 2010.
5. Pradip Dey and Manas Ghosh, Programming in C, Oxford University Press, New Delhi, 2018.

6. Yashavant P. Kanetkar, Let Us C, BPB Publications,16th Edition, 2020
7. H. M.Deitel, P. J. Deitel, C How to Program, Pearson Education., New Delhi, 7th Edition, 2016.

L: 45; P: 30; TOTAL: 75 PERIODS

Course Code	BUILDING MATERIALS	L	T	P	E	C
23CE24C		3	0	0	2	4

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Component

CO1: Classify the basic building materials and explain its relevant application

CO2: Demonstrate the typical and prospective uses of lime, cement, and aggregates

CO3: Describe the process for producing concrete and it's applications

CO4: Explain the applications of timbers and other materials

CO5:Illustrate the applications of Modern building materials

Softskill Component

CO6 : develop team spirit, communication, problem solving and interpersonal skills related to basic and modern building materials with the help of field study and presentation.

CO1: Classify the basic building materials and explain its relevant application. L:9,E:6

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.

Experiential Activity

Prepare a report on different types of stones and bricks available in the market with its uses.

CO2:Demonstrate the typical and prospective uses of lime, cement, and aggregates L:12,E:6

Lime – Preparation of lime mortar – Cement – Ingredients – Manufacturing process – Types and Grades – Properties of cement and Cement mortar – Hydration – Compressive strength – Tensile strength – Fineness– Soundness and consistency – Setting time – fine aggregates – river sand – crushed stone sand – properties – coarse Aggregates – Crushing strength – Impact strength – Flakiness Index – Elongation Index – Abrasion Resistance – Grading

Experiential Activity

Prepare a report on different grades and types of cements available in the market with its application

CO3: Describe the process for producing concrete and it's applications L:6,E:6

Concrete – Ingredients – Manufacturing Process – Batching plants –mixing – transporting – placing – compaction of concrete –curing and finishing – Ready mix Concrete – Mix specification.

Experiential Activity

Arrange a visit to the ready mix plant and prepare a report on it.

CO4: Explain the applications of timbers and other materials **L:9,E:6**

Timber – Market forms – Industrial timber– Plywood – Veneer – Thermocol – Panels of laminates – Steel – Aluminum and Other Metallic Materials – Composition – Aluminium composite panel – Market forms – Mechanical treatment – Paints – Varnishes – Distempers – Bitumen.

Experiential Activity

Give a presentation on different types of paints, varnishes, distempers , plywoods and Bitumen available in the market

CO5:Illustrate the applications of Modern building materials. **L:9,E:6**

Glass – Ceramics – Sealants for joints – Fibre glass reinforced plastic – Clay products – Refractories – Composite materials – Types – Applications of laminar composites – Fibre textiles– Geo-membranes and Geotextiles for earth reinforcement.

Experiential Activity

Give a presentation on geotextiles, geomembranes available in the market and mention it's application on the field

TEXT BOOKS:

1. Varghese.P.C, "Building Materials", PHI Learning Pvt. Ltd, New Delhi, 2015.
2. Gambhir.M.L., "Concrete Technology", 5th Edition, Tata McGraw Hill Education, 2017
3. Anil Kumar Misra, "Building Materials and Construction", S.Chand& Company Ltd, 2017

REFERENCES:

1. Jagadish.K.S, "Alternative Building Materials Technology", New Age International, 2017.
2. Gambhir. M.L., & Neha Jamwal., "Building Materials, products, properties and systems", Tata McGraw Hill Educations Pvt. Ltd, New Delhi, 2017.
3. IS456 - 2000: Indian Standard specification for plain and reinforced concrete, 2011
4. IS4926 - 2003: Indian Standard specification for ready–mixed concrete, 2012
5. IS383 - 1970: Indian Standard specification for coarse and fine aggregate from natural Sources for concrete, 2011
6. IS1542-1992: Indian standard specification for sand for plaster, 2009
7. IS 10262-2019: Indian Standard Concrete Mix Proportioning –Guidelines, 2019.
8. IS 2386-2021: Indian Standard for Methods of test for aggregates for concrete,2021.

L: 45,E:30; TOTAL: 75 PERIODS

Course Code	**INNOVATION THROUGH DESIGN THINKING**	**L**	**T**	**P**	**E**	**C**
23GN02C	**(Common to all B.E. / B.Tech. Degree Programmes)**	**0**	**0**	**0**	**4**	**2**

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Experiential Component

CO1:Analyse the impact of design thinking process.

CO2: Practice design thinking process through real world problems.

Soft skill Component

CO3: Present survey conclusions on selected real-world problems.

CO1: Analyse the impact of design thinking process **30**

Design thinking process: history and phases - Ideation tools: brainstorming, mind mapping, scrambler method, six thinking hats -case studies.

CO2: Practice design thinking process through real world problems **30**

Real world problem selection-Practicing the preliminary stages of design thinking process - work presentation.

TEXT BOOKS

1. Falk Uebernickel, Li Jiang, Walter Brenner, Britta Pukall, Therese Naef, "Design Thinking: The Handbook", WS Professional, 2020
2. PavanSoni, "Design Your Thinking: The Mindsets, Toolsets and Skill Sets for Creative Problem solving", Penguin Random House, 2020

REFERENCES

1. Michael Lewrick, "The Design Thinking Playbook", Wiley, 2019
2. Kathryn Christopher, "Design Thinking in Engineering", Kendall Hunt Publishing Company,2019
3. Robert Curedale, "Design Thinking Process & Methods" Design Community College Inc, 5th Edition, 2019
4. David Lee, "Design Thinking in the Classroom", Ulysses Press, 2018
5. Jimmy Jain, "Design Thinking for Startups", Notion Press, 2018
6. Monika Hestad Silvia Rigoni Anders Grnli, "The Little Booklet on Design Thinking: An Introduction", Zaccheus Entertainment, 2nd Edition, 2017
7. Scott Swan, Michael G.Luchs and Abbie Griffin, "Design Thinking: New Product Development Essentials", Wiley-Blackwell, 2016
8. D.M. Arvind Mallik, "Design Thinking for Educators", Notion Press, 2019

E:60; TOTAL:60 PERIODS

23GN05C	PROFESSIONAL ETHICS AND HUMAN VALUES	L	T	P	E	C
	(Common to all B.E. / B.Tech. Degree Programmes)	**2**	**0**	**0**	**0**	**2**

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

CO1: Recognize and practice the core human values and theories related to ethical behavior.
CO2: Analyze the engineering ethical breach from past study.
CO3: Distinguish and apply safety, responsibility and rights in workplaces.

CO1: Recognize and practice the core human values and theories related to ethical behavior **L: 10**

Moral dilemmas and moral autonomy - Kohlberg's theory - Gilligan's theory - Consensus and controversy –Case studies: Vigil mechanism, Whistle blowing - Protected disclosures - Personal ethics, work ethics and human values - Governing Regulation.

CO2 : Analyze the engineering ethical breach from past study **L: 10**

Engineering as experimentation - engineers as responsible experimenters - codes of ethics - a

balanced outlook on law - Case study: The challenger disaster

CO3 : Distinguish and apply safety, responsibility and rights in workplaces **L: 10**

Safety and risk - assessment of safety and risk - risk benefit analysis and reducing risk - Collegiality and loyalty - respect for authority – confidentiality; Collective bargaining, Conflicts of interest - Case study; Occupational crime - professional rights - employee rights - Intellectual Property Rights (IPR) - discrimination. Case studies: The Three mile island and Chernobyl disaster

TEXT BOOK

1. Mike W Martin and Roland Schinzinger, "Ethics in Engineering", McGraw Hill, New York,5th Edition, 2022

REFERENCES

1. BehnamTaebi, "Ethics and Engineering: An Introduction", Cambridge University Press, 2021
2. Ajesh Faizal, Aswathy S U, Roy V I, "Professional Ethics in Engineering: an Industry Perspective", Noor Publishing, 2021
3. R.S.Naagarazan, "A Textbook on Professional Ethics and Human Values", New age International Pvt. Ltd; 3rdedition, 2022
4. Dr. P. Elamurugan, "Professional Ethics in Engineering", Notion Press, 2021

L:30; TOTAL:30 PERIODS

Course Code	FLUID MECHANICS	L	T	P	E	C
23CE31C		3	1	0	0	4

COURSE OUTCOMES

Upon Successful completion of this course, the students will be able to

CO1: Illustrate the basic fluid properties.

CO2: Determine the pressure, hydrostatic forces and the development of continuity equation in the fluid.

CO3: Compute the rate of flow and losses in pipes.

CO4: Describe the concepts of boundary layer.

CO5: Explain the idea of dimensional and model analysis with other model/prototype problems.

CO1: Illustrate the basic fluid properties. **L:7 , T:3**

Scope of Fluid mechanics - Definitions – Fluid and fluid mechanics – Dimensions and units – Fluid properties: Density, Specific weight, Specific gravity, viscosity, Compressibility, Bulk modulus, Surface tension, capillarity, vapour pressure.

CO2: Determine the pressure, hydrostatic forces and the development of continuity equation in the fluid. **L:11, T:3**

Pascal's Law and Hydrostatic equation – Pressure measurement - Buoyancy – Meta centre - Forces on plane and curved surfaces - Fluid Kinematics - Classification of fluid flows - Continuity equation (one, two and three dimensional forms) – Velocity potential functions and Stream function - Flow net.

CO3: Compute the rate of flow and losses of energy in pipes **L:10, T:3**

Euler and Bernoulli's equations – Application of Bernoulli's equation – Discharge measurement – Laminar flows through pipes and between plates – Hagen Poiseuille

equation – Turbulent flow – Major and minor losses of flow in pipes.

CO4: Describe the concepts of boundary layer **L:8, T:3**

Definition of boundary layer – Thickness and classification – Displacement and momentum thickness -Drag force on a flat plate due to boundary layer – Separation of boundary layer concept.

CO5: Examine the idea of dimensional and model analysis with other model/prototype problems. **L:9,T:3**

Dimensional Analysis – Methods of dimensional analysis (Rayleigh‟s method, Buckingham's Pi-theorem) – Model analysis - Types of forces acting in moving fluid – Dimensionless numbers – Model laws and its problems.

TEXT BOOKS:

1. Bansal R.K, Fluid mechanics & Hydraulic machines, Laxmi Publishing Private Limited, New Delhi,11th Edition, 2024.
2. Modi, P.N & Seth, S.M "Hydraulics and fluid Mechanics", Standard book house, New Delhi, 21stEdition, 2017.
3. Yunus A. Cengel , John M. Cimbala , Fluid Mechanics: Fundamentals and Applications, Tata McGraw Hill Education Private Limited, New Delhi, 4th Edition, 2017

REFERENCES:

1. Jain A.K., "Fluid Mechanics including Hydraulic Machines", Khanna Publishers, New Delhi, 2016.
2. Ramamrutham S, Hydraulics Fluid Mechanics and Fluid Machines, Dhanpat Rai Publishing Company, 9thEdition, 2014
3. Subramanya.K; Fluid Mechanics and Hydraulic Machines; Tata McGraw Hill Education Private Limited, New Delhi, 2nd Edition, 2018.

L: 45; T : 15 ; TOTAL: 60 PERIODS

Course Code	BIOLOGY FOR ENGINEERS	L	T	P	E	C
23CE32C		3	0	0	0	3

COURSE OUTCOMES:

Upon successful completion of the course the students will be able to

CO1: describe the fundamental concepts Species evolution and cell biology

CO2: explain the structure and stability of biomolecules

CO3: comprehend the structure and function of enzymes

CO4: interpret the major bio-energetic pathways

CO5: explain the analytical techniques used for the analysis of biomolecules

CO1: describe the fundamental concepts in species evolution and cell biology **L L:9**

Modern concept of natural selection and speciation- Lamarkism, Darwinism/Neo-Darwinism - classification based on cellularity and ultrastructure. Cell - prokaryotic and eukaryotic cells-Structural and function of mitochondria, chloroplast, lysosomes, golgi bodies, plasma membrane, cytoskeleton, cell wall and nucleus-cell cycle-cell division: mitosis and meiosis. Photosynthesis: photovoltaic cells, bionic leaf. Human Blood

substitutes; hemoglobin-based oxygen carriers (HBOCs)

CO2: explain the structure and stability of biomolecules **L:9**

Introduction to bio molecules - Monomeric units and polymeric structures of sugars, starch, cellulose, amino acids, proteins, nucleotides and DNA/RNA, and lipids. Molecular interactions: covalent and non covalent interactions –methods to measure the interactions. Antigens-antibodies interaction.

CO3: comprehend the structure and function of enzymes **L:9**

Introduction, classification of enzymes - specific activity- enzyme activity- chemical nature of enzymes. Protein and non protein nature of enzymes. Metalloenzymes and metal activated enzymes. Coenzymes and cofactors- prosthetic group, coenzymes involved in different metabolic pathways. Lock and key, induced fit and transition state hypotheses. Mechanism of enzyme catalysis- acid-base catalysis, reversible and irreversible Inhibition. Factors affecting the enzyme activity; Concentration, pH and temperature. Kinetics of a single-substrate enzyme catalysed reaction, Michealis-Menten Equation- enzyme mediated reactions. Industrial applications of enzymes: biosensors and bio bleaching.

CO4: interpret the major bio-energetic pathways **L :9**

Thermodynamics in biological systems, exothermic and endothermic versus endergonic and exergoinc reactions, concept of K_{eq} and its relation to standard free energy, spontaneity, ATP as an energy currency. Glucose synthesis: Glycolysis and Krebs cycle. Energy yielding and energy consuming reactions. Concept of energy charge. Regulation of blood glucose and homeostasis - glycogenesis and glycogenolysis and their regulation - measurement of blood glucose level.

CO5: explain the analytical techniques used for the analysis of biomolecules **L:9**

Chromatographic techniques: principle and applications of columnchromatography, TLC and HPLC**.** Microscopic Techniques: principle and applications of Fluorescence microscopy, Scanning electron microscopy, Transmission Electron microscope. Spectroscopic techniques**:** principle and applications of UV-Visible spectroscopy, Fluorescence spectroscopy and Mass spectroscopy. ELISA and Western blot.

TEXT BOOKS:

1. Y. Nelson, L. David, Lehninger, Principles of Biochemistry, International Edition. New York: W. H. Freeman, Macmillan Learning, 8th Edition, 2021.
2. Nagata, Kazuhiro, Real-Time Analysis of Biological Interactions, Springer, Japan, 3rd Edition, 2015.
3. Bibekanand and Mallick, Biology for Engineers, McGraw Hill Education, 1st Edition, 2021.
4. Thyagrarajan S, Biology for Engineers, McGraw Hill Education, 1st Edition, 2013.

REFERENCES:

1. P.N.Bartlett, Bioelectrochemistry: Fundamentals, Experimental Techniques and Applications, 2nd Edition, John Wiley & Sons, 2014.
2. Ratner and Hoffmann, Biomaterial Science: An Introduction to Materials in Medicine, 2nd Edition, 2015.
3. D.V. Vranken, G.A.Weiss, Introduction to Bioorganic Chemistry and Chemical Biology, CRC, Taylor & Francis, 1stEdition, 2012.

L: 45; L:45; TOTAL: 45 PERIODS

Course Code	STATISTICS AND NUMERICAL METHODS	L	T	P	E	C
23CE33C		3	1	0	0	4

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Component

CO1: calculate the various measures of dispersion.

CO2: apply the principles of hypothesis testing in small and large samples.

CO3: analyze the variances in design of experiments.

CO4: apply numerical techniques to solve algebraic equation and calculate derivatives and integrals.

CO5: compute numerical solution of differential equations.

CO1 : calculate the various measures of dispersion

Central tendencies - Mean, median, mode - Measures of Dispersion: Mean deviation, and Quartile Deviation - *Carry out performance study on measures of central tendencies: Case Study through software*–Moments – Skewness – Kurtosis - Correlation and Regression. **L:9, T:3**

CO2 : apply the principles of hypothesis testing in small and large samples

Sampling distributions - Estimation of parameters - Statistical hypothesis – Central limit theorem - Large sample tests based on Normal distribution for single mean and difference of means - Confidence interval for mean - Chi-square distribution - Contingency table for independent of attributes – Goodness of fit. **L:9,T:3**

CO3 : analyze the variances in design of experiments

Tests based on t and F distributions for mean, variance and proportion - ANOVA - One way and two way classifications - Completely randomized design – Randomized block design – Latin square design – 2^2 factorial design. **L:9,T:3**

CO4: apply numerical techniques to solve algebraic equation and calculate derivatives and integrals

Solution of Algebraic and transcendental linear equations - Newton - Raphson Method- Solution of simultaneous equations – Gauss Elimination method – Gauss Jacobi's method- Gauss Seidel method – Interpolation – Lagrange's Method - Numerical Differentiation – Newton's forward difference and backward difference formula – Numerical integration - Single integration using Trapezoidal and Simpson's 1/3 rd and 3/8 th rules. **L:9,T:3**

CO5 : compute numerical solution of differential equations

Taylor's Series Method – Euler's Method – Runge Kutta fourth order Method – Predictor - corrector Methods – Milne's Method - Solution of one dimensional heat equation by explicit and implicit methods - Two dimensional Laplace and Poisson equations – Liebman's iteration Process- *Determine numerical solution of ordinary differential equations and partial differential equations: Activity through software.* **L:9,T:3**

TEXT BOOKS:

1. Richard A. Johnson, Irwin Miller, John Freund, Miller & Freund's, Probability and Statistics for Engineers, 9th Edition, Pearson Education Limited, Global Edition, 2017.
2. Grewal, B.S., Numerical Methods in Engineering & Science: With Programs in C, C++ & MATLAB, 10th Edition, Khanna Publishers, New Delhi, 2014.
3. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, Wiley India, 2017.

REFERENCES:

1. R.E. Walpole, R.H. Myers, S.L. Myers, and K Ye, Probability and Statistics for Engineers and Scientists, Pearson Education, Asia, 9th Edition, 2016.
2. M.R. Spiegel, J. Schiller and R.A. Srinivasan, Schaum Outlines, Probability and Statistics, Tata McGraw Hill Edition, 2017.
3. Chapra, S. C and Canale, R. P. Numerical Methods for Engineers, 7th Edition, Tata McGraw - Hill, New Delhi, 2016.

L: 45; T:15; TOTAL: 60 PERIODS

Course Code	SOLID MECHANICS	L	T	P	E	C
23CE34C		3	0	2	0	4

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Component

CO1: Explain the basic engineering properties of solids.

CO2: Analyze the plane truss.

CO3: Analyze the transverse loading on beams to draw shear force and bending moment diagram.

CO4: Calculate the deflection in beams and shear stresses

CO5: Determine Torsion in shafts and springs

Practical Component

CO6: Perform experiments making measurements of loads, displacements and Strains

CO7: Determination of deflection in beams experimentally.

CO8: Compute the strength of the material and stiffness properties of Structural elements

CO1: Explain the basic engineering properties of solids. **L:9, P:12**

CO6: Perform experiments making measurements of loads, displacements and Strains

Rigid bodies and deformable solids – stability, strength, stiffness – ***Tension, compression and shear stresses and verify experimentally***– strain, elasticity, Hooke's law, limit of proportionality, modulus of elasticity, ***Experimental verification of stress-strain behavior for steel and concrete***, lateral strain – Temperature stresses – Deformation of simple and compound bars – Shear modulus, bulk modulus, relationship between elastic constants – Biaxial state of stress – Stress at a point – Stress on inclined plane – Principal stresses and principal planes – Mohr's circle of stresses.

CO2: Analyze the plane truss. **L:9**

Stability and equilibrium of plane frames – Types of trusses – Analysis of forces in truss member's -method of joints, method of sections, method of tension coefficients.

CO3: Analyze the transverse loading on beams to draw shear force and bending moment diagram. **L:9**

Beams – Types of supports – Simple and fixed, types of load – Concentrated, uniformly distributed, uniformly varying load, combination of above loading – Relationship between bending moment and shear force – Bending moment, shear force diagram for simply supported, cantilever and over hanging beams – Theory of simple bending-Bending stress.

CO4:Calculate the deflection in beams and shear stresses **L:9, P:6**

CO7: Determination of deflection in beams experimentally

Deflection of beams – Double integration method – Macaulay's method – Slope and deflection using moment area method, Conjugate Beam method.

Conduct experiment to obtain the load deflection curve using flexure

Variation of shear stress – Shear stress distribution in rectangular, I sections, solid circular sections, hollow circular sections, angle and channel sections.

L:9, P: 12

CO5: Determine Torsion in shafts and springs

CO8: Compute the strength of the material and stiffness properties of Structural elements.

Stresses and deformation in circular shafts (solid and hollow) – ***Experimental determination of modulus of rigidity using Torsion Equation***- Stepped shafts – Shafts fixed at both ends – Leaf springs – Stresses in helical springs – ***Experimental verification of deflection of springs.***

TEXT BOOKS

1. Stephen Timoshenko - Strength of Materials, CBS publishers &Distributors Pvt. Ltd, New Delhi, 2021
2. Rajput.R.K. Strength of Materials, S.Chand and Co, New Delhi, 2021.
3. Bansal R.K. Strength of materials, Laxmi Publications, New Delhi, 6th Edition, 2023.

REFERENCES

1. Rattan. S.S, Strength of Materials‖, Tata McGraw Hill Education Private Limited, New Delhi, 2017
2. Punmia.B.C., Ashok Kumar Jain and Arun Kumar Jain, SMTS–I Strength materials, Laxmi publications, New Delhi, 2018
3. Srinath, L.S. Advanced mechanics and solids, Tata-McGraw Hill Publishing Company Limited, 3rdEdition 2017.

L: 45; P: 30; TOTAL: 75 PERIODS

Course Code	SURVEYING	L	T	P	E	C
23CE35C		3	0	2	0	4

COURSEOUTCOMES

Upon successful completion of this course, the students will be able to

Theory component:

CO1: Explain the basic principles and types of surveying.

CO2: Interpret the working principle and field applications of leveling.

CO3: Apply the theodolite in the field surveying.
CO4: Explain surveys for Engineering projects as per IS codes and demonstrate the EDM
CO5: Implement the concepts of remote sensing and GIS.

Practical component:

CO6: Experiment with chain and compass surveying
CO7: Perform leveling and generate contour maps.
CO8: Experiment with theodolite and measure horizontal and vertical angles

CO1:Explain the basic principles and types of surveying **L: 9, P:12**

CO6: Experiment with chain, compass and plane table surveying

Survey of India - Definition - Principles - Classification - Field and office work - survey instruments, their care and adjustment -Ranging and chaining-Reciprocal ranging -Prismatic compass – Surveyor‘s compass - Bearing - Systems and conversions – Local attraction- Plane table instruments and accessories- ***Experimental determination of area using chain, compass and plane table***

CO2: Interpret the working principle and field applications of leveling. **L:9, P:6**

CO7: Perform leveling and generate contour maps.

Leveling-Important Definitions-types of levels-Benchmarks- Temporary and permanent adjustments - Curvature and refraction - Reciprocal leveling - Longitudinal and cross sections -***perform experiment for longitudinal and cross sectioning for construction of roads*** - Plotting -Calculation of areas and volumes -Contouring - Methods - Characteristics, uses of contours and contouring by block levels-Capacity of reservoirs.

CO3: Illustrate the application of theodolite in the field surveying. **L:9,P:12**

CO8: Experiment with theodolite and measure horizontal and vertical angles

Theodolite - Description and uses - Temporary and permanent adjustments of vernier transit–Types-Horizontal angles-Vertical angles-***measurement of horizontal and vertical angles experimentally using different methods***- Heights and distances-Traversing-Closing error and distribution- - Omitted measurements.- Introduction about Precise Theodolite.

CO4: Explain surveys for Engineering projects as per IS codes and demonstrate the EDM **L: 9**

Surveys for engineering projects-Setting out works as per IS11134-Route Surveys as per IRC SP019 –Alignment of Tunnels as per IS 5878 –Introduction, working principles and construction of Electromagnetic distance measurement and ***demonstration*** – Merits and Demerits.

CO 5: Implement the remote sensing concepts and GIS Software **L:9**

Definition – types – components – principles – Maps – Definitions – Map projections – types of map projections - map analysis – GIS definition – basic components – GIS Software ***(demonstration).***

TEXT BOOKS:

1. Punmia.B.C., Ashok K. Jain and Arun K Jain, Surveying Vol.I,II and III, 17th Edition, Lakshmi Publications Private Limited, New Delhi, 2022.
2. Kanetkar T.P., Surveying and Levelling, Vol.I, United Book Corporation, Pune, 24th Reprint,2022.

REFERENCES:

1. Clark D., Plane and Geodetic Surveying, Vol.I, C.B.S. Publishers and Distributors, New Delhi, 6th Edition, Reprint, 2022.
2. James M.Anderson and Edward M.Mikhail, Introduction to Surveying ,McGraw-Hill Book Company, 8th Edition, 2022.
3. Bannister and S.Raymond, Surveying, 8th Edition, Longman 2022.

L:45,P:30;TOTAL:75 PERIODS

Course Code	BUILDING PLANNING AND DRAWING	L	T	P	E	C
23CE36C		1	0	0	2	2

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO 1: Explain the basic concepts of various elements of Residential / Institutional / Workshop buildings.

CO2: Create plans, elevations and sectional views of various buildings using drafting software

CO 1: Explain the basic concepts of various elements of Residential / Institutional / Workshop buildings. **L:10**

Introduction to buildings, classification of buildings, building components, orientation of building, principles of architecture composition - Building Byelaws. Principles of planning of residential and public building.

CO 2: Create plans, elevations and sectional views of various buildings using drafting software. **E:20**

Experiential Learning in Peers

1. Draw developed plan, elevation, section, site plan from the given line plan for a load bearing residential building (2BHK) with stair case.
2. Plans for residential building of minimum three rooms including w/c, bath and staircase as per principles of planning.
3. Plans for public building-school building, primary health centre, restaurant, bank, post office, hostel, Function Hall and Library.
4. Draw developed plan, elevation, section, site plan from the given line plan for framed structure residential building including stair case (2BHK, G+1).

TEXT BOOKS

1. Varma B.P, Civil Engineering Drawing & House Planning, 13th Edition, Khanna Publishers, Delhi, 2023.
2. S.S.Bhavikatti, M.V.Chitawadagi, Building Planning and Drawing, IK International publishing House, 2014

REFERENCES

1. Kumaraswamy N, Kameswara Rao A, Building Planning & Drawing, 9th Edition, Charotar Publishing, 2023.
2. Shah, Kale and Patki, Building Drawing with integrated approach to Built Environment, Tata McGraw Hill, 2017.

L:15, E:30; TOTAL:45PERIODS

23GN03C	INTELLECTUAL PROPERTY RIGHTS STUDY	L	T	P	E	C
	(Common to all B.E. / B.Tech. Degree Programmes)	**0**	**0**	**0**	**4**	**2**

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Experiential Component

CO1: Survey and practice the basic elements of existing patents.

CO2: Investigate and present the state of art technologies through effectual IP search.

Soft Skill Component

CO3: Present patent survey conclusions

CO1 Survey and practice basic elements of existing patents **30**

Basic elements of IPR – claims – infringements – Patent examination and Report - Case studies: patent survey.

CO2 Investigate and present the state of art technologies through effectual IP search **30**

Importance of IP search-factors to be considered for effective IP search-Hands-on Practice

REFERENCES

1. D.P.Mittal, "Indian Patents Law and Procedure", Taxman Publication, 2002
2. B.L.Wadera, "Patents, trademarks, copyright, Designs and Geographical Judications", 2010
3. P. Narayanan, "Intellectual Property Law", Eastern Law House, 2022
4. N.S. Gopalakrishnan & T.G.Agitha, "Principles of Intellectual Property", Eastern Book Company, Lucknow, 2009.

E:60 TOTAL:60 PERIODS

Course Code	APTITUDE EXCELLENCE	L	T	P	E	C
23GN04C		**0**	**0**	**2**	**0**	**1**

COURSE OUTCOMES

Upon the completion of the course the students will be able to

CO1: Infer appropriate methods to simplify computation

CO2: Develop problem solving skills on Time and Work and enhance arithmetic ability

CO3: Interpret fundamentals in quantitative techniques and solve problems quickly

CO4: Improve quantitative skills and solve problems on permutation and Combination

CO5: Acquire the knowledge of Cognitive ability and solve puzzles effectively

CO1: Infer appropriate methods to simplify computation

Simplification: Nested Series simplification(fraction) - BODMAS rule –Viraculum (or Bar) rule – Modulus of a real number –Multiplication shortcuts-Comparing Fractions-Data Sufficiency **P:6**

CO2: Develop problem solving skills on Time and Work and enhance arithmetic ability

Time and Work: Work Done - Days from Work:- Ratio – Efficiency –Work and wages - Data Sufficiency **P:6**

CO3: Interpret fundamentals in quantitative techniques and solve problems quickly

Time Speed Distance: Body moving in the same direction- Body moving in the opposite direction-Average speed- Meeting point- Data Sufficiency **P:6**

CO4: Improve quantitative skills and solve problems on permutation and Combination

Probability Permutation Combination: Fundamental Counting Principle – Computing Permutation – Circular Permutation – Computing Combinations- Data Sufficiency **P:6**

CO5: Acquire the knowledge of Cognitive ability and solve puzzles effectively

Abstract reasoning: Mirror and water image – Figure Matrix –Pattern Completion – Logical puzzles –Dot situation - Ranking ordering. **Cognitive ability:** Blood Relation - Direction Sense Test-Data Sufficiency **P:6**

REFERENCE BOOKS

1. R.V.Praveen, "Quantitative Aptitude and Reasoning", 3rd Edition , Eastern Economy Edition, PHI Learning 2016
2. Arun Sharma," Quantitative Aptitude for CAT", McGraw Hill Edge, 10th Edition, 2022
3. Dr.R.Aggarwal, " Quantitative Aptitude", S Chand Publishing, Revised Edition, 2017

P:30; TOTAL: 30 PERIODS

Course Code	**STRENGTH OF MATERIALS**	**L**	**T**	**P**	**E**	**C**
23CE41C		**3**	**0**	**0**	**0**	**3**

COURSE OUTCOMES

Upon successful completion of this course, the students will be able to

Theory component

CO1: Apply the concept of Energy principles
CO2: Analyze indeterminate structures
CO3:Evaluate the State of stress in three dimension and failure theories
CO4:Analyze Columns and Cylinders
CO5: Analysis of beams subjected to Unsymmetrical bending, curved beams and Shear centre.

CO1: Apply the concept of Energy principles **L:10**

Strain energy and strain energy density – strain energy in traction, shear in flexure and torsion – Castigliaon's theorem – principle of virtual work – application of energy theorems for computing deflections in beams and trusses – Maxwell's reciprocal theorem.

CO2: Analyze indeterminate structures **L:8**

Propped cantilever and fixed beams-fixed end moments and reactions for concentrated load (central, noncentral), uniformly distributed load, triangular load (maximum at centre and maximum at end) – theorem ofthree moments – analysis of continuous beams – shear force and bending moment diagrams for continuousbeams.

CO3: Evaluate the state of stress in three dimension and failure theories **L:8**

Determination of principal stresses and principal planes in three dimension–volume trics train–dilatation and distortion – theories of failure – principal stress dilatation – principal strain – shear stress – strain energy and distortion energy theories

CO4: Analyze Columns and Cylinders **L: 10**

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 – middle third rule – core section – columns of unsymmetrical sections – (angle channel sections) – thin cylinders and shells – under internal pressure – deformation of thin cylinders and shells - thick cylinders – compound cylinders.

CO5: Analysis of beams subjected to Unsymmetrical bending, curved beams and Shear center. **L: 9**

Unsymmetrical bending of beams of symmetrical and unsymmetrical sections – curved beams – Winkler Bach formula – stress concentration – Shear flow – Shear center.

TEXT BOOKS

1. Bansal R.K. "Strength of materials", Laxmi Publications, New Delhi, 2022.
2. S.S.Bhavikatti, "Strength of Materials", Vikas Publishing Company Private Limited, New Delhi,2021.

REFERENCES

1. Hibbeler, R.C., Mechanics of Materials, Pearson, 2022
2. Dr. B. C. Punmia ,Er. Ashok Kr. Jain ,Dr.Arun Kumar Jain. "Strength of Materials, Laxmi Publishing Private Limited, New Delhi, 2019.
3. Rajput R.K. "Strength of Materials", S.Chand & Company Limited, New Delhi, 2022.

L: 45; L:45; TOTAL: 45 PERIODS

Course Code		L	T	P	E	C
23CE42C	**WATER SUPPLY ENGINEERING**	3	0	0	0	3

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Component

CO1: Examine the sources of water and their characteristics.
CO2: Design the conveyance system along with the appurtenances.
CO3: Design the suitable components of a water treatment plant.
CO4: Demonstrate the different types of advanced water treatment processes.
CO5: Analyze and design water distribution networks.

CO1: Examine the sources of water and their characteristics **L:9**

Public water supply system - Planning - Objectives - Design period - Population forecasting -Water demand - Sources of water and their characteristics - Surface and Groundwater - Impounding reservoir well hydraulics - Development and selection of source - Water quality - Characterization-Water quality standards.

CO2: Design the conveyance system along with the appurtenances. **L:9**

Water supply - intake structures - Functions and drawings - Pipes and conduits for water - Pipe materials - Hydraulics of flow in pipes - Transmission main design - Laying, jointing and testing of pipes - Drawings appurtenances - Types and capacity of pumps - Selection of pumps and pipe materials.

CO3: Design the suitable components of a water treatment plant **L:9**

Objectives - Unit operations and processes - Principles, functions of flash mixers, flocculators, sedimentation tanks , and sand filters – Disinfection - Ozonation and UV - Water softening- demineralization

CO 4: Demonstrate the different types of advanced water treatment processes. **L:9**

Aerator - Iron and manganese removal- Defluoridation - Desalination - Reverse Osmosis-membrane Systems – Construction, Operation & Maintenance aspects of Water Treatment Plants - Recent advances - Membrane Processes – Arsenic treatment.

CO5: Analyse and design water distribution network. **L:9**

Requirements of water distribution - Components - Service reservoirs - Functions and drawings - Economic way of design of Network - Computer applications - Analysis of distribution networks - Appurtenances - operation and maintenance - Leak detection-methods -principles of design of water supply in buildings - House service connection - Fixtures and fittings - Systems of plumbing and drawings of types of plumbing.

TEXT BOOKS

1. Modi, P.N., Water Supply Engineering, Vol.I Standard Book House, New Delhi, 2018
2. Garg, S.K. Environmental Engineering, Vol.I Khanna Publishers, New Delhi, 2018
3. Duggal K.N., "Elements of Environmental Engineering" S.Chand and Co. Ltd., New Delhi, 2014.

REFERENCES

1. Punmia B.C, Ashok Jain and Arun Jain, Water Supply Engineering, Laxmi Publications (P) Ltd., New Delhi 2016.
2. Gray N.F, "Water Technology", Elsevier India Pvt. Ltd. New Delhi, 2006.
3. Manual on Water Supply and Treatment, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 2023.

L: 45; L:45; TOTAL: 45 PERIODS

Course Code	**HYDRAULICS AND HYDRAULIC**	**L**	**T**	**P**	**E**	**C**
23CE43C	**MACHINES**	**3**	**0**	**2**	**0**	**4**

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Component

CO1: Apply the concepts of open channel flow and design the economical Section
CO2: Analyze the flow measurement and specific energy
CO3: Analyze the varied channel-flow and dam flow profile characteristics
CO4: Evaluate the performance characteristics of various types of turbines
CO5: Demonstrate the different types of pumps for various Engineering applications

Practical Component

CO6: Evaluate the co-efficient of discharge for notches (Rectangular, Triangular)
CO7: Determine the impact of jet on Vanes (Flat/Inclined/Curved)
CO 8: Evaluate the efficiency of Hydraulic Machines (Pumps/Turbines)

CO1: Apply the concepts of open channel flow and design the economical Section L:10

Definition and differences between pipe flow and open channel flow - classification of Flow in channels - Properties of open channel - Velocity distribution in open channel — Discharge through Manning's and Chezy's formula –Most economical sections of channels.

CO2: Analyze the flow measurement and specific energy L:8,
CO6: Evaluate the co-efficient of discharge for notches (Rectangular, Triangular) P:3

Flow measurement by notches and weirs – Specific energy– Determination of normal depth and velocity - Critical flow and its computation – application of specific energy and discharge diagrams to Channel Transition.

CO3: Analyze the rapidly varied channel-flow and dam flow profile characteristics L:10

Non-Uniform flow through open channel - Dynamic equations of gradually varied flow – Assumptions – Characteristics of flow profiles – Draw down and back water curves – Profile determination – Graphical integration, direct step and standard step method – Hydraulic jump – Location of hydraulic jump.

CO4: Evaluate the performance characteristics of various types of turbines L:9,
CO7: Determine the impact of jet on Vanes(flat / inclined/curved) P:12

Impact of jets on plane and curved plates - Classification of Turbines – Selection of turbine – Impulse turbine – Radial flow Reaction turbines - Francis turbine - draft tube – Axial flow reaction turbine - Propeller and Kaplan turbine – Specific speed of turbine.

CO5: Demonstrate the different types of pumps for various Engineering applications L:8,
CO8: Evaluate the efficiency of Hydraulic machines (Pumps & Turbines) P:15

Classification of Pumps - Centrifugal pump - Work done – Multistage centrifugal pump – NPSH - Specific speed of pump - Characteristics curve - reciprocating pump – negative slip - flow separation conditions - air vessels - indicator diagram

TEXT BOOKS

1. Bansal R.K, Fluid mechanics & Hydraulic machines, Laxmi Publishing Private Limited, New Delhi, 11th Edition, 2024.
2. Modi, P.N & Seth, S.M "Hydraulics and fluid Mechanics", Standard book house, New Delhi, 21st Edition, 2017.
3. Yunus A. Cengel , John M. Cimbala , Fluid Mechanics: Fundamentals and Applications, Tata McGraw HillEducation Private Limited, New Delhi, 4th Edition, 2017 .

REFERENCES

1. Jain A.K., "Fluid Mechanics including Hydraulic Machines", Khanna Publishers, New Delhi, 2016.
2. Ramamrutham S, Hydraulics Fluid Mechanics and Fluid Machines, Dhanpat Rai Publishing Company, 9th Edition, 2014
3. Subramanya.K; Fluid Mechanics and Hydraulic Machines; Tata McGraw Hill Education Private Limited, New Delhi, 2nd Edition, 2018

L: 45; P: 30; TOTAL: 75 PERIODS

Course Code	CONCRETE TECHNOLOGY	L	T	P	E	C
23CE44C		3	0	2	0	4

COURSE OUTCOMES

Upon successful completion of this course, the students will be able to

Theory Component

CO1: Describe the requirements of cement, aggregates, and water for concrete
CO2: Select suitable admixtures for enhancing the properties of concrete
CO3: Design concrete mixes as per IS method of mix design
CO4: Determine the properties of concrete in fresh and hardened states.
CO5: Manufacture the special concretes for specific requirements.

Practical Component

CO6: Determine the physical properties of cement
CO7: Determine the physical properties of aggregates
CO8: Determine the workability and mechanical properties of concrete

CO1: Understand the requirements of cement, aggregates, and water for concrete **L: 9,**
CO6: Determine the physical properties of cement **P: 20**
CO7: Determine the physical properties of aggregates

Cement-Different types - Chemical composition and Properties - Aggregates-Classification-Mechanical properties and tests as per BIS Grading requirements - Water- Quality of water for use in concrete

TESTS ON CEMENT - Determination of fineness of cement, specific gravity of cement, consistency of cement, and initial and final setting time of cement .TEST ON FINE AGGREGATE - Determination of specific gravity and water absorption of fine aggregate and grading of fine aggregate. TEST ON COARSE AGGREGATE - Determination of compacted and loose bulk density of coarse aggregate, impact value of coarse aggregate, elongation index of coarse aggregate, flakiness index of coarse aggregate, crushing value of coarse aggregate and specific gravity of coarse aggregate

CO2: Select suitable admixtures for enhancing the properties of concrete **L:9**

Accelerators-Retarders- Plasticisers- Super plasticizers- Waterproofers - Mineral Admixtures like Fly Ash, Silica Fume, Ground Granulated Blast Furnace Slag, and Metakaolin - Effects of admixtures on concrete properties

CO3: Design concrete mixes as per IS method of mix design **L:9**

Principles of Mix Proportioning- Properties of Concrete Related to Mix Design - Design Mix and Nominal Mix-BIS Method of Mix Design - Mix Design Examples.

CO4: Determine the properties of concrete at fresh and hardened state **L: 9,**
CO8: Determine the workability and mechanical strength of concrete **P: 20**

Workability - Segregation and Bleeding – Relationship between water-cement ratio and strength of concrete

- Compressive and Flexural strength requirements as per BIS - Properties of Hardened concrete- Stress- strain curve for concrete - Modulus of elasticity. TEST ON CONCRETE - Determination of slump of concrete, compressive strength of concrete, flexural strength of concrete and modulus of elasticity

CO5: Manufacture the special concretes for specific requirements **L:9**

High-strength concrete - Fibre reinforced concrete – Ferrocement - Ready mix concrete - Shotcrete – Polymer concrete - High-performance concrete- self-compacting concrete - Geopolymer Concrete.

TEXTBOOKS

1. Gupta.B.L., Amit Gupta, "Concrete Technology", Jain Book Agency, 2022.
2. Shetty,M.S, "Concrete Technology", S.Chand and Company Ltd, New Delhi, 2019

REFERENCES

1. Neville, A.M; "Properties of Concrete", Pitman Publishing Limited, London, 2018
2. Gambhir.M.L, Concrete Technology, Fifth Edition, McGraw Hill Education, 2017.
3. Job Thomas, Concrete Technology, Cencage Learning India Private Ltd, New Delhi, 2015.
4. IS10262-2019 Recommended Guidelines for Concrete Mix Design, Bureau of Indian Standards, NewDelhi.

L: 45, P: 30; TOTAL: 75 PERIODS

Course Code	SOIL MECHANICS	L	T	P	E	C
23CE45C		3	0	2	0	4

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Component

Upon completion of this course, the students will be able to

CO1: Compute the index properties of soil and classify soil according to the IS Classification system.

CO2: Discuss the principle of soil water movement and its effect on stress distribution

CO3: Evaluate the Vertical stresses and compute compaction and consolidation characteristics of soil

CO4: Determine the shear strength parameters of soil

CO5: Analyze the Slope Stability of Soil

Practical Component

CO6: Demonstrate the basic index properties of soil and prepare a soil report based on the IS Classificationsystem.

CO7: Perform Experiments to determine the coefficient of permeability of cohesionless soil and cohesivesoil.

CO8: Demonstrate the experiment to ascertain the compaction characteristics and coefficient of consolidation of soil.

CO9: Perform Experiments to determine shear strength parameters of soil.

CO1: Compute the basic index properties of soil and classify soil according to the IS Classification system. **L:10, P:12**

CO6: Demonstrate the basic index properties of soil and prepare a soil report based on the IS Classification system.

Nature of Soil - Problems with soil - phase relation -Index properties – clay mineralogy

structural arrangement of grains - sieve analysis - sedimentation analysis – Atterberg's limits - Classification for engineering purposes - BIS Classification system.

CO2: Discuss the principle of soil water movement and its effect on stress distribution **L:9,**
CO7: Perform Experiments to determine the coefficient of permeability of cohesionless soil and cohesive soil. **P:4**

Soil water – Various forms – Capillary rise – Suction - Effective stress concepts in soil – Total, neutral and effective stress distribution in soil - Permeability – Darcy's Law- Permeability measurement in the laboratory – field measurement pumping out in unconfined and confined aquifer - Quick sand condition - Seepage - Introduction to flow nets.

CO3: Evaluate the Vertical stresses and compute compaction and consolidation characteristics of soil **L:10, P:6**
CO8: Demonstrate the experiment to ascertain the compaction characteristics and coefficient of consolidation of soil.

Stress distribution in soil media – Boussinesque formula – Stress due to line load and Circular and rectangular loaded area - Approximate methods - Use of influence charts - Soil compaction - factors affecting compaction – Field compaction methods-Components of settlement - Terzaghi's one dimensional consolidation theory - Laboratory consolidation test – Computation of rate of settlement – consolidationsettlement.

CO4: Determine the shear strength parameters of soil **L:9,**
CO9: Perform Experiments to determine shear strength parameters of soil **P:8**

Shear strength of cohesive and cohesionless soils - Mohr - Coulomb failure theory - Measurement of shear strength, direct shear, Triaxial compression, UCC and Vane shear tests – Pore pressure parameters – Factors influences shear strength of soil- Liquefaction of sand.

CO5: Analyze the Slope Stability of Soil **L:7**

Slope failure mechanisms - Modes - Infinite slopes - Finite slopes – Method of slices – Modified Bishop's method - Friction circle method - Stability number – Problems – Slope protection measures.

TEXT BOOKS

1. Punmia, B.C., Soil Mechanics and Foundations‖, Laxmi Publications Private Limited, 18th Edition, 2023.
2. Arora, K.R, Soil Mechanics and Foundation Engineering, Standard Publishers, 7th Edition, 2020(Reprint).

REFERENCES

1. Craig.R.F., Soil Mechanics, Spon Press E & F N, London and New York, 9th Edition, 2019.
2. Gopal Ranjan, A S R Rao, ―Basic and Applied Soil Mechanics, New Age International Publication, 4th Edition, 2022.
3. Murthy, V.N.S., Text book of Soil Mechanics and Foundation Engineering, CBS Publishers Distribution Limited., New Delhi, 2018.
4. Palanikumar.M., Soil Mechanics, Prentice Hall of India, Learning Private Limited Delhi, 2013.

L: 45; P: 30; TOTAL: 75 PERIODS

Course Code	**SYSTEM MODELING PROJECTS**	**L**	**T**	**P**	**E**	**C**
23CE46C		**0**	**0**	**2**	**2**	**2**

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Practical component:

CO1: Apply basic mathematics, science, and engineering concepts to develop models for systems or products across various domains.

Experiential component:

CO2: Develop and analyze models using fundamental principles to solve real-life problems.

Soft skill component:

CO3: Develop the ability to work collaboratively in teams to model and simulate systems while effectively communicating technical results using suitable tools and techniques.

COURSE OVERVIEW

This course is designed to equip students with the skills to develop and analyze mathematical models for various systems across different domains. It focuses on applying fundamental principles of mathematics, science, and engineering to represent and predict the behaviour of these systems. Through hands-on experience, students will learn to create robust models that address real-world challenges, ranging from system optimization to problem-solving in practical applications. The course emphasizes integrating theoretical concepts with practical solutions, preparing students to design efficient and effective models while promoting technical excellence and professional growth.

P: 30; E:30; TOTAL:60 PERIODS

23MC01C	**CONSTITUTION OF INDIA**	**L**	**T**	**P**	**E**	**C**
		2	**0**	**0**	**0**	**0**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO1: Describe the salient features of the Indian Constitution.
CO2: Discuss the structure and functions of parliament.
CO3: Elaborate the structure and functions of state legislature.
CO4: Explain the fundamentals of organization and working of the Judiciary.
CO5: Discuss the foreign policy of India.

CO1: Describe the salient features of the Indian Constitution **6**

Salient Features – Preamble-Pillars of constitution - Fundamental Rights – Directive Principles of State Policy - Fundamental Duties.

CO2: Discuss the structure and functions of parliament **6**

Powers and Functions of President and Prime Minister - Council of Ministers – The Legislature Structure and Functions of Lok Sabha and Rajya Sabha – Speaker.

CO3: Elaborate the structure and functions of state legislature **6**

Features of Federal System - Administrative Relationship between Union and States

- Powers and Functions of Governor and Chief Minister – Council of Ministers – State Legislature.

CO4: Explain the fundamentals of organization and working of the Judiciary **6**
Organization and Composition of Judiciary - Powers and Functions of the Supreme Court - Judicial Review – High Courts.

CO5: Discuss the foreign policy of India **6**
Foreign Policy of India – VISA Application Process- International Institutions like UNO, WTO, SAARC and Environmentalism.

TEXT BOOKS

1. Basu D.D," Introduction to Indian Constitution", Prentice Hall of India, 2015.
2. Gupta D.C, "Indian Government and Politics", Vikas Publishing House, 2010.

REFERENCES

1. Pylee M.V, "Introduction to the Constitution of India", Vikas Publishing House, 2011.
2. Kashyap S, "Our Constitution", National Book Trust, 2010.
3. Shukla V N, "Constitution of India", Eastern Book Company Ltd., 2011.

L: 30; TOTAL: 30 PERIODS

23CE51C	STRUCTURAL ANALYSIS	L	T	P	E	C
		3	1	0	0	4

COURSE OUTCOMES

Upon completion of this course, the students will be able to
CO1: Use the strain energy principles in analysis of indeterminate structures
CO2: Construct influence line diagrams for a structure under moving load.
CO3:Analyse three hinged, two hinged and fixed arches
CO4:Analyze the continuous beams and rigid frames by slope defection method
CO5: Analyze the continuous beams and rigid frames by moment distribution method

CO1: Use the strain energy principles in analysis of indeterminate structures. L:9, T:3
Determination of Static and Kinematic Indeterminacies –Analysis of statically indeterminate structures - continuous beams, plane frames and indeterminate plane trusses by strain energy method (up to two degree of redundancy),Lack of fit - Temperature stresses.

CO2: Construct influence line diagrams for a structure under moving load. L: 9, T:3
Influence lines for reactions in statically determinate structures –Influence lines for shear force and bending moment in beam sections - influence lines for member forces in pin jointed plane frames. - Influence line for support reactions, shearing force and bending moments for indeterminate beams - propped cantilevers, fixed beams and continuous beams - Muller Breslau's principle.

CO3: Analyze three hinged, two hinged and fixed arches L: 9, T:3

Arches - Types of arches - Analysis of three-hinged, two-hinged and fixed arches - Parabolic and circular arches - Settlement and temperature effects.

CO4: Analyze the continuous beams and rigid frames by slope defection method L: 9, T: 3

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.

CO5: Analyze the continuous beams and rigid frames by moment distribution method L:9, T:3

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 loadings

TEXT BOOKS

1. R.C.Hibbeler, Structural Analysis in SI units, Pearson India, Tenth Edition, 2019.
2. Bhavikatti,S.S, Structural Analysis, Vol.1 & 2, Vikas Publishing House Pvt. Ltd., New Delhi-4, Fifth edition, 2021.

REFERENCES

1. Punmia B. C., Ashok Kumar Jain & Arun Kumar Jain, "Theory of structures (SMTS 2)", Laxmi Publications, New Delhi, 2017
2. Thandavamoorthy, ''Analysis of Structures", Oxford &IBH Publishers, New Delhi.2011
3. Reddy C. S., "Basic Structural Analysis", Tata McGraw Hill Publishing Company, 2005.
4. Gambhir.M.L., Fundamentals of Structural Mechanics and Analysis, PHI Learning Pvt. Ltd., 2011.

L: 45; T: 15; TOTAL: 60 PERIODS

23CE52C DESIGN OF REINFORCED CONCRETE ELEMENTS

L	T	P	E	C
3	0	0	0	3

COURSE OUTCOMES

Upon completion of this course, the students will be able to
CO1:Explain the design concepts and design the elements under flexure by working stress method.
CO2: Design the structural reinforced concrete elements under flexure by limit state method.
CO3: Design the structural reinforced concrete elements under shear, torsion, anchorage, and development length by limit state method.
CO4:Design the structural reinforced concrete elements under compression by limit state method.
CO5: Design the footings by limit state design method.

CO1: Explain the design concepts and design the elements under flexure by working stress method. 9

Concept of working stress method, ultimate load method, and limit state method -Limit state philosophy as detailed in IS code - Advantages of limit state method over other methods - characteristic strength and design strength of materials, characteristic loads and design loads, partial safety factors for loads and material strength, cover for durability and fire resistance - Design of beams and slabs by working stress method.

CO2: Design the structural reinforced concrete elements under flexure by limit state design method. 9

Limit state of collapse for flexure: assumptions, stress-strain curves for concrete and steel, stress block, maximum strain in concrete, limiting values of neutral axis for different grades of steel, balanced and under reinforced sections; Analysis and design of singly and doubly reinforced rectangular and flanged sections - Design of one way and two-way slabs using IS code provisions.

CO3: Design the structural reinforced concrete elements under shear, torsion, anchorage, and development length by limit state design method. **9**

Limit state of collapse for shear, torsion, bond and anchorage: Design of beams for shear and torsion; Design of beams for combined bending, shear and torsion; Design for development length and end anchorages; Reinforcement detailing.

CO4: Design the structural reinforced concrete elements under compression by limit state design method. **9**

Braced and unbraced columns; Design of columns for axial load – square, rectangular and circular cross-sections with lateral and spiral ties; Design of columns for uniaxial and biaxial eccentricities using interaction charts.

CO5: Design the footings by limit state design method. **9**

Design of footing: isolated footing - square and rectangular; combined footing – rectangular and trapezoidal.

TEXT BOOKS

1. Unnikrishna Pillai and Devdas Menon, Reinforced Concrete Design (Fourth Edition), Tata Mc Graw Hill Publishing Company Ltd., New Delhi, 2021.
2. P.C. Varghese, Limit State Design of Reinforced Concrete, Prentice Hall of India, Pvt. Ltd., New Delhi, 2008.

REFERENCES

1. B.C.Punmia, Ashok Kumar Jain and Arun Kumar Jain, Limit State Design of Reinforced Concrete, Laxmi Publications, Revised edition, 2016
2. M.L. Gambhir, Fundamentals of Reinforced Concrete Design, Prentice Hall of India Private Limited, New Delhi, Fifth Printing, 2011.
3. N. Subramanian, Design of Reinforced Concrete Structures, Oxford University Press, New Delhi, 2014.
4. N. Krishna Raju and R.N. Pranesh, Reinforced Concrete Design IS 456-2000, Principles and practice, New Age International (P) Ltd Publishers, New Delhi, 2018.
5. S.N. Sinha, Reinforced Concrete Design, Tata McGraw-Hill, New Delhi, 2017.
6. Self-learning materials – Online courses - https://nptel.ac.in/courses/105105105.

IS CODES

1. IS 456:2000 Plain and Reinforced Concrete – Code of Practice.
2. IS 875(1-2):1987 Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures.
3. IS 875(3):2015 Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures
4. IS 875(4-5):1987 Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures
5. SP 16:1980 Design Aids for Reinforced Concrete to IS 456:1978.
6. SP 34:1987 Handbook of concrete reinforcement and detailing.
7. Handbook for Limit State Design of Reinforced Concrete Structures – Roorkee.

L: 45, TOTAL: 45 PERIODS

23CE53C	**FOUNDATION ENGINEERING**	**L**	**T**	**P**	**E**	**C**
		3	**0**	**0**	**0**	**3**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO1: Plan and execute detailed site investigation program to select type of foundation.

CO2: Apply principles to evaluate the bearing capacity of shallow foundations by analyzing soil conditions.

CO3: Examine the types of footing and raft based on contact pressure distribution.

CO4: Interpret the load carrying capacity and settlement of piles and pile group.

CO5: Illustrate the behavior of soil behind retaining structures.

CO1: Plan and execute detailed site investigation program to select type of foundation L:7

Scope and objectives – Methods of exploration-Augur boring – Wash boring and rotary drilling– Geophysical methods- Depth of boring – Spacing of bore hole –Sampling–Representative and undisturbed sampling – Sampling techniques – Split spoon sampler, Thin tube sampler, Stationary piston sampler –Penetration tests (SPT and SCPT) – Bore log report – Data interpretation (Strength Parameters and Liquefaction potential) –selection of foundation based on structural load and SBC.

CO2:Apply principles to evaluate the bearing capacity of shallow foundations by analyzing soil conditions L:10

Introduction – Location and depth of foundation – Codal provisions – Bearing capacity of shallow foundation on homogeneous deposits–Terzaghi's formula and BIS formula–factors affecting bearing capacity – Problems - Bearing Capacity from insitu tests (SPT, SCPT and plate load) – Allowable bearing pressure, Determination of settlement of foundations on granular and clay deposits – Total and differential settlement - Allowable settlements –Codal provision – Methods of minimizing settlement, differential settlement.

CO3: Examine the types of footing and raft based on contact pressure distribution L:10

Types of foundation – Contact pressure distribution and settlement below footings and raft- Isolated and combined footings – Types and proportioning -Strip foundation- Mat foundation– Types, applications uses and proportioning-principle of floating foundation- Seismic force considerations-Codal provisions.

CO4: Interpret the load carrying capacity and settlement of piles and pile group. L:9

Types of piles and their function – Factors influencing the selection of pile –Pile installation methods- Carrying capacity of single pile in granular and cohesive soil - Static formula - Dynamic formulae (Engineering news and Hiley‟s)– Capacity from in-situ tests (SPT and SCPT) – Negative skin friction – Uplift capacity – Group capacity by different methods (Feld‟s rule, Converse Labarre formula and block failure criterion) – Settlement of pile groups – Interpretation of pile load test – Forces on pile caps – Under reamed piles – Capacity under compression and uplift-Codal provisions

CO5: Illustrate the behavior of soil behind retaining structures. L:9

Plastic equilibrium in soils – Active and passive states – Rankine‘s theory – Cohesionless and cohesive soil – Coulomb‘s wedge theory – Condition for critical failure plane –Types of retaining walls- Earth pressure on retaining walls of simple configurations – Culmann Graphical method – Pressure on the wall due to line load – Stability analysis of retaining walls.

TEXTBOOKS:

1. Arora, K.R, Soil Mechanics and Foundation Engineering, Standard Publishers, 7th Edition, 2020 (Reprint).
2. Murthy, V.N.S., Text book of Soil Mechanics and Foundation Engineering, CBS Publishers Distribution Ltd., New Delhi.2014.

3. Punmia, B.C., Soil Mechanics and Foundations, Laxmi Publications Private Limited, 18th Edition, 2023.

REFERENCES:

1. Joseph E Bowles, ―Foundation Analysis and design‖, McGraw Hill Education, 6th Edition, 2022.
2. Varghese, P.C., ―Foundation Engineering‖, Prentice Hall of India Private Limited, New Delhi, 2nd Edition,2016
3. Das, B.M. ―Principles of Foundation Engineering, Cengage India Pvt Ltd., 9th Edition, 2019.

L: 45; L:45; TOTAL: 45 PERIODS

23CE54C	**WASTEWATER ENGINEERING**	**L**	**T**	**P**	**E**	**C**
		3	**0**	**2**	**0**	**4**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

Theory Component

CO1: Estimate sewage generation and design sewer system.
CO2: Perform basic design of the unit operations used in sewage treatment
CO3: Design the suitable secondary treatment processes
CO4: Acquire knowledge of advance treatment technology
CO5: Perceive the concepts of self-purification of streams and sludge disposal methods

Practical Component

CO6: Determine the physical and chemical characteristics of wastewater and compare with discharge standards

CO1: Estimate sewage generation and design sewer system.
CO6: Determine the physical and chemical characteristics of wastewater and compare with discharge standards **9+30**

Sources***, Characteristics of sewage and its composition*** - population equivalent - Estimating quantity of sewage - Storm runoff estimation - Sewerage - separate, combined and partially separate system - Hydraulic design of flow in sanitary sewers -Sewer design- sewer materials -Laying and testing - sewer appurtenances – sewage pumping - Discharge standards for Effluents

CO2: Perform basic design of the unit operations used in sewage treatment **9**

Objectives – Unit Operations and Processes - Collection system - Selection of treatment processes - Primary treatment – Principles, functions and design of sewage treatment units - screens - grit chamber - primary sedimentation tanks - Onsite sanitation - Septic tank - Operation and Maintenance aspects.

CO3: Design the suitable secondary treatment processes **9**

Objectives – Selection of Treatment Methods – Principles, Functions and design - Activated Sludge Process - Sludge Volume Index- Natural systems - Ponds and Lagoons - Trickling filters - Rotating biological contactors - Operation and Maintenance aspects.

CO4: Acquire knowledge of advance treatment technology **9**

Hybrid system - Sequential Batch Reactor - Anaerobic systems - Anaerobic filters - UASB - Biogas recovery- Reclamation and Reuse of sewage - Constructed Wetland - Nutrient removal systems-DEWATS (Basics).

CO5: Perceive the concepts of self-purification of streams and sludge disposal methods. 9

Dilution – Self-purification of surface water bodies - Oxygen sag curve – Streeter Phelps equation - Eutrophication - Land Disposal – Sewage farming – Sewage sickness - sodium hazards - Soil dispersion system- Sludge Digestion- characterization - Thickening – Dewatering – Drying - Disposal - Septage Management.

TEXT BOOKS

1. Garg, S.K., Environmental Engineering Vol. II, Khanna Publishers, New Delhi,43rd Edition, 2024
2. Duggal K.N., "Elements of Environmental Engineering" S.Chand and Co. Ltd., New Delhi, 2014.

REFERENCES

1. Metcalf and Eddy- Wastewater Engineering–Treatment and Reuse, Tata Mc.Graw-Hill Company, New Delhi, 2010.
2. Syed R. Qasim "Wastewater Treatment Plants 'Planning, Design, and Operation", Second Edition CRC Press, Washington D.C.,2017
3. Gray N.F, "Water Technology", Elsevier India Pvt. Ltd., New Delhi, 2006.
4. APHA, "Standard Methods for the Examination of Water and Wastewater", 22nd Ed. Washington, 2012.

L: 45; P:30,TOTAL: 75 PERIODS

23CE55C	HIGHWAYENGINEERING	L	T	P	E	C
		3	0	2	0	4

COURSE OUTCOMES

Upon completion of this course, the students will be able to

Theory component:

CO1: Illustrate the planning and engineering surveys for highway alignment.
CO2: Design the geometric elements of highway
CO3:Design the flexible and rigid pavements
CO4: Evaluate the properties of highway materials and demonstrate the construction practices
CO5: Identify and evaluate the various defects in pavements and its treatment

Practical component:

CO6: Draft the typical cross section and road profile using drafting tools
CO7: Identify the properties of pavement materials and bituminous mix
CO8: Evaluation of on-site pavement conditions and preparation of failure diagnosis report

CO1: Illustrate the planning and engineering surveys for highway alignment L:9

Significance of highway planning – Modal limitations towards sustainability - History of road development in India – factors influencing highway alignment – Soil suitability analysis - Road ecology - Engineering surveys for alignment, objectives, conventional and modern methods (RS & GIS and GPS techniques) - Classification of highways – Locations and functions

CO2:Design the geometric elements of highway

CO6: Draft the typical cross section and road profile using drafting tools L:9, P:6

Typical cross sections of Urban and Rural roads as per IRC - 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 [IRC Standards Only].

CO3: Design the flexible and rigid pavements L:9

Pavement components and their functions - Design principles of Flexible and Rigid pavement-factors affecting the Design of pavements -Design practice for flexible and rigid Pavements (IRC methods only) – Embankments- Problems in Flexible pavement design.

CO4:Evaluate the properties of highway materials and demonstrate theconstruction practices
CO7: Identify the properties of pavement materials and bituminous mix L:9, P:15

Highway construction materials, properties, testing methods – CBR Test for subgrade - tests on aggregate & bitumen – Test on Bituminous mixes-Construction practice including modern materials and methods, Water Bound Macadam Road, Bituminous and Concrete Road, Polymer Modified Bitumen, Different materials – Glass, Fiber, Plastic, Geo-Textiles, Geo-Membrane – Quality control measures - Highway drainage — Construction machineries.

CO5:Identify and evaluate the various defects in pavements and its treatment
CO8: Evaluation and preparation of on-site pavement failure report L:9, P:9

Types of defects in Flexible pavements – Surface defects, Cracks, Deformation, Disintegration – Symptoms, Causes and Treatments. - Defects in Rigid Pavements – Scaling, Shrinkage, Warping, Structural Cracks spalling of Joints and Mud Pumping – and Special Repairs. - Pavement Evaluation – Pavement Surface Conditions and Structural Evaluation, Evaluation of pavement Failure and strengthening – Failure report preparation - Overlay design by Benkelman Beam Method [Procedure only].

TEXT BOOKS

1. Veeraragavan.A, KhannaK and JustoC.E.G. Highway Engineering, Nem Chand & Bros Publishers,2023.
2. Rangwala, Textbook of Highway Engineering, CPHS publishing House Pvt Ltd, 2022.

REFERENCES

1. Kadiyali L.R. “Principles and Practice of Highway Engineering”, Khanna Technical Publications, Delhi, 8thEdition 2021.
2. Subhash C Saxena, “Textbook of Highway and Traffic Engineering”. CBS Publishers, 2017.
3. Veeraragavan. A, Khanna K and Justo C.E.G. “Highway Materials and Pavement Testing”, 2023.
4. IRC 37:2018 –“Guidelines for the Design of Flexible pavements” (Fourth Revision).
5. IRC 58:2018 –“Guidelines for the Design of Plain Jointed Rigid Pavements for Highways” (Fourth Revision).
6. MoRTH Specifications for Road and Bridge work, 5th Edition by IRC (2013).

L: 45, P:30; TOTAL: 75 PERIODS

23CE56C	**DESIGN AND DETAILING LABORATORY**	**L**	**T**	**P**	**E**	**C**
		0	**0**	**2**	**2**	**2**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

Practical Component

CO1: Design the structural elements of multi storied frame structure

CO2: Design and Sketch the various Structures with detailing

CO3: Design and detailing of connections in Industrial steel truss

Experiential Component:

CO4: Design and develop a detailing model for the different civil engineering structures

Softskill Component:

CO5: Communicate effectively and work collaboratively as a team to develop projects, present simulation findings, and engage in constructive feedback sessions.

CO1: Design the structural elements of multi storied frame structure

1. Analysis and design of structural components (Beam, Column and footing) using Stadd pro.
2. Structural detailing of Reinforced Cement Concrete Elements such as Slab, beam, Column with footings etc.

CO2: Design and Sketch the various Structures with detailing

1. Design of RCC circular water tank and drafting reinforcement detailing
2. Design of cantilever Retaining wall and drafting reinforcement detailing

CO3: Design and detailing of connections in Industrial steel truss

1. Analysis and design of steel roof truss using Stadd pro.
2. Detailing of Steel structures (steel connection detailing - beam-to-column connection, beam-to-beam Connection and bracket connection)

L: 30, E: 30; TOTAL: 60 PERIODS

REFERENCES

1. V. B. Sikka, "A course in Civil Engineering Drawing", S. K. Kataria& Sons Publishers, Seventh Edition, 2022.
2. D. N. Ghose, "Civil Engineering Drawing and Design", CBS Publishers & Distributors Pvt. Ltd., 2nd Edition, 2010.
3. Unnikrishnan Pillai and Devadas Menon, Reinforced Concrete Design (Fourth Edition), Tata Mc Graw Hill Publishing Company Ltd., New Delhi, 3rd Edition, 2021.
4. Subramanian N., "Design of Steel Structures", Oxford University Press, New Delhi, 2016
5. IS 456:2000,Plain and Reinforced Concrete -Code of Practice(Fourth edition)
6. IS 875:1987(Part 3), Code of practice for design loads(Other than earthquake)for buildings and structures (Wind Load)
7. IS 875(3):2015 Code of Practice for Design Loads (Other than Earthquake) for Buildings andStructures
8. IS 875(4-5):1987 Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures
9. SP 16:1980 Design Aids for Reinforced Concrete to IS 456:1978.
10. SP 34:1987 Handbook of concrete reinforcement and detailing.
11. IS 800:2007, General Construction in Steel, Code of Practice (Third Edition)

23CE57C	**SIMULATION USING MODERN TOOLS**	**L**	**T**	**P**	**E**	**C**
		0	**0**	**2**	**2**	**2**

COURSE OUTCOMES

Upon completion of this course, students will be able to:

Practical Component:

CO1: Implement and simulate mathematical models for Civil Engineering systems using Simulation software.

CO2: Analyze and interpret the results obtained from the simulated models to understand system behaviour.

Experiential Component:

CO3: Develop a mathematical model to simulate a specific real-world system.

Softskill Component:

CO4: Communicate effectively and work collaboratively as a team to develop projects, present simulation findings, and engage in constructive feedback sessions.

COURSE CONTENT

CO1: Implement and simulate mathematical models for Civil Engineering systems using Simulation software.

CO2: Analyze and interpret the results obtained from the simulated models to understand system behaviour. P:20

Develop mathematical models for various Civil engineering applications for Structural, Environmental, Geo technical, Transportation and Construction management domains. Influence of material properties on strength characteristics of concrete, Development of plane stress and plane strain models, Plasticity models based on yield criteria, Stress-strain Behaviour for isotropic materials, Shear strength analysis of soil properties, compaction & consolidation characteristics of soil, Critical time analysis based with Streeter Phelps equation, Disinfection efficiency using Chicks law, Growth kinetics of microbes with first order reaction, Spot speed delay studies, Traffic flow models at intersection points, Analyse the critical path for project works.

Simulate the mathematical model and analyse the results.

CO3: Develop a mathematical model to simulate a specific real-world system.

CO4: Communicate effectively and work collaboratively as a team to develop projects, present simulation findings, and engage in constructive feedback sessions. E:40

Students are expected to identify and select a real-world Civil Engineering system and create a mathematical model that accurately represents its behavior. They implement the model using computational tools such as MATLAB, run simulations to observe the system's response under various conditions, and critically analyze the results, evaluating the system's performance against predefined criteria.

Example:

Simulation of Mechanical behavior for concrete systems

Simulation of properties of treated water after unit processes

Simulation of settlement of structures based on Soil properties

P: 20; E:40;TOTAL:60PERIODS

REFERENCES

1. Dukkipati, R.V. MATLAB:An Introduction with Applications, New Age International Publications, 2010.
2. Pratap, Rudra. Getting Started with MATLAB, Oxford University Press, 2019.
3. Gilat, Amos. MATLAB:An Introduction with Applications, Wiley Editorial Team, 2023.

LIST OF EXPERIMENTS:

Experiment1: **Simulation of Mechanical Behaviour of Concrete under Compression**

To simulate the stress-strain behaviour of concrete under uniaxial compression.

Experiment2: Plane Stress and Plane Strain Analysis

To model and simulate plane stress and strain in structural elements.

Experiment3: Simulation of Soil Consolidation

To simulate primary consolidation of clay using Terzaghi's 1D theory.

Experiment4: Shear Strength Analysis of Soil

To simulate shear strength of soil using Mohr-Coulomb theory.

Experiment5: Soil Compaction Simulation

To simulate compaction characteristics and determine MDD and OMC.

Experiment6: BOD-DO Modelling using Streeter-Phelps Equation

To simulate DO and BOD levels in a polluted stream.

Experiment7: Disinfection Simulation using Chick's Law

To simulate disinfection of pathogens in water treatment.

Experiment8: Traffic Flow Simulation at Intersection

To simulate traffic flow and queue lengths at a signalized intersection.

Experiment9: Spot Speed and Delay Analysis

To simulate and analyse spot speed and delay on urban roads.

Experiment10: Project Scheduling using CPM

To simulate project scheduling and identify the critical path.

23CE61C	**CONSTRUCTION ENGINEERING AND MANAGEMENT**	**L**	**T**	**P**	**E**	**C**
		3	**0**	**0**	**0**	**3**

COURSE OUTCOMES

Upon successful completion of this course, students will be able to:

CO1: Demonstrate the functions of construction industry and the role of various stakeholders in a project

CO2: Develop project planning and scheduling techniques using modern tools

CO3: Apply resource management and project control techniques in construction projects

CO4: Illustrate the legal, contractual, and ethical aspects of construction projects

CO5: Implement cost, quality, and safety management in construction projects

CO1: Demonstrate the functions of construction industry and the role of various stakeholders in a project **L:9**

Overview of Construction Industry - Key Stakeholders and Project Participants - Characteristics of Construction Projects - Project Life Cycle and Phases - Types of Construction Organizations - Work Breakdown Structure (WBS) - Sustainable Construction Practices in the Industry.

CO2: Develop project planning and scheduling techniques using modern tools L:9

Estimation of Project Time and Cost - Network Planning and Scheduling (Critical Path Method, PERT) - Bar Chart vs. Network Diagrams - Advanced Techniques: AOA, AON, Precedence Networks - Software Tools for Scheduling (MS Project, Primavera) - Resource Allocation and Time Optimization.

CO3: Apply resource management and project control techniques in construction projects L:9

Resource Scheduling and Management - Project Monitoring and Control - Network Analysis and Float Calculations - Critical Path Method (CPM) and Schedule Compression - Cost-Time Tradeoff and Project Crashing - Resource Planning: Human Resources, Materials, Equipment - Construction Procurement and Inventory Control - Equipment Management in Construction Projects.

CO4: Illustrate the legal, contractual, and ethical aspects of construction projects L:9

Introduction to Construction Contracts - Types of Contracts and Selection Criteria - Contract Formation and Legal Framework - Drafting Contract Documents (IBRD/MORTH) - Construction Contract Management - Dispute Resolution, Arbitration, and Legal Issues - Ethical Considerations in Construction Contracts.

CO5: Implement cost, quality, and safety management in construction projects L:9

Introduction to Cost Management and Budgeting - Financial Management in Construction Projects - Cost Control Techniques and Tools - Quality Management Systems (ISO, Six Sigma) - Safety Management and Site Safety Standards - Site Management, Project Administration, and Communication - Risk Management and Mitigation Strategies.

TEXT BOOKS

1. Frederick Gould & Nancy Joyce "Construction Project Management (5th Edition)", Pearson in 2022
2. K.K.Chitkara, Construction Project Management‖, Tata McGraw-Hill Education,2019

REFERENCES

1. Vazirani V.N. & Chandola S.P., Heavy Construction, Khanna Publications.
2. Jha J. & Sinha S.K., Construction & Foundation Engineering, Khanna Publications.
3. Verma L.C., Standardisation - A New Discipline Peurifoy R.L., & Ledbetter W.B., Construction Planning Equipment & Methods
4. **IS 1200**: Method of Measurement of Works of Civil Engineering
5. **IS 15883**: Guidelines for Quality Control in Construction of Concrete Structures

L:45; TOTAL: 45 PERIODS

23CE62C **DESIGN OF STEEL STRUCTURES**

L	T	P	E	C
3	0	0	0	3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO1:Design simple and eccentric connections.

CO2: Design tensile members.

CO3: Design compression members.

CO4:Analyse and design laterally supported and unsupported beams and plate girders.

CO5: Analyse and design roof trusses and industrial structures.

CO1: Design simple and eccentric connections **L:9**

Properties of steel – Structural steel sections - Limit State DesignConcepts– Loads on Structures – Design of riveted, bolted, welded connections – Eccentricconnections –Types of failure – Efficiency of connections – prying action – HSFG bolts**.**

CO2: Design tensile members **L:9**

Types of sections - Net area - Net effective sections for angles and Tee in tension - Behaviour and Design of simple and built-up members subjected to tension - Shear lag effect -Design of lug angles - tension splice

CO3: Design compression members. **L:9**

Types of compression members – Section classifications - Theory of columns – Basis of current codal provision forcompression member design – Slenderness ratio – Design of single section and compound section compression members – Design of lacing and battening type columns – Design of column bases – Gusseted base.

CO4: Analyse and design laterally supported and unsupported beams and plate girders **L:9**

Types of simple beam connections - Design of laterally supported and unsupported beams – Built up beams – Beams subjected to biaxial bending – Design of plate girders riveted and welded – Intermediate and bearing stiffeners – Websplices.

CO5: Analyse and design roof trusses and industrial structures **L:9**

Roof trusses – Roof and side coverings – Design loads – design of purlin and elements oftruss for simple trusses–Design of joints and end bearing – Design of gantry girder – Introduction to Pre- engineered building.

TEXT BOOKS

1. Subramanian N, “Design of Steel Structures”, Oxford University Press, New Delhi, 2017
2. Duggal S.K., Design of Steel Structures, Tata McGraw Hill, Publishing Co. Ltd., New Delhi, 2019.
3. Bhavikatti S.S, Design of Steel Structures, Ik International Publishing House, New Delhi, 2017.

REFERENCES

1. Gaylord, E.H., Gaylord, N.C., and Stallmeyer, J.E., “Design of Steel Structures”, 3rdEdition, McGraw-Hill Publications, 1992.
2. Gambhir M L, Fundamentals of Structural Steel Design, McGraw Hill Education India Pvt Limited, 2013
3. IS 800 (2007), "Indian Standard on General Construction in Steel", Code of Practice.

4. SP (6) - "ISI Handbook for Structural Engineers", Structural Steel Sections (1964).
5. IS 875 (Part 1-5) 1987 "Code of Practice for Design Loads (Other Than Earthquake) For Buildings and Structures".

L: 45; L:45; TOTAL: 45 PERIODS

23CE63C	WATER RESOURCES AND IRRIGATION ENGINEERING	L	T	P	E	C
		3	0	0	0	3

COURSE OUTCOMES

Upon Successful completion of this course, the students will be able to

CO1: Apply the principles of water resources planning to estimate water requirements and fix storage capacity

CO2: Develop water budget for effective use of surface and groundwater

CO3: Estimate duty, delta, base period, and irrigation efficiencies for different crops and seasons.

CO4: Apply appropriate irrigation methods and management practices

CO5: Analyze and design various impounding structures for effective water conveyance and control.

CO1: Apply the principles of water resources planning to estimate water requirements and fix storage **8**

Water resources survey – Water resources of India and Tamilnadu – Description of water resources planning – Estimation of water requirements for irrigation and drinking- Single and multipurpose reservoir – Multi objective - Fixation of Storage capacity -Strategies for reservoir operation - Design flood-levees and flood walls

CO2: Develop water budget for effective use of surface and groundwater **8**

Economics of water resources planning; – National Water Policy – Consumptive and non-consumptive water use - Water quality – Scope and aims of master plan - Concept of basin as a unit for development - Water budget- Conjunctive use of surface and ground water

CO3: Estimate duty, delta, base period, and irrigation efficiencies for different crops and seasons **10**

Crops and Seasons – Crop water Requirement – Duty, Delta, crop period and Base period – Factors affecting duty - Irrigation efficiencies -Numerical Problems on water requirement and Irrigation efficiencies- Estimation of Consumptive use of water

CO4: Apply appropriate irrigation methods and management practices **10**

Lift irrigation – Tank irrigation – Well irrigation – Irrigation methods: Surface and Sub-Surface and Micro Irrigation – Merits and demerits – Irrigation scheduling – Water distribution – Participatory irrigation management with a case study–IoT application in irrigation.

CO5: Analyze and design various impounding structures for effective water conveyance and control **9**

Types of Impounding structures: Earthen and Gravity dams – Diversion Head works – Canal drop – Cross drainage works – Canal regulations – Canal outlets – Canal lining – Kennady's and Lacey's Regime theory- spillway

L:45; TOTAL: 45 PERIODS

TEXT BOOKS

1. G.L.Asawa, *Irrigation and Water Resources Engineering*, 2nd Edition, New Delhi: New Age International, 2025.
2. N.N. Basak, *Irrigation Engineering*, 2nd Edition,New Delhi: McGraw-Hill Education, 2020.

REFERENCES

1. P. N. Punmia, *Irrigation and Power Engineering*, 16thEd. New Delhi: Laxmi Publications, 2020.
2. K. Subramanya, *Hydrology and Water Resources Engineering*. New Delhi: Tata McGraw-Hill, 2008.
3. L.W.Mays, *Water Resources Engineering*. Hoboken, NJ: Wiley, 2011.

23CE64C	**ESTIMATION AND COSTING LAB**	**L**	**T**	**P**	**E**	**C**
		1	**0**	**2**	**0**	**2**

COURSE OUTCOMES

Upon Successful completion of this course, the students will be able to

CO1: Understand the various specifications and components of the buildings and roads.

CO2: Prepare a Report on detailed estimates of the building construction.

CO3: Prepare a Report on detailed estimates of the road construction.

CO1: Understand the various specifications and components of the buildings and roads 15

Load bearing and Framed structures – Calculation of quantities of Earthwork, PCC, Brick work, RCC, Plastering for Residential building - Standard Data – Observed Data – Schedule of rates – Market rates – Materials and Labour – Standard Data for Man Hours and Machineries for common civil works – Rate Analysis for all Building and Roads – Cost Estimates - Principles for Report Preparation – Report on Estimate of residential building – Roads.

CO2: Prepare a Report on detailed estimates of the building construction. 30

CO3: Prepare a Report on detailed estimates of the road construction.

1. Estimation of building using individual wall method.
2. Estimation of building using centre line method.
3. Estimation of Earthwork for roads and canals by i) Mid-sectional area method, ii) Mean area method.
4. Estimation of Earthwork for roads and canals by i) Prismoidal method, ii) Trapezoidal method.
5. Estimation of Reinforcement bar bending and bar requirement schedules for given plans.
6. Preparation for approximate estimate for road project.
7. Estimating cost of building on plinth area method.
8. Analysis of Rate for different items of works in Building Construction.
9. Prepare a Report on Estimates for the Construction of Residential Building
10. Prepare a Report on the Estimate for a Road Construction

L:30; P: 60; TOTAL: 90 PERIODS

TEXT BOOKS

1. B.N Dutta ‘Estimating and Costing in Civil Engineering’, CBS Publishers & Distributors (P) Ltd, 28thRevised Edition, 2020.
2. B.S.Patil, ‘Civil Engineering Contracts and Estimates’, 7thEdition, University Press, 2015.

3. D.N. Banerjee, 'Principles and Practices of Valuation', V Edition, Eastern Law House, 2015.

REFERENCES

1. Hand Book of Consolidated Data–8/2000, Vol.1, TNPWD.
2. Tamil Nadu Transparencies in Tenders Act, 1998 and rules 2000.
3. Arbitration and Conciliation Act, 1996.
4. Standard Bid Evaluation Form, Procurement of Good or Works, The World Bank, April 1996.
5. Standard Data Book for Analysis and Rates, IRC, New Delhi, 2019.

23CE65C	**PRODUCT DEVELOPMENT PRACTICE**	**L**	**T**	**P**	**E**	**C**
		0	**0**	**0**	**4**	**2**

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Experiential Component

CO1: Identify and analyze real-world problems using empathy techniques and reverse engineering approaches.

CO2: Apply forward engineering to develop innovative solutions, focusing on technical feasibility, patentability, and market potential.

Soft skill component

CO3: Demonstrate the functionality of the developed product through prototypes and validate its commercial and patenting potential.

CO1: Identify and analyze real-world problems using empathy techniques and reverse engineering approaches.

- Empathy-driven customer need identification **25**
- Problem definition and market analysis
- Study of existing solutions and reverse engineering analysis
- Deriving specifications and functional gaps
- Conceptual design based on gaps and feasibility

CO2: Apply forward engineering to develop innovative solutions, focusing on technical feasibility, patentability, and market potential.

- Concept refinement and solution detailing **35**
- Prototype development (hardware/software)
- Technical, financial, and IP (intellectual property) feasibility study
- Cost estimation and business model canvas
- Prototype demonstration and product documentation

Course Code	INDIAN CULTURE AND HERITAGE	L	T	P	E	C
23MC03C		2	0	0	0	0

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO1: Describe Indian culture, civilization and its features.

CO2: Demonstrate Stone Age, Indian races and their contribution in pre-historic culture.

CO3: Explain historical development of Indian culture.

CO4: Explain the significance, conditions and development of Vedic culture.

CO5: Analyse the advent of Islam and European culture.

CO1: Describe Indian culture, civilization and its features. 6

Introduction to Culture - Meaning and Scope - Culture and Civilization – General Characteristics Features of Indian Culture - Geographical Impact on Indian Culture.

CO2: Demonstrate Stone Age, Indian races and their contribution in pre-historic culture. 6

Dravidian Culture - Old Stone Age - New Stone Age - Metal Age - Indian Races and their Contribution to Indian Culture.

CO3: Explain historical development of Indian culture. 6

Indus Valley Culture - City Planning - Social and Religious Conditions - Vedic and Later Vedic Cultures - Dharmasastras and Caste Systems - Comparison of Indus and Vedic Culture – Importance of Indus Valley and Vedic Cultures.

CO4: Explain the significance, conditions and development of Vedic culture. 6

Sangam Literature - Society - Political and Economic Conditions - Trade - Religion and Fine Arts.

CO5: Analyse the advent of Islam and European culture. 6

Impact on Indian Culture and Heritage – Reform Movements - Brahma Samaj, Ariya Samaj, Self Respect Movement – Post Colonial Development.

TEXT BOOKS

1. Luniya B.N, Evolution of Indian Culture, Lakshmi Narain Agarwal Publishers, Agra, 1986.
2. Jeyapalan N, History of Indian culture, Atlantic publishers, New Delhi, 2001.
3. Sharma H.C, Indian Culture and Heritage‖, Neha Publishers & Distributors, New Delhi, 2012.

REFERENCES

1. John G.A, Dictionary of Indian Philosophy (Sanskrit-English)‖, University of Madras, Madras, 1998.
2. Misra R.S, Studies in philosophy and Religion‖, Bharathiya Vidya Prakasans, Varanasi, 1991.
3. Misra S.K, Culture and Rationality‖, Sage publications India Pvt. Ltd., New Delhi, 1988.
4. Suda J.P, Religious in India‖, Sterling Publishers Pvt. Ltd., New Delhi, 1978.

L: 30, TOTAL: 30 PERIODS

Course Code	PROJECT MANAGEMENT AND FINANCE	L	T	P	E	C
23GN06C		2	0	0	0	2

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO1: Select and formulate projects

CO2: Estimate the project cost and make an investment decision
CO3: Apply the scheduling and resource allocation techniques to control and monitor the project

CO1: Select and formulate projects **10**

Project – Concepts –Project Life Cycle – Project constraints- Generation and Screening of Project Ideas - Project identification – Preliminary Analysis, Market, Technical, Financial, Economic and Ecological - Pre-Feasibility Report and its Clearance, Project Estimates and Techno-Economic Feasibility Report, Detailed Project Report – Different Project Clearances required.

CO2 Estimate the project cost and make an investment decision **10**

Project Evaluation under certainty –Capital budgeting techniques; Methodology for project evaluation – Social Cost Benefit Analysis, Commercial or National Profitability, social or national profitability.

CO3 Apply the scheduling and resource allocation techniques to control and monitor the project **10**

Developing a Project Plan - Developing the Project Network – Constructing a Project Network (Problems) – PERT – CPM – Crashing of Project Network (Problems - Case Study) – Resource Leveling and Resource Allocation – Steps in Project Appraisal Process – Project Control Process – Control Issues – Project Audits – the Project Audit Process – project closure – team, team member and project manager evaluations.

L:30; TOTAL:30 PERIODS

TEXT BOOKS

1. Clifford Gray, Erik Larson and Gautam Desai, Project Management: The Managerial Process, Tata McGraw Hill, 8th Edition, 2021
2. Prasanna Chandra, Projects, Planning, Analysis, Selection, Financing, Implementation and Review, Tata Mc-GrawHill, 2023

REFERENCES

1. M Y Khan, P K Jain ,Management Accounting, McGraw Hill, 8th Edition, 2021
2. KantiSwarup, P.K.Gupta and Man Mohan, Operations Research, S.Chand & Sons, 2019
3. Sudhakar, G P, ―Project management: the managerial aspects, New Century Pub, 5thEdition, 2020.
4. Gopalakrishnan P and Ramamoorthy V.E., Textbook of Project Management‖, Trinity Press, 2022 Dr. K.L. Gupta, Management Accounting, SahityaBhawan Publications, 2022
5. Prem Kumar Gupta, Dr.D.S.Hira, Problems in Operation Research (Principles & Solutions), Kindle Edition, 2018

L: 30; TOTAL: 30 PERIODS

23CE71C	MINI PROJECT	L	T	P	E	C
		0	0	0	6	3

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Experiential component:

CO1: Identify and define an engineering problem through need analysis, systematic literature review and feasibility study.

CO2: Develop an appropriate methodology, preliminary design/model, and project plan with required resources and timelines.

Soft skill component:

CO3: Communicate project ideas effectively through structured documentation, teamwork, and technical presentations.

Course content:

Selection of topic/problembased on relevance to industry / society / research, literature review – survey of existing solutions – research papers, identification of gaps, defining the problem clearly. Objectives of the project & scope.

Project Planning, Methodology, Block diagrams, Flow diagrams, Algorithm design, Resource identification, Basic simulation and prototype (if applicable), Life cycle costing.

Structured documentation and Presentation

E:90; TOTAL: 90 PERIODS

23CE81C	CAPSTONE PROJECT/INDUSTRYPRACTICE	L	T	P	E	C
		0	0	0	12	6

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Experiential component:

CO1: Identify, analyze, and define a significant engineering problem using based on need assessment, literature survey and domain knowledge.

CO2: Apply appropriate engineering methods, design principles, tools, and modern software to develop and implement asolution or prototypewith sustainability considerations.

CO3: Conduct experiments, analyze data, evaluate results, and interpret findings with integrity and ethics.

Softskill component:

CO4: Prepare comprehensive project documentation and effectively present technical results in reputed conferences / journals

Course Content

- Domain Analysis, Problem Identification, Literature Review / Market survey, Methodology, Design and Implementation, Experimental Work / Simulation / Analytical studies / Optimization / Testing, Project Management - Life cycle costing, Documentation & Presentation.

E:180; TOTAL: 180 PERIODS

R-2023 B.E. CIVIL ENGINEERING

PROGRAMME ELECTIVE COURSES

23CE01E	**PRESTRESSED CONCRETE STRUCTURES**	**L**	**T**	**P**	**E**	**C**
		3	**0**	**0**	**0**	**3**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO1: Examine the basics of prestressed concrete

CO2: Analyze the limit state of serviceability

CO3: Analyze the Limit state of strength and anchorage zone sresses

CO4: Design of prestressed circular tanks and pipes

CO5: Evaluate the prestressed composite structures and continuous beams

CO1: Examine the basics of prestressed concrete **L:9**

Basic concepts – Principles of prestressing – Classification and types – Advantages Over ordinary reinforced concrete – Materials required – High strength concrete and high tensile steel – Methods of prestressing – Analysis of sections of stresses by stress concept, strength concept and load balancing concept.

CO2:Analyze the limit state of serviceability **L:9**

Factors influencing deflections – Calculation of Short term deflections of uncracked members – Prediction of long term deflections due to creep and shrinkage – Losses in pretensioned and post- tensioned members – Estimation of crack width.

CO3: Analyze the Limit state of strength and anchorage zone stresses **L:9**

Basic assumptions for calculating flexural stresses – Design of sections of Type 1 and Type II post- tensioned and pretensioned beams – Location of wires in pre-tensioned beams – Design for shear based on IS 1343 Code –Determination of anchorage zone stresses in post-tensioned beams by Magnel‘smethod,Guyon‘s method and IS 1343 code – Design of anchorage zone reinforcement.

CO4: Design of prestressed circular tanks and pipes **L:9**

Concept of circular prestressing – Design of prestressed concrete pipes and cylindrical water tanks- Design of Poles and Sleepers

CO5: Evaluate the prestressed composite structures and continuous beams **L:9**

Types of composite construction – Analysis of stresses – Differential shrinkage – Deflections of composite members –Flexural strength of composite members – Design of Composite sections – Methods of achieving continuity in continuous beams – Analysis of secondary moments – Concordant cable.

TEXT BOOKS

1. KrishnaRaju N, Prestressed concrete, Tata McGraw Hill Company, New Delhi, 2018.
2. GS Pandit. and SPGupta., Prestressed concrete, Oxford and IBH publishing Company Private Limited, 2019.
3. Rajagopalan, N, “Prestressed Concrete”, Alpha Science, 2010.

REFERENCES

1. Lin T.Y. Design of prestressed concrete structures, Asia Publishing House, Bombay 2010.
2. P.Dayaratnam, P.Sarah, Prestressed Concrete Structures, CBS Publishers & distributors Pvt. Ltd, New Delhi, 2020.

3. Dr. Praveen Nagarajan, Prestressed Concrete Design, Pearson Publication Pvt. Ltd, New Delhi - 2013

L: 45; TOTAL: 45 PERIODS

23CE02E	PREFABRICATEDSTRUCTURES	L	T	P	E	C
		3	0	0	0	3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO1: Explain principles of prefabrication and apply modular coordination in construction.
CO2: Utilize prefabricated components effectively in structural systems.
CO3: Apply joint flexibility considerations and material efficiency in design
CO4: Explain joints and connections for structural integrity.
CO5: Implement design measures for abnormal loads using codal provisions.

CO1: Explain principles of prefabrication and apply modular coordination in construction. 9

Introduction-Need, Advantages & limitation of prefabrication–Principles of prefabrication–Modular coordination – Standardization–Materials–Systems–Production–Transportation–Erection.

CO2: Utilize prefabricated components effectively in structural systems. 9

Behavior and types of structural components–Large panel systems–roof and floor slabs–Walls panels-Beams-Columns-Shearwalls

CO3: Apply joint flexibility considerations and material efficiency in design 9

Design philosophy- 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- Design for stripping,stacking, transportation and erection of elements

CO4: Explain joints and connections for structural integrity. 9

Types of Joints – based on action of forces - compression joints - shear joints - tension joints - based on function - construction, contraction, expansion -Types of structural connections - Beam to Column - Column to Column-Beam to Beam-Column to foundation.

CO5: Implement design measures for abnormal loads using codal provisions. 9

Progressive collapse – Codal provisions – Equivalent design loads for considering abnormal effects such as earthquakes, cyclones,etc.,- Importance of avoidance of progressive collapse.

TEXT BOOKS

1. Bruggeling, A.S.G., and Huyghe, G.F. "Prefabrication with Concrete," 3rd ed., CRC Press, USA, 2020.
2. Lewitt, M. "Precast Concrete: Materials, Manufacture, Properties, and Usage," 5th ed., CRC Press, London and New Jersey, 2021.

REFERENCES

1. Handbook on Precast Concrete Buildings," Indian Concrete Institute, 2nd ed., 2023.
2. Koncz, T. "Manual of Precast Concrete Construction," Vol. I, II, and III, 2nd ed., Springer, 2020
3. Bachmann, H., and Steinle, A. "Precast Concrete Structures," 2nd ed., Ernst & Sohn, Berlin, 2018.

L: 45; TOTAL: 45 PERIODS

23CE03E	DESIGN OF REINFORCED CONCRETEAND BRICK MASONRY STRUCTURES	L	T	P	E	C
		3	0	0	0	3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO1: Analyse and design the retaining wall

CO2: Design different types of water tanks as per the IS 3370-2009.

CO3: Design different flat slabs and Grid Floor System.

CO4: Design Slab system using yield line theory and according to the codal provisions.

CO5: Design brick masonry in accordance with IS 1905-1987.

CO1: Analyse and design the retaining wall L:9

Retaining walls - Types - Earth pressure - Effects of surcharge - Stability requirements - Design of cantilever-type retaining wall and counterfort-type retaining wall - Detailing of reinforcement.

CO2: Design different types of water tanks as per the IS 3370-2009. L:9

General design requirements - Underground tanks and tanks resting on ground - Overhead Circular and rectangular tanks - Analysis and design using Working Stress method - Detailing of reinforcement - Codal provisions.

CO3: Design different flat slabs and Grid Floor System. L:9

Types of flat slab - Design of Interior and Exterior panels using Direct Design Method - Equivalent Frame Method. Grid floor system – Application – Design consideration – analysis and design of Grid Floor.

CO4: Design Slab system using yield line theory and according to the codal provisions. L:9

Yield line - Assumptions - Characteristics - Upper Bound and Lower Bound Theories - Yield Line Analysis - Design of Square, Rectangular, Polygonal and Triangular slabs - Different Boundary conditions.

CO5: Design brick masonry in accordance with IS 1905-1987. L:9

Introduction - Classification of walls - Effective height of wall and column - Effective length of walls - Design loads, load dispersion - Permissible stresses - Design of axially and eccentrically loaded brick wall- Introduction to heritage structures.

TEXTBOOKS

1. N. Krishna Raju Advanced Reinforced Concrete Design IS 456-2000, CBS Publishers and Distributors, New Delhi, Third Edition, 2022.
2. Dayaratnam P., Brick and Reinforced Brick Structures, Oxford & IBH Publishing House, 2019.

REFERENCES

1. M.L. Gambhir, Design of Reinforced Concrete structures, Prentice Hall of India Private Limited, New Delhi, 2019.
2. P.C.Varghese, Advanced Reinforced Concrete Design, Prentice Hall of India, Pvt. Ltd., New Delhi, 2023.
3. N. Subramanian, Design of Reinforced Concrete Structures, Oxford University Press, New Delhi, 2014.

4. B.C. Punmia, Ashok Kumar Jain and Arun Kumar Jain, RCC Designs (Reinforced Concrete Structures), Laxmi Publications Pvt. Ltd., New Delhi, 2022.
5. Self-learning materials – online courses - http://nptel.ac.in/courses/ 105105104/20
6. IS 456:2000 Plain and Reinforced Concrete – Code of Practice.
7. IS 875(1-2):1987 Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures.
8. IS 875(3):2015 Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures
9. IS 875(4-5):1987 Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures
10. IS 2911(1): 2010 Design and construction of pile foundations – Code of practice – Concrete piles
11. IS 3370(Part 1-2): 2009 Code of Practice for Concrete Structures for the Storage of Liquids.
12. IS 3370 (Part 4): 1967 Code of Practice for Concrete Structures for the Storage of Liquids
13. SP 16:1980 Design Aids for Reinforced Concrete to IS 456:1978.
14. SP 34:1987 Handbook of concrete reinforcement and detailing.

L: 45; TOTAL: 45 PERIODS

23CE04E	**FINITE ELEMENT TECHNIQUES**	**L**	**T**	**P**	**E**	**C**
		3	**0**	**0**	**0**	**3**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO1: Apply the concepts of Finite Element Techniques
CO2: Analyse one dimensional problems using Finite Element Techniques
CO3: Analyse two dimensional problems using Finite Element Techniques
CO4: Analyze truss members using Finite Element Techniques
CO5: Utilize Finite Element software applications

CO1: Apply the concepts of Finite Element Techniques L:9

General steps in finite element method - Applications - Concept of an element - various element shapes - one, two and three dimensional elements - stresses and equilibrium - boundary conditions - strain displacement relations - stress strain relations - Potential energy and equilibrium - Weighted residual and weak formulations - Variational approach - Rayleigh Ritz method

CO2: Analyse one dimensional problems using Finite Element Techniques L:9

One Dimensional Second Order Equations – Discretization – Element types- Linear and Higher order Elements – Derivation of Shape functions and Stiffness matrices and force vectors- Assembly of Matrices – Solution of problems for beam, bar and truss, heat transfer.

CO3: Analyse two dimensional problems using Finite Element Techniques L:9

Second Order 2DEquations involving ScalarVariable Functions –Variational formulation—Local–Global transformation-Stiffness matrix–Stress calculation Triangular and Quadratic Elements-Isoparametric formulations –Plane stress and Plane strain problems– shape functions –stiffness matrix

CO4: Analyze truss members using Finite Element Techniques L:9

Plane trusses – Local–Global transformation-Stiffness matrix– Stress calculations

CO5:Utilize Finite Element Software applications L:9

Introduction to FEA Software-Modelling-generation of node numbers-Mesh Generation-Analysis – Post Processing.

TEXTBOOKS

1. J.N.Reddy, An Introduction to Finite Element Method, McGraw-Hill, Intl. Student Edition, 2017.
2. Tirupathi R.Chandrupatla, Ashok D.Belegundu, "Introduction to finite elements in engineering" Fourth Edition , Prentice Hall of India, New Delhi, 2012.
3. Seshu,P, "Text Book of Finite Element Analysis", Prentice-Hall of India Pvt. Ltd., New Delhi, 2007.

REFERENCES

1. Bathe," Finite Element Procedures", Prentice Hall, Person Education Inc., 2014.
2. Krishnamoorthy,C.S, "Finite Element Analysis Theory and Programming" Second Edition, Tata McGraw Hill Publishing Co. Ltd. New Delhi 2017.
3. RaoS.S, "The Finite Element Method in Engineering", Butterworth-Heinemann, 2010.
4. David.V.Hutton, "Fundamentals of Finite Element Analysis", Tata McGraw Hill, 2017.

L: 45; TOTAL: 45 PERIODS

23CE05E COMPUTER AIDED DESIGN OF STRUCTURES

L	T	P	E	C
3	0	0	0	3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO1: Formulate algorithm for solving equations and construct algorithm for truss problems using matrix method

CO2: Construct algorithm for design of reinforced concrete members

CO3: Construct algorithm for design of steel members

CO4: Construct algorithm for analysis of prestressed concrete members

CO5: Formulate spread sheet for design of structural elements and quantity estimation

CO1: Formulate algorithm for solving equations and construct algorithm for truss problems using matrix method L:9

Equation solving and Matrix method: Algorithm for solving simultaneous equations – Gauss elimination method and Gauss Jacobi Method; banded and semi-banded matrices – local and global coordinate system; element stiffness matrix – structure stiffness matrix – algorithm for solving trusses by matrix stiffness method

CO2:Construct algorithm for design of reinforced concrete members L:9

Reinforced cement concrete design: Algorithm for stress strain relationship in mild steel – cold formed steel – stress-strain relationship in concrete; algorithm for bending moment coefficients in slab; algorithm for developing design tables for beams – rectangular and flanged sections.

CO3: Construct algorithm for design of steel members **L:9**

Steel design: Algorithm for analysis and design of Tension members and Compression Members; Algorithm for moment carrying capacity of steel beams.

CO4: Construct algorithm for analysis of pre-stressed concrete members **L:9**

Prestressed concrete: Algorithm for analysis of prestressed rectangular and I sections in flexure – algorithm for finding losses in prestress.

CO5:Formulate spread sheet for design of structural elements and quantity estimation **L:9**

Spread sheets: Algorithm for developing spread sheet for various structural elements like beam-slab-column-footing and for quantity estimation

TEXT BOOKS:

1. Krishnamoorthy, C.S and Rajeev, S, "Computer Aided Design", Narosa Publication House, New Delhi, 2005.
2. Krishnaraju N, "Prestressed Concrete", Tata McGraw-Hill, New Delhi, 2018

REFERENCES

1. Pandit G, Gupta, S, "Structural Analysis – A Matrix Approach", McGraw-Hill Education, India, New Delhi, 2012.
2. Peter W, Christensen, A, "An Introduction to Structural Optimisation", Springer 2009.
3. Punmia BC and Jain,A.K, "Comprehensive Design of Steel Structures", Laxmi Publications, 2012.

L:45; TOTAL: 45 PERIODS

23CE06E	**ADVANCED STRUCTURAL ANALYSIS**	**L**	**T**	**P**	**E**	**C**
		3	**0**	**0**	**0**	**3**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO1: Analyse the indeterminate pin jointed plane frames continuous beams and rigid frames using matrix flexibility method.

CO2: Understand the concept of matrix stiffness method and analysis of continuous beams, pin jointed trusses and rigid plane frames.

CO3: Make use of the fundamental theory of FEA method.

CO4: Analyse the structure using plastic mechanism.

CO5: Analyse the suspension bridges with stiffening girders.

CO1: Analyse the indeterminate pin jointed plane frames continuous beams and rigid frames using matrix flexibility method. **9**

Primary structures - Compatibility conditions – Formation of flexibility matrices - Analysis of indeterminate pin- jointed plane frames, continuous beams and rigid jointed plane frames by Matrix flexibility approach.

CO2: Understand the concept of matrix stiffness method and analysis of continuous beams, pin jointed trusses and rigid plane frames. **9**

Restrained structure –Formation of stiffness matrices - equilibrium condition - Analysis of Continuous Beams, Pin-jointed plane frames and rigid frames by Matrix stiffness method.

CO3: Make use of the fundamental theory of FEA method. **9**

Introduction – Discretization of a structure – Displacement functions – Truss element – Beam element– Triangular elements - Plane stress and plane strain.

CO4: Analyse the structure using plastic mechanism. **9**

Plastic theory - Statically indeterminate structures – Plastic moment of resistance – Plastic modulus – Shape factor – Load factor – Plastic hinge and mechanism – collapse load - Static and kinematic methods – Upper and lower bound theorems - Plastic analysis of indeterminate beams and frames.

CO5: Analyse the suspension bridges with stiffening girders. **9**

Equilibrium of cable – length of cable - anchorage of suspension cables – stiffening girders - cables with three hinged stiffening girders – Influence lines for three hinged stiffening girders.

TEXT BOOKS

1. R.C.Hibbeler, Structural Analysis in SI units, Pearson India, Ninth Edition, 2024.
2. Bhavikatti,S.S, Structural Analysis,Vol.1 & 2, Vikas Publishing House Pvt. Ltd., New Delhi, 2021.

REFERENCES

1. William Weaver, Jr and James M.Gere, Matrix analysis of framed structures, CBS Publishers & Distributors, 2nd Edition, Delhi,2004
2. Punmia.B.C, Ashok Kumar Jain and Arun Kumar Jain, Theory of structures, Laxmi, Publications, 2020.
3. Vazrani.V.N and Ratwani,M.M, Analysis of Structures, Vol-II, Khanna Publishers, 2015

L:45; TOTAL: 45 PERIODS

23CE07E	DESIGN OF STEEL CONCRETE COMPOSITE STRUCTURES	L	T	P	E	C
		3	0	0	0	3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO1: Understand the fundamental concept of composite action
CO2: Design simply supported and continuous composite Beams
CO3: Design the composite floors
CO4: Design the encased and in-filled composite columns
CO5: Design steel concrete composite Trusses

CO1:Understand the fundamental concept of composite action **L:9**

Modular ratio – Transformed section – Composite action – No interaction - Full interaction – Types characteristics and applications– Slip calculation –Stress block – Ultimate moment capacity. Provisions of IS: 11384 and Euro Code-4-2004.

CO2: Design simply supported and continuous composite Beams **L:9**

Introduction to Composite beams - Ultimate moment behavior –Types and load transferring mechanism of Shear connectors - Profile decking - Design consideration for simply supported and continuous composite beam (with or without profile deck) – Problems

CO3: Design the composite floors **L:9**

Introduction of composite floors - Discuss on shear transferring mechanism in profile deck system -Bending resistance of composite slab - Design consideration of composite floor- Design of Composite floor.

CO4: Design the encased and in-filled composite columns **L:9**

Introduction to composite columns and its applications-Types of Materials and advantages- Design consideration of both encased and in-filled composite column under –Design of axial compression, uni-axial bending and biaxial bending columns– Problems

CO5: Design steel concrete composite Trusses **L:9**

Behavior and application of composite truss-Design consideration–stud specifications–Load calculation - Design of composite truss.

TEXTBOOKS

1. Johnson R.P., Composite Structures of Steel and Concrete, Volume I, Black well scientific publication, U.K.2018.
2. Narayanan R, Composite steel structures – Advances, Design and construction, Elsevier, Applied science, UK, 2006.
3. D.J.OehlersandM.A.Bradford,"CompositeSteelandConcreteStructuralMembers",Fundamental behaviour, Pergamon press, Oxford, 1995

REFERENCES

1. IS:11384-1985,Code of Practice for Composite Construction in Structural Steel and Concrete.
2. INSDAG Handbook on Composite Construction- Institute for Steel Development and Growth Publishers, Calcutta
3. Owens.G.W and Knowles.P, Steel Designers Manual, Seventh Edition, Steel Concrete Institute (UK), Oxford Blackwell Scientific Publications, 2011.

L:45; TOTAL: 45 PERIODS

23CE08E ADVANCED STEEL STRUCTURES

L	T	P	E	C
3	0	0	0	3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO1: Design the steel members subjected to combined forces.
CO2:Explain and design different types of steel connections.
CO3:Analyze and design industrial structures subjected to wind and seismic forces.
CO4:Explain the effect of axial force and shear force on steel structures using plastic theory.
CO5: Design of compression and flexural Cold-formed Steel members

CO1: Design the steel members subjected to combined forces **L:9**

Design Philosophies and Design Codes(IS, EC, AISC)– Stability Criteria–Beam-Columns and Frames (Sway and Non-Sway) - Design of Purlins subjected to combined forces.

CO2: Explain and design different types of steel connections. **L:9**

Types of connections – Welded and Bolted – Design of simple base, Gusseted base and Moment Resisting Base – Flexible Connections - Seated Connections – Unstiffened and Stiffened Seated Connections – Moment Resistant Connections.

CO3: Analyze and design industrial structures subjected to wind and seismic forces. L:9

Structural Configurations - Functional and Serviceability Requirements- Analysis and design of industrial buildings – Sway and non-sway frames –Gantry Girders –Earthquake resistant design of steel buildings.

CO4: Explain the effect of axial force and shear force on steel structures using plastic theory L:9

Introduction, Shape factor -Moment redistribution - Beam, Sway, Joint and Gable mechanisms - Combined mechanisms– Analysis of portal frames, Effect of axial force and shear force on plastic moment capacity, Connection Requirements– Moment resisting connections–Design of continuous beams.

CO5: Design of compression and flexural Cold-formed Steel members. L:9

Introduction to Direct Strength Method - Behaviour of Compression Elements - Effective width for load and deflection determination – Behaviour of Unstiffened and Stiffened Elements – Design of webs of beams – Flexural members – Lateral buckling of beams– Design of Compression Members.

TEXTBOOKS

1. S.K.Duggal, Limit State Design of Steel Structures, McGraw Hill Book Company, 2017
2. Subramanian.N, Design of Steel Structures, Oxford University Press, 2016.
3. LynnS.Beedle, Plastic Design of Steel Frames, John Wiley and Sons, 1997.
4. Narayanan.R.et.al., Teaching Resource on Structural steel Design, INSDAG, Ministry of Steel Publishing, 2000.

REFERENCES

1. Wie WenYu, Design of Cold-Formed Steel Structures, McGraw Hill Book Company,2019
2. A.S.Arya and J.L.Ajmani, Design of steel structures, Nem Chand Bros, Roorkee.
3. Gambhir. M.L., "Fundamentals of Structural Steel Design", McGraw Hill Education India Pvt. Ltd., 2013.
4. All relevant IS, EC and AISC code books

L: 45; TOTAL: 45 PERIODS

23CE09E	BASICS OF DYNAMICS AND ASEISMIC DESIGN	L	T	P	E	C
		3	0	0	0	3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO1: Develop the simulation and mathematical model development of SDOF system
CO2: Construct the simulation and mathematical model development of MDOF system
CO3: Discuss the fundamentals of seismology
CO4: Identify the various causes and effects of earthquakes on structures
CO5: Evaluate the structures subjected to Seismic loading.

CO1: Develop the simulation and mathematical model development of SDOF system L: 10

Definition of degree of freedom – Idealization of structure as Single Degree of Freedom (SDOF) system – 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.

CO2: Construct the simulation and mathematical model development of MDOF system L: 10
Formulation of equation of motion for multidegree 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.

CO3: Discuss the fundamentals of seismology L: 6
Elements of Engineering Seismology – Definitions, Introduction to Seismic hazard, Earthquake phenomenon – Seismo-tectonics – Seismic Instrumentation – Characteristics of Strong Earthquake motion – Estimation of Earthquake Parameters.

CO4: Identify the various causes and effects of earthquakes on structures L: 9
Causes of Earthquake-Effect of earthquake on different types of structures – Behaviour of RCC, Steel and prestressed Concrete Structures under earthquake loading – Pinching Effect – Bouchinger Effects – Evaluation of Earthquake forces – IS Code 1893: 2016 – Response Spectra – Lessons learnt from past earthquakes.

CO5: Evaluate the structures subjected to Seismic loading L:10
Causes of damage – Planning considerations/Architectural concept (IS 4326–2013) – 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).

TEXT BOOKS

1. Chopra, A.K., Dynamics of Structures – Theory and Applications to Earthquake Engineering‖, 6th Edition, Pearson Education, 2023.
2. Pankaj Agarwal& Manish Shrikhande, Earthquake resistant Design of Structures, PHI Learning, 13th Printing, 2014.
3. S.R. Damodarasamy and S. Kavitha, Basics of Structural Dynamics and Aseismic Design, Publisher: PHI (1 December 2009).

REFERENCES

1. Biggs, J.M., ―Introduction to Structural Dynamics‖, McGraw–Hill Book Co., N.Y., 2013
2. Dowrick, D.J., ―Earthquake Resistant Design and Risk Reduction‖, John Wiley & Sons, London, 2011,NPEEE Publications.
3. Elements of Vibration Analysis, Meirovitch L, Mcgraw Hill Education, second edition, 2014.
4. Mario Paz & Young Hoon Kim ―Structural Dynamics – Theory & Computation, Springer Publishers, Sixth Edition, 2019

L:45; TOTAL: 45 PERIODS

23CE10E	**MUNICIPAL SOLID WASTE MANAGEMENT**	**L**	**T**	**P**	**E**	**C**
		3	**0**	**0**	**0**	**3**

COURSE OUTCOMES

Upon completion of this course, the students will be able to,

CO1: Demonstrate an understanding of the nature, composition, and classification of municipal solid waste.

CO2: Apply the principles of reduction, reuse, and recycling (3Rs)

CO3: Apply national and international regulatory requirements and environmental standards

CO4: Apply suitable techniques for the processing of solid waste

CO5: Design and evaluate sanitary landfill systems.

CO1: Demonstrate an understanding of the nature, composition, and classification of municipal solid waste **L:9**

Sources and types of municipal solid wastes- Public health and environmental impacts of improper disposal of solid wastes- sampling and characterization of wastes - factors affecting waste generation rate and characteristics - Elements of integrated solid waste management – Requirements and salient features of Solid waste management rules (2016) – - Role of public and NGO's- Public Private participation – Elements of Municipal Solid Waste Management Plan.

CO2: Apply the principles of reduction, reuse, and recycling (3Rs) **L:9**

Waste Management Hierarchy - Reduction, Reuse and Recycling - source reduction of waste – On-site storage methods – Effect of storage, materials used for containers – segregation of solid wastes – Public health and economic aspects of open storage – case studies under Indian conditions –Microplastics overview- Recycling of Plastics and Construction/Demolition wastes.

CO3: Interpret and apply national and international regulatory requirements and environmental standards **L:9**

Methods of Residential and commercial waste collection – Collection vehicles – Manpower – Collection routes – Analysis of waste collection systems; Transfer stations –location, operation and maintenance; options under Indian conditions – Drone application in solid waste management - Field problems- solving.

CO4: Apply suitable techniques for the processing of solid waste **L:9**

Objectives of waste processing – Physical Processing techniques and Equipment; Resource recovery from solid waste composting and bio-methanation; Thermal processing options – case studies under Indian conditions.

CO5: Design and evaluate sanitary landfill systems. **L:9**

Land disposal of solid waste- Sanitary landfills – site selection, design and operation of sanitary landfills – Landfill liners – Management of leachate and landfill gas- Leachate Treatment Technologies-Landfill bioreactor – Dumpsite Rehabilitation

TEXTBOOKS

1. William A. Worrell, P. Aarne Vesilind, Solid Waste Engineering, Cengage Learning, 2021.
2. John Pitchel ,Waste Management Practices-Municipal, Hazardous and industrial – CRC Press, Taylor and Francis, New York, 2014

REFERENCES

1. CPHEEO (2014), "Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organisation, Government of India, New Delhi.
2. George Tchobanoglous and FrankKreith (2002).Handbook of Solid waste management, McGraw Hill, New York.

L:45; TOTAL: 45 PERIODS

23CE11E	**INDUSTRIAL WASTE MANAGEMENT**	**L**	**T**	**P**	**E**	**C**
		3	**0**	**0**	**0**	**3**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO1: Identify the types, characteristics and effects of industrial waste in environment
CO2: Evaluate the concepts of Pollution prevention
CO3: Employ the various treatment technologies of waste from major industries
CO4: Apply the options for wastewater reuse & residue management
CO5: Execute the technologies for managing Industrial waste

CO1: Identify the types, characteristics and effects of industrial waste in environment L:9

Types of industries and industrial pollution – Industrial scenario in India – Regulatory requirements for treatment of industrial wastewater, industrial waste survey, industrial wastewater generation rates, population equivalent, Bioassay studies – effects of industrial effluents on streams, land, sewage treatment plants and human health.

CO2: Evaluate the concepts of Pollution prevention L: 8

Prevention Vs Control of industrial pollution – benefits and barriers. Source reduction techniques – waste audit, evaluation of pollution prevention options, environmental statement as a tool for pollution prevention, waste minimization circles.

CO3: Employ the various treatment technologies of waste from major industries L:10

Equalization – neutralization, Removal of organic and inorganic solids-oil separation, flotation, precipitation, Aerobic and anaerobic biological treatment – Advanced Chemical oxidation - Electro chemical oxidation, wet air oxidation, ozonation, photocatalysis – Heavy metal removal, Refractory organics separation by adsorption – Individual and common effluent treatment plants

CO4: Apply the options for wastewater reuse & residue management L: 9

Evaporation – Evaporators types and classification – Zero Liquid discharge systems – Quality requirements for wastewater reuse, industrial reuse, disposal on water and land – Residuals from industrial wastewater treatment units - quantification and characteristics of sludge – thickening, digestion, conditioning, dewatering and disposal of sludge, Management of RO rejects.

CO5: Execute the technologies for managing Industrial waste L: 9

Industrial manufacturing process description, waste water characteristics, source reduction options and waste treatment flow sheet for textiles, tanneries, pulp and paper, metal finishing, sugar and distilleries.

TEXT BOOKS

1. Eckenfelder, W. W., Industrial Water Pollution Control, McGraw Hill, 2014.
2. Industrialwastewatermanagement,Treatment&disposal,WaterEnvironment"FederationAlexandria Virginia,ThirdEdition,2008

REFERENCES

1. Nelson Leonard Nemerow, “Industrial waste Treatment”, Elsevier, 2007.
2. LawranceK.Wang, YungTseHung, Howard H.Loand Constantine Yapijakis “Handbook of Industrial and Hazardous waste Treatment”, Second Edition, 2004.

3. Paul L.Bishop―Pollution Prevention:-Fundamentals and Practice, McGraw–Hill International, 2000.
4. Pfeffer, J.T., "Solid Waste Management Engineering", Prentice Hall, 1992.
5. Wentz, C., "Hazardous Waste Management". McGraw-Hill, New York, 1995.
6. Pichtel, John, Waste Management Practices: Municipal, Hazardous and Industrial. CRC Press, Taylor and Francis Group, 2005.

L: 45; TOTAL: 45 PERIODS

23CE12E	**AIR AND NOISE POLLUTION CONTROL ENGINEERING**	**L**	**T**	**P**	**E**	**C**
		3	**0**	**0**	**0**	**3**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO1: Illustrate the air pollution, air pollutants and air quality standards
CO2: Discuss the various types and sources of air pollution and its effects
CO3: Know about the sampling, meteorology and air quality modeling
CO4: Elaborate the principles of air pollution control equipment
CO5: Identify the sources, effects and control of vehicular, indoor air and noise pollution

CO1: Illustrate the air pollution, air pollutants and air quality standards L: 9

Structure And Composition Of Atmosphere – Air Pollution – Definition - Air Pollution And Global Climate - Units Of Measurements Of Pollutants - Air Quality Criteria - Emission Standards - National Ambient Air Quality Standards - Air Pollution Indices - Air Quality Management In India.

CO2: Discuss the various types and sources of air pollution and its effects L: 9

Sources and classification of Air Pollutants - Man Made - Natural Sources - Pollution Due To Automobiles - Analysis Of Air Pollutants - Air Pollution And Its Effects On Human Beings, Plants And Animals - Economic Effects Of Air Pollution - Effect Of Air Pollution On Meteorological Conditions

CO3: Know about the sampling, meteorology and air quality modeling L: 9

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.

CO4: Elaborate the principles of air pollution control equipment L: 9

Control - Source Correction Methods - Control Equipment - Particulate Control Methods – Bag House Filter - Settling Chamber - Cyclone Separators - Inertial Devices - Electrostatic Precipitator - Scrubbers - Control of Gaseous Emissions - Absorption - Principles of Adsorption and Combustion Devices

CO5: Identify the sources, effects and control of vehicular, indoor air & noise pollution L: 9

Noise Pollution: Sources and Effects of Noise Pollution – Measurement – Noise Standards - General Control Measures - Control of Noise at Source, Control of Transmission, Protection of Exposed Person - Control of Other Types of Noise - Preventive Measures - Sound Absorbents

TEXT BOOKS

1. C.S.Rao, "Environmental Pollution Control Engineering", 4th Edition 2021, New Age International Private Limited
2. S.C.Bhatia, Textbook of Noise Pollution and its Control, 2023, Atlantic Publishers and Distributor

REFERENCES

1. Noel De Nevers, "Air pollution control engineering", 3rd Edition 2018, New Age International Private Limited.
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",2nd Edition 2020, BS Publications
4. 1981 Air (Prevention and Control of Pollution) Amendment Act, 2024
5. Central Pollution Control Board, Guidelines for real time sampling and analysis, 2013.

L: 45; TOTAL: 45 PERIODS

23CE13E	**ENVIRONMENTAL POLICY AND LEGISLATION**	**L**	**T**	**P**	**E**	**C**
		3	**0**	**0**	**0**	**3**

COURSE OUTCOMES

Upon completion of this course, the students will be able to
CO1: Discuss the origins and sources of environmental laws
CO2: Impart the knowledge on the key principles of water pollution act
CO3: Impart the knowledge on the key principles of air pollution act
CO4: Analyze environmental laws within various contexts
CO5: Interpret the environmental litigation process in environmental policies

CO1: Discuss the origins and sources of environmental laws **L:9**

Indian Constitution and Environmental Protection – National Environmental policies – Precautionary Principle and Polluter Pays Principle – Concept of absolute liability – multilateral environmental agreements and Protocols – Montreal Protocol, Kyoto agreement, Rio declaration – Environmental Protection Act, Water (P&CP) Act, Air (P&CP) Act – Institutional framework (SPCB/CPCB/MoEF)

CO2: Impart the knowledge on the key principles of water pollution act **L:9**

Power & functions of regulatory agencies - responsibilities of Occupier Provision relating to prevention and control Scheme of Consent to establish, Consent to operate – Conditions of the consents – Outlet – Legal sampling procedures, State Water Laboratory – Appellate Authority – Penalties for violation of consent conditions etc. Provisions for closure/directions in apprehended pollution situation.

CO3: Impart the knowledge on the key principles of air pollution act **L:9**

Power & functions of regulatory agencies - responsibilities of Occupier Provision relating to prevention and control Scheme of Consent to establish, Consent to operate – Conditions of the consents – Outlet – Legal sampling procedures, State Air Laboratory – Appellate Authority – Penalties for violation of consent conditions etc. Provisions for closure/directions in apprehended pollution situation.

CO4: Analyze environmental laws within various contexts **L:9**

Genesis of the Act – delegation of powers – Role of Central Government - EIA Notification – Sitting of Industries – Coastal Zone Regulation - Responsibilities of local bodies mitigation scheme etc., for Municipal Solid Waste Management - Responsibilities of Pollution Control Boards under Hazardous Waste rules and that of occupier, authorisation – Biomedical waste rules – responsibilities of generators and role of Pollution Control Boards

CO5: Interpret the environmental litigation process in environmental policies **L:9**

Relevant Provisions of Indian Forest Act, Public Liability Insurance Act, CrPC, IPC - Public Interest Litigation - Writ petitions - Supreme Court Judgments in Landmark cases - 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)

TEXT BOOKS

1. Leelakrishnan P., Environmental Case Book, Lexis Nexis, 2000
2. Shanthakumar S, Environmental Law – An Introduction, Butterworths, 2004

REFERENCES

1. Leelakrishnan P, Environmental Law in India, Butterworths, 1998
2. Shyam Diwan and Armin Rosencranz, Enviromental Law and Policy in India, Oxford, 2001
3. CPCB "Pollution Control acts, Rules and Notifications issued there under "Pollution Control Series – PCL/2/1992, Central Pollution Control Board, Delhi, 1997.

L: 45; TOTAL: 45 PERIODS

23CE14E	**HYDROLOGY**	**L**	**T**	**P**	**E**	**C**
		3	**0**	**0**	**0**	**3**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO1: Discuss the hydrological process and estimate the rainfall characteristics.
CO2: Estimate the losses of precipitation and runoff
CO3: Interpret the concept of hydrographs
CO4: Apply the concepts of groundwater
CO5: Implement the flood routing and understand about droughts

CO1: Discuss the Hydrological process and estimate the rainfall characteristics **L:10**

Hydrological Cycle - Climate - Weather - Layers in Atmosphere - Types and Forms of Precipitation - Measurement of Rainfall - Spatial Measurement Methods - Thiessen and Isohyetal Method - Frequency and Intensity/Duration Analysis - Cyclones - Fonts - Wind - Monsoon - Clouds - Requirements of Precipitation.

CO2: Estimate the losses of precipitation and runoff **L:9**

Factors Affecting Runoff - Effective Rainfall - Losses From Precipitation - Evaporation Process - Reservoir Evaporation - Measurement Of Evaporation - Infiltration Process - Measurement Of Infiltration - Infiltration Indices

CO3: Interpret the concept of hydrographs L:9

Factors Affecting Hydrograph - Base Flow Separation - Unit Hydrograph - Derivation Of Unit Hydrograph - S Curve Hydrograph - Unit Hydrograph Of Different Deviations - Synthetic Unit Hydrograph.

CO4: Apply the concepts of groundwater L:9

Origin - Classification And Types - Properties Of Aquifers - Governing Equations - Recuperation Test - Transmissibility - Specific Capacity - Pumping Test - Importance Rain Water Harvesting In Rural And Urban Areas

CO5: Implement the flood routing and understand about droughts L:8

Flood Estimation - Flood Frequency Studies - Flood Routing - Reservoir Flood Routing - Flood Control - Storm - Definitions Of Droughts - Meteorological, Hydrological And Agricultural Droughts - Case Studies On Recent Floods And Droughts In India.

TEXT BOOKS

1. Subramanya, K and Priyank J. Sharma., Engineering Hydrology, Tata McGraw - Hill Publishing Company, Limited, 6th Edition, 2024.
2. Jayarami Reddy.P, Hydrology, Tata McGraw - Hill Publications Private Limited, New Delhi, 3rd Edition,2021.

REFERENCES

1. Santosh Kumar Garg, Hydrology and Water Resources Engineering, Khanna Publications Private Limited, New Delhi, 2021.
2. Singh, V.P., - Hydrology, McGraw - Hill Inc., Limited, 2017.
3. Chow, V.T. and Maidment, Hydrology for Engineers, McGraw - Hill Inc., Limited, 2017.

L: 45; TOTAL: 45 PERIODS

23CE15E	**ENVIRONMENT IMPACT ASSESSMENT**	**L**	**T**	**P**	**E**	**C**
		3	**0**	**0**	**0**	**3**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO1: Interpret the fundamentals and need for environmental and social assessment
CO2: Implement different methodologies for impact prediction and assessment
CO3: Prepare the plan for environmental impact assessments reports
CO4: Assess socio-economic investigation of the environment in a project
CO5: Gain knowledge to prepare EIA reports for various projects

CO1: Interpret the fundamentals and need for environmental and social assessment L: 8

Environmental Impact Assessment (EIA) – Objectives – Historical development – Factor affecting EIA in project life cycle – EIA Notification and Legal Framework in India – components of EIA Stakeholders and their Role in EIA

CO2: Implement different methodologies for impact prediction and assessment L: 10

Screening and Scoping in EIA – Drafting of Terms of Reference -Baseline monitoring, Prediction and Assessment of Impact on land, water, air, noise and energy, flora and fauna - Matrices – Networks – Checklist Methods - overlay - Analysis of alternatives

CO3: Assess socio-economic investigation of the environment in a project L: 10

Baseline monitoring of Socio-economic environment – Identification of Project Affected Personal – Rehabilitation and Resettlement Plan- Economic valuation of Environmental impacts – Cost benefit Analysis- Public Consultation

CO4: prepare the plan for environmental impact assessments reports L: 9

Plan for mitigation of adverse impacts on various environmental matrices – Environmental Monitoring Plan – EIA Report Preparation – Review of EIA Reports – Environmental Clearance – preparation and implementation - Post Project Audit

CO5: Gain knowledge to prepare EIA reports for various projects L: 8

EIA case studies pertaining to Infrastructure Projects – Real Estate Development – Roads and Bridges – Mass Rapid Transport Systems - Ports and Harbor – Airports - Dams and Irrigation projects - Waste Processing and Disposal facilities Mining Projects.

TEXT BOOKS

1. Introduction to Environmental Impact Assessment by John Glasson, Riki Therivel, 5thEdition, 2019.
2. Environmental Impact Assessment Methodologies by Anjaneyulu Yerramilli (Author), Valli Manickam (Author), 2nd Edition, 2020

REFERENCES

1. Ministry of Environment and Forests, EIA Notification and Sectoral Guides, Government of India, New Delhi, 2010
2. Environment (Protection) Amendment Rules, 2022 e Environment (Protection) Amendment Rules, 2022.
3. Environmental Science and Engineering, by Suresh K. Dhaneja – S.K. Katania & Sons Publication, New Delhi.
4. Environmental Pollution and Control, by Dr H.S. Bhatia – Galgotia Publication (P) Ltd., Delhi
5. World Bank –Source book on EIA

L: 45; TOTAL: 45 PERIODS

23CE16E	**CLIMATE CHANGE ADAPTATION MITIGATION AND MANAGEMENT**	**L**	**T**	**P**	**E**	**C**
		3	**0**	**0**	**0**	**3**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO1: Understand carbon cycle, physical basis of the natural greenhouse effect
CO2: Know the growing scientific consensus established through the IPCC
CO3: Plan climate change mitigation and adaptation projects
CO4: Gain in-depth knowledge on climate models
CO5: Process the model outputs for climate impact assessment

CO1: Understand carbon cycle, physical basis of the natural greenhouse effect L: 8
Atmosphere – weather and Climate - climate parameters – Temperature, Rainfall, Humidity, Wind – Global ocean circulation – El Nino and its effect - Carbon cycle

CO2: Know the growing scientific consensus established through the IPCC L: 9
Greenhouse gases - Total carbon dioxide emissions by energy sector – industrial, commercial, transportation, residential – Impacts – air quality, hydrology, green space - Causes of global and regional climate change – Changes in patterns of temperature, precipitation and sea level rise – Greenhouse effect

CO3: Plan climate change mitigation and adaptation projects L:9
Effects of Climate Changes on living things – health effects, malnutrition, human migration, socioeconomic impacts- tourism, industry and business, vulnerability assessment-infrastructure, population and sector – Agriculture, forestry, human health, coastal areas

CO4: Gain in-depth knowledge on climate models L:10
IPCC Technical Guidelines for Assessing Climate Change Impact and Adaptation - Identifying adaption options – designing and implementing adaption measures – surface albedo environment-reflective roofing and reflective paving – enhancement of evapotranspiration - tree planting programme – green roofing strategies – energy conservation in buildings – energy efficiencies – carbon sequestration.

CO5: Process the model outputs for climate impact assessment L: 9
Energy source – coal, natural gas – wind energy, hydropower, solar energy, nuclear energy, geothermal energy – biofuels – Energy policies for a cool future - Energy Audit.

TEXT BOOKS

1. RuddimanW.F, FreemanW.H. and Company, "Earth's Climate Past and Future", 2001
2. Velma. I. Grover "Global Warming and Climate" Change. Vol I and II.CRC Press, 2008

REFERENCES

1. IPCC Fourth Assessment Report, Cambridge University Press, Cambridge, UK, 2007
2. Thomas E, Lovejoy and Lee Hannah "Climate Change and Biodiversity", TERI Publishers, 2005

L: 45; TOTAL: 45 PERIODS

23CE17E	**SOIL POLLUTION ENGINEERING**	**L**	**T**	**P**	**E**	**C**
		3	**0**	**0**	**0**	**3**

COURSE OUTCOMES

Upon completion of this course, the students will be able to
CO1: Discuss the basic concepts of soil pollution
CO2: Analyse the process of contaminant interaction and detection of soil pollution
CO3: Outline the criteria for selection of landfill and issues in land reclamation
CO4: Adopt the remediation technologies
CO5: Regulate the sustainable soil management practices

CO1: Discuss the basic concepts of soil pollution L:7
Introduction to Soil Pollution, Sources, Classification of soil pollution –sources and Causes of Soil Pollution, impacts on physical, chemical, nutritional and biological characteristics; effects on ecosystem services.

CO2: Analyse the process of contaminant interaction and detection of soil pollution L:11
Contaminant Behavior-Adsorption, desorption Soil Contaminant Transport Mechanisms-Diffusion, advection, and dispersion, Soil Sampling Techniques Methods, tools, and equipment for soil sampling. Analysis of Soil Pollutants- Methods for detecting heavy metals, organic pollutants, and other contaminants, Soil Quality Indicators -Parameters indicating soil health and contamination.

CO3: Outline the criteria for selection of landfill and issues in land reclamation L:10
Safe disposal of waste – Site selection for landfills – Characterization of land fill sites and waste – Risk assessment – Stability of landfills – Current practice of waste disposal – Monitoring facilities -Importance of land reclamation, rehabilitation, National & International practices (SERI guidelines), Mine pit limnology Engineering reclamation: Issues, site preparation.

CO4: Adopt the remediation technologies. L:9
Soil vapour extraction – Soilwashing – Solidification and Stabilization – Electro-kinetic remediation – Thermal desorption – Vitrification – In-situ and Ex-situ Bioremediation – Phytoremediation – Soil fracturing – Bio-stimulation – Bioaugmentation –Chemical oxidation-Mine Tailings Management.

CO5: Regulate the sustainable soil management practices L:8
Soil Pollution Prevention and Control Strategies-Integrated Pest Management (IPM), waste minimization.Sustainable Agriculture and Soil Health Management-Organic farming, soil conservation. Regulations and Policy Measures for Soil Protection-Global, national, and local policies on soil pollution control-Case studies.

TEXT BOOKS

1. Ibrahim A. Mirsal, Soil Pollution Origin, Monitoring & Remediation, Springer-Verlag Berlin Heidelberg, (2008).
2. Krishna R. Reddy and Jeffrey A. Adams, Sustainable Remediation of Contaminated Sites, Momentum Press, (2015).
3. Hari D. Sharma and Krishna R. Reddy, Geo-Environmental Engineering: Site Remediation, Water Contaminant and Emerging Water Management Technologies, John Wiley & Sons Limited, (2004).

REFERENCES

1. Ku. Jeff, Practical Design Calculations for Groundwater and Soil Remediation, CRC Press LLC, (1999)
2. Vietnam environmental protect law, HCM Tonghop Publisher, (2015)
3. Soil pollution a reality – FAO, United Nation, Rome (2018).

L: 45; TOTAL: 45 PERIODS

23CE18E	**ENVIRONMENT, HEALTH AND SAFETY**	**L**	**T**	**P**	**E**	**C**
		3	**0**	**0**	**0**	**3**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

Upon the successful completion of the course, the student will be able to
CO1: Identify the need for EHS in industries and related Indian regulations

CO2: Describe the various types of Health hazards, effect, assessment and control methods
CO3: Illustrate the various safety systems in working environments
CO4: Identify the methodology for preparation of Emergency Plans and Accident investigation
CO5: Explain the EHS Management System and its elements

CO1: Identify the need for EHS in industries and related Indian regulations L:9

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.

CO2: Describe the various types of Health hazards and control methods L:9

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

CO3: Illustrate the various safety systems in working environments L:9

Features of Satisfactory and Safe design of work premises – good housekeeping - 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

CO4: Identify the methodology for preparation of Emergency Plans and Accident investigation L:9

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

CO5: Explain the EHS Management System and its elements L:9

Concept of Environmental Health and Safety Management – Elements of Environmental Health and Safety Management Policy and implementation and review – ISO 45001-Strucure and Clauses-Case Studies

TEXT BOOKS

1. Fundamentals of Industrial Safety and Health by Dr.K.U.Mistry, Siddharth Prakashan, 2012
2. The Facility Manager's Guide to Environmental Health and Safety by Brian Gallant, Government Inst Publ., 2007.

REFERENCES

1. Effective Environmental, Health, and Safety Management Using the Team Approach by Bill Taylor, Culinary and Hospitality Industry Publications Services, 2005.
2. Environmental and Health and Safety Management by Nicholas P.Cheremisinoff and Madelyn L. Graffia, William Andrew Inc. NY, 1995
3. Industrial Health and Safety Acts and Amendments, by Ministry of Labour and Employment, Government of India

L: 45; TOTAL: 45 PERIODS

23CE19E	**GROUND IMPROVEMENT TECHNIQUES**	**L**	**T**	**P**	**E**	**C**
		3	**0**	**0**	**0**	**3**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO1: Demonstrate suitable ground improvement techniques based on different soil conditions.
CO2: Apply appropriate dewatering and drainage systems for given site conditions.
CO3: Demonstrate in-situ treatment methods for cohesionless and cohesive soils.
CO4: Implement the concept and function of reinforcement in ground improvement.
CO5: Apply suitable grouting techniques for soil stabilization in various scenarios.

CO1: Demonstrate suitable ground improvement techniques based on different soil conditions. L: 7

Role of ground improvement in foundation engineering - methods of ground improvement – Geotechnical problems in alluvial, laterite and black cotton soils –Liquefaction-Selection of suitable ground improvement techniques based on soil condition.

CO2: Apply appropriate dewatering and drainage systems for given site conditions. L:9

Dewatering Techniques - Well points – Vacuum and electro osmotic methods – Seepage analysis for two dimensional flows for fully and partially penetrated slots in homogeneous deposits – Design for simple cases.

CO3: Demonstrate in-situ treatment methods for cohesionless and cohesive soils. L:12

Insitu densification of cohesionless soils - Dynamic compaction - Vibroflotation, Sand compaction piles and deep compaction. Consolidation of cohesionless soils - Preloading with sand drains, and fabric drains, Stabilization of soft clay ground using stone columns and Lime piles-Installation techniques – Simple design - Relative merits of above methods and their limitations.

CO4: Implement the concept and function of reinforcement in ground improvement L:9

Concept of reinforcement – Types of reinforcement material – Reinforced earth wall – Mechanism– Simple design - Applications of reinforced earth; Functions of Geotextiles in filtration, drainage, separation, road works and containment applications – soil nailing and Gabbien wall technique.

CO5: Apply suitable grouting techniques for soil stabilization in various scenarios. L:8

Types of grouts – Grouting equipment and machinery – Injection methods – Grout monitoring,Stabilization with cement, lime and chemicals – Stabilization of expansive soil.

L:45; TOTAL: 45 PERIODS

TEXTBOOKS:

1. Purushothama Raj. P, “Ground Improvement Techniques”, Firewall Media, 2005.
2. Bikash Chandra chattopadhyay and JoyantaMaity, “ Ground Improvement Techniques”,PHI Learning Pvt. Ltd., 2017
3. Koerner, R.M., “Designing with Geosynthetics” (Fourth Edition), Prentice Hall, Jersey, 2012.

REFERENCES:

1. Koerner, R.M. “Construction and Geotechnical Methods in Foundation Engineering”,Mc-Graw Hill, 1994.
2. Pappala, A.J.,Huang,J., Han, J., and Hoyos, L.R., Ground Improvement and Geosynthetics; Geotechnical special publication No.207, Geo Institute, ASCE, 2010
3. Winterkorn, H.F. and Fang, H.Y. “Foundation Engineering Hand Book”. Van NostrandReinhold, 1994.

23CE20E	**EARTHQUAKE GEOTECHNICAL ENGINEERING**	**L**	**T**	**P**	**E**	**C**
		3	**0**	**0**	**0**	**3**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO1: Demonstrate the causes and mechanisms of earthquakes to seismic risk assessment.

CO2: Illustrate the behavior of soils under dynamic loadingthrough appropriate testing and analysis methods.

CO3: Demonstrate understanding of ground response analysis, site effects, and design ground motion development.

CO4: Apply seismic codes to design foundations, slopes, and retaining walls for earthquake resistance.

CO5: Implement effective earthquake hazard mitigation measures in geotechnical design and planning.

CO1: Demonstrate the causes and mechanisms of earthquakes to seismic risk assessment. L:8

Mechanism of Earthquakes - Causes of earthquake - Earthquake Fault sources - Elastic Rebound theory - Seismic wave in Earthquake shaking - Definition of earthquake terms - Locating an earthquake - Quantification of earthquakes.

CO2: Illustrate the behavior of soils under dynamic loading through appropriate testing and analysis methods. L:9

Strong Motion Records -characteristics of ground motion - Factors influencing ground motion - Estimation of frequency content parameters - Seismic site investigations - Evaluation of Dynamic soil properties.

CO3: Demonstrate understanding of ground response analysis, site effects, and design ground motion development. L:10

Wave propagation Analysis - Site Amplification, Ground Response Analysis - Method of analysis - One Dimensional Analysis - Equivalent linear Analysis – shear beam Analysis - site effects - Design Ground Motion - Developing Design Ground Motion. Application of software package - codal recommendations.

CO4: Apply seismic codes to design foundations, slopes, and retaining walls for earthquake resistance. L:10

Earthquake Resistant Design of foundation of buildings - Design considerations - Geotechnical - Architectural - Structural - Capacity Design - Seismic analysis. Earthquake Response of slopes - Evaluation of slope stability - pseudostatic Analysis - Newmark's Study of Block Analysis - Dynamic Analysis - Earth pressure due to ground shaking valuation - Lateral Deformation - codal provisions.

CO5: Implement effective earthquake hazard mitigation measures in geotechnical design and planning. L:8

Seismic risk vulnerability and hazard - Risk mapping - scale – changing percept of risk – vulnerability Atlas of India. Hazard assessment - Maintenance and modifications to improve hazard resistance; Seismic microzonation – methodology – scale of mapping - Different type of foundation and its impact on safety.

TEXT BOOKS

1. Steven L. Kramer and Jonathan P. Stewart, "Geotechnical Earthquake Engineering", CRC Press. ISBN: 9781032842745, 2nd Edition (2024)
2. Kameswara Rao, N.S.V., "Dynamics soil tests and applications", A.H. Wheeler Publishing Company Limited– New Delhi, ISBN: 9788175442030, 2002.

REFERENCES

1. Robin K. McGuire., "Seismic Hazard and Risk Analysis", Earthquake Engineering Research Institute (EERI), ISBN: 9780943198019, 2004
2. Wai-Fah Chen and Charles Scawthem, Earthquake Engineering Hand book, Caspress,2003.
3. Robert W. Day, Geotechnical Earthquake Engineering Hand book, Second Edition, McGraw Hill, 2012.
4. IkuoTowhata, "Geotechnical Earthquake Engineering" Springer series in Geomechanics and Geo Engineering, Scientific Publishing services Pvt. Ltd., 2008.

L: 45; TOTAL: 45 PERIODS

23CE21E	**GEO-ENVIRONMENTAL ENGINEERING**	**L**	**T**	**P**	**E**	**C**
		3	**0**	**0**	**0**	**3**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO1: Demonstrate understanding of the concepts and principles of geo-environmental engineering

CO2: Explain and relate the mechanisms of contaminant transport and the characterization of contaminated sites.

CO3: Apply suitable methods to decontaminate sites for safe reuse.

CO4: Employ appropriate containment techniques for the safe disposal of wastes.

CO5: Utilize and adapt soil–waste stabilization techniques to convert waste into resource materials.

CO1: Demonstrate understanding of the concepts and principles of geo-environmental Engineering **7**

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- Environmental laws and regulations.

CO2: Explain and relate the mechanisms of contaminant transport and the characterization of contaminated sites. **10**

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 – risk assessment – case studies.

CO3: Apply suitable methods to decontaminate sites for safe reuse. **10**

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, electro-kinetic remediation, soil heating, vitrification, bio remediation, phyto

remediation – ground water remediation – pump and treat, In-situ flushing, permeable reacting barrier, bio-mining, In-situ air sparging - case studies.

CO4: Employ appropriate containment techniques for the safe disposal of wastes. 9

Source and characteristics of waste - site selection for landfills – components of landfills – liner system – soil, geomembrane, geosynthetic clay, geo-composite liner system – leachate collection – final cover design – monitoring landfill.

CO5: Utilize and adapt soil–waste stabilization techniques to convert waste into resource materials. 9

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 stabilization – case studies.

TEXTBOOKS:

1. Hari D. Sharma and Krishna R.Reddy, Geo-Environmental Engineering – John Wiley and Sons, INC, USA, 2004.
2. Hsai-Yang Fang and Ronald C. Chaney, Introduction to Environmental Geo technology-CRC Press, Taylor and Francis Group,Second Edition, 2016

REFERENCES:

1. Daniel B.E, Geotechnical Practice for waste disposal, Chapman & Hall, London, 1993
2. Lagrega, M.d., Buckingham, P.L., and Evans, J.C., Hazardous Waste Management, McGraw Hill, Inc. Singapore, 1994.
3. Westlake, K., Landfill Waste pollution and Control, Albion Publishing Ltd., England, 1995.

L: 45; TOTAL: 45 PERIODS

23CE22E	**EARTH RETAINING STRUCTURES**	**L**	**T**	**P**	**E**	**C**
		3	**0**	**0**	**0**	**3**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO1: Demonstrate understanding of earth pressure theories and their application to retaining structures.

CO2: Apply earth pressure concepts to analyse and design rigid retaining structures.

CO3: Integrate and implement design principles for flexible retaining walls and ground anchors.

CO4: Employ earth pressure concepts to design and evaluate braced and slurry-supported excavations, and underground utilities.

CO5: Analyse and interpret slope stability using total and effective stress approaches.

CO1: Demonstrate understanding of earth pressure theories and their application to retaining structures. L: 8

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.

CO2: Apply earth pressure concepts to analyse and design rigid retaining structures. L:9

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

CO3: Integrate and implement design principles for flexible retaining walls and ground anchors. L: 9

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.

CO4: Employ earth pressure concepts to design and evaluate braced and slurry-supported excavations, and underground utilities. L: 10

Lateral pressure on sheeting in braced excavation, stability against piping and bottom heaving. Earth pressure around tunnel lining, shaft and silos – Soil anchors – Soil pinning – Basic design concepts-Slurry Supported Trenches-Basic principles – Slurry characteristics – Specifications – Diaphragm walls – stability Analysis.

CO5: Analyse and interpret slope stability using total and effective stress approaches. L: 9

Stability of infinite and finite slopes; total and effective stress approaches. Limit equilibrium methods including Method of Slices, Bishop's, Janbu's, and wedge analysis. Introduction to numerical methods for slope stability. Special aspects of slope analysis including groundwater and rainfall effects. Use of stability charts. Role of geosynthetics in slope stabilization. Case studies on slope failure and stabilization.

.

TEXTBOOKS:

1. Muni Budhu, Soil Mechanics and Foundation, John Wiley and Sons, INC 2011
2. Braja M Das and Khaled Shoban, "Principles of Geotechnical Engineering", Cengage Learning, 8th Edition, 2015

REFERENCES:

1. Clayton, C.R.I., Militisky, J. and Woods, R.I., Earth pressure and Earth-Retaining structures, Second Edition, Survey University Press, 1993.
2. Militisky, J. and Woods, R., Earth and Earth retaining structures, Routledge,1992.
3. Hajnal, I., Marton, J. and Regele, Z., Construction of diaphragm walls, A Wiley – Inderscience Publication, 1984.
4. Petros P. Xanthakos., Slurry walls as structural systems, McGraw-Hill, Inc., New York, 1994.

L: 45; TOTAL: 45 PERIODS

23CE23E	**TRAFFIC ENGINEERING AND MANAGEMENT**	**L**	**T**	**P**	**E**	**C**
		3	**0**	**0**	**0**	**3**

COURSE OUTCOMES

Upon successful completion of this course, the students will be able to:

CO1: Demonstrate the fundamentals and characteristics of road traffic.

CO2: Conduct traffic studies and analyze traffic data for planning and design.
CO3: Design traffic control devices and intersections.
CO4: Apply traffic management techniques for improving efficiency and safety.
CO5: Implement modern practices in traffic management including Intelligent Transportation Systems.

CO1:Demonstrate the fundamentals and characteristics of road traffic. L:9

Scope of Traffic Engineering – Importance and objectives – Road user characteristics – Vehicular characteristics – Traffic stream parameters: Speed, Flow, Density – Fundamental diagrams – Traffic volume studies, Speed studies, Journey time and Delay studies, Origin-Destination (O-D) surveys – Parking studies and pedestrian studies.

CO2: Conduct traffic studies and analyze traffic data for planning and design. L:9

Traffic data collection techniques – Presentation and analysis of traffic data – Statistical applications in traffic engineering (mean, standard deviation, percentile speeds) – Concepts of capacity and Level of Service (LOS) for urban roads and highways – Design service volume.

CO3: Design traffic control devices and intersections. L:9

Traffic control devices: Road signs, Markings, Traffic signals – Signal design: Webster's method, Co-ordinated signal systems – Traffic rotary design principles – At-grade and grade-separated intersections – Channelization concepts.

CO4: Apply traffic management techniques for improving efficiency and safety L:9

Traffic Management Measures: One-way streets, Tidal flow, Reversible lanes, Parking control, Traffic calming devices, Access control – Speed management strategies – Road Safety Audits – Accident studies and Black Spot identification.

CO5: Implement modern practices in traffic management including Intelligent Transportation Systems L:9

Introduction to ITS applications in traffic management – Latest Technologies in ITS - Area Traffic Control Systems (ATCS) – Advanced Traffic Management Systems (ATMS) – Electronic Toll Collection (ETC) – Smart Parking Systems – Case studies of traffic management systems in Indian cities.

L: 45; TOTAL:45 PERIODS

TEXT BOOKS

1. Kadiyali, L.R., Traffic Engineering and Transport Planning, Khanna Publishers, 2021.
2. Khanna, S.K. and Justo, C.E.G., Highway Engineering, Nem Chand & Bros, 2023.

REFERENCES

1. Papacostas, C.S. and Prevedouros, P.D., Transportation Engineering & Planning, Prentice Hall, 2019.
2. Indian Roads Congress (IRC) Codes: IRC 93 (Traffic Signals), IRC 106 (Traffic Surveys), IRC SP:41.
3. TRB Highway Capacity Manual (HCM) 2016 – Transportation Research Board, USA.
4. MoRTH, Road Safety and Traffic Management Guidelines, Government of India, 2020.

23CE24E	**PAVEMENT ENGINEERING**	**L**	**T**	**P**	**E**	**C**
		3	**0**	**0**	**0**	**3**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO1: Demonstrate the concepts of pavement stability and its functional behavior

CO2: Design the flexible pavement

CO3: Design the rigid pavement

CO4: Analyze pavement performance through structural evaluation methods

CO5: Apply stabilization techniques and geosynthetics in pavements

CO1: Demonstrate the Concepts of pavement stability and its functional behavior L:9

Introduction - Pavement as layered structure - Pavement types – Pavement stability-Stress and deflections in pavements under repeated loading.

CO2: Design the flexible pavement L:9

Empirical– Semi empirical and theoretical Methods – Design procedure as per latest IRCguidelines - Design and specification of rural road-IIT pave software for flexible pavement design.

CO3: Design the rigid pavement L:9

Cement concrete pavements - Modified Westergard approach - Design procedure as perlatest IRC guidelines - Joints in rigid pavements - Concrete roads and their scope in India

CO4: Analyze pavement performance through structural evaluation methods L:9

Pavement Evaluation [Condition and evaluation surveys] - Structural Evaluation byDeflection Measurements, Present Serviceability Index] – Strengthening of Pavement - Pavement maintenance. [IRC Recommendations Only**]**

CO5: Apply stabilization techniques and geosynthetics in pavements L:9

Stabilisation with special reference to highway pavements - Choice of stabilizers –Testing and field control – Stabilisation for rural roads in India - Geosynthetics (geotextiles & Geogrids) in roads.

TEXT BOOKS

1. Khanna, S.K. and Justo C.E.G. and Veeraragavan, A, Highway Engineering, Nem Chand and Brothers, Revised 10th Revised Edition,2017
2. Dr. L.R. Kadiyali and Dr. N.B. Lal., ―Principles and Practice of Highway Engineering, Khanna Tech. Publications, New Delhi, 2023

REFERENCES

1. Yoder R.J and Witczak M.W., Principles of Pavement Design, John Wiley, 2000.
2. Guidelines for the Design of Flexible Pavements, IRC: 37 - 2012, The Indian roads Congress, New Delhi
3. Guideline for the Design of Plain jointed Rigid Pavements for Highways, IRC: 58-2002, the Indian Roads Congress, New Delhi.
4. Design and Specification of Rural Roads (Manual), Ministry of rural roads, Government of India, New Delhi, 2001.

L: 45; TOTAL: 45 PERIODS

23CE25E	**TRANSPORTATION PLANNING PROCESS**	**L**	**T**	**P**	**E**	**C**
		3	**0**	**0**	**0**	**3**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO1: Utilize the fundamentals of the transportation planning process for demand estimation.

CO2: Apply the concepts of trip generation for travel forecasting.

CO3: Use appropriate methods for analyzing trip distribution patterns.

CO4: Employ mode choice behavior principles and mode split models.

CO5: Implement traffic assignment techniques to evaluate route optimization.

CO1: Utilize the fundamentals of the transportation planning process for demand estimation **L:9**

Importance of transportation planning, Integration of Land Use and Transport; Systems Approach toTransport Planning; Four Steps in the Transport Planning Process; Travel Demand ModellingApproach; Traffic Analyses Zones - internal and external; Various Transportation Surveys for thecollection of data - methodology, analyses of data and presentation of results

CO2: Apply the concepts of trip generation for travel forecasting. **L:9**

Definition and importance; Trip Production and Attraction, Types of trips; Factors governing trip generation: population related data, land and building use, socio-economic, Trip generation models: Types, Assumptions made.

CO3: Use appropriate methods for analyzing trip distribution patterns. **L:9**

Definition and objective; Data collection, analyses and presentation of trip matrix table, Desire Line Diagram, Development of Gravity, growth factor methods for Trip Distribution, Calibration of gravity model and its validation.

CO4: Employ mode choice behavior principles and mode split models. **L:9**

Factors influencing mode choice - Household characteristics; Zonal Characteristics; Network characteristics - Modal split: pre-distribution or post distribution - Mode wise trip matrix and modal split analyses- Overview of Probit and Logit model

CO5: Implement traffic assignment techniques to evaluate route optimization. **L:9**

Meaning and objective; General principles; Assignment Techniques- all-or-nothing assignments, multiple route assignment, capacity restraint, diversion curves, Trip assignment route selection; Modewise trip matrices; element of transportation network, nodes and links, speed flow curves, minimum path trees.

TEXT BOOKS

1. Kadiyali, L.R., Traffic Engineering and Transport Planning, Khanna Publishers, Delhi, 2024.
2. Papacostas, C.S., and Prevedouros, P.D., Transportation Engineering and Planning, Pearson Education, India, 2024.
3. Bruton, Michael J., Introduction to Transportation Planning, Routledge, London, 2024.

REFERENCES

1. Dickey, John W., Metropolitan Transportation Planning, Routledge, New Delhi, 2024.
2. Khisty, C. Jotin, and Lall, Kent B., Transportation Engineering: An Introduction, Pearson Education, India, 2022.
3. Ortúzar, Juan de Dios, and Willumsen, Luis G., Modelling Transport, John Wiley & Sons, 2023.
4. Chennai Comprehensive Traffic Study, Chennai Metropolitan Development Authority, 2021.
5. Ortúzar, J.D., and Willumsen, L.G., Modeling Transport, John Wiley & Sons, New York, 2020.
6. PTV Visum and PTV Line statistical software for transport planning.

L: 45; TOTAL: 45 PERIODS

23CE26E	URBAN PLANNING AND DEVELOPMENT	L	T	P	E	C
		3	0	0	0	3

COURSE OUTCOMES

Upon Successful completion of this course, the students will be able to

CO1: Demonstrate the basic issues and meaning of terminologies in urban planning.
CO2: Demonstrate the different types of theories of urban planning and city development.
CO3: Relate the different types of plan, their strategies and their preparation process.
CO4: Utilize the planning standards, evaluate the constraints and the financial mechanism.
CO5: Demonstrate various town and country planning acts and their functions.

CO1: Demonstrate the basic issues and meaning of terminologies in urban planning L:9

Definition of Human settlement, Urban area, Town, City, Metropolitan City, Megalopolis, Urbanisation, Urbanism, Sub-urbanisation, 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 urbanisation, - Atal Mission for Rejuvenation and Urban Transformation (AMRUT)

CO2: Demonstrate the different types of theories of urban planning and city Development L:9

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, Radbun Concept, Neighbourhoods, Urban heat island, Theories of Ekistics, Bid-rent Theory by William Alonso, Green Belt Concept.

CO3: Relate the different types of plan, their strategies and their preparation process. L:9

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 Regional Plan (RP), Master Plan (MP), and the Detailed Development Plan (DDP), Methodologies for the preparation of the RP, MP, and the DDP – Case Studies.

CO4: Utilize the planning standards, evaluate the constraints and the financial

mechanism. **L:9**

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.

CO5: Demonstrate various town and country planning acts and their functions. L:9

Town and Country Planning, Local Bodies and Land Acquisition Acts, Development and Building Rules, Site analyses, Layouts and Buildings Design.

TEXT BOOKS

1. Goel, S.L Urban Development and Management, Deep and Deep publications, New Delhi 2022.
2. George Chadwick, A Systems view of planning, Pergamon press, Oxford 1978.
3. Singh V.B, Revitalised Urban Administration in India, Kalpaz publication, Delhi, 2021.
4. Edwin S.Mills and Charles M.Becker, Studies in Urban development, A World Bank publication, 1986

REFERENCES

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 Development and Building Rules, 2019.
6. Urban & Regional Development Plans Formulation & Implementation (URDPFI) Guidelines, Vol I & II, Jan 2015, Govt of India, Ministry of Urban Development.
7. http:/.moud.gov.in

L: 45; TOTAL: 45 PERIODS

23CE27E	**INTELLIGENT TRANSPORT SYSTEMS**	**L**	**T**	**P**	**E**	**C**
		3	**0**	**0**	**0**	**3**

COURSE OUTCOMES

Upon successful completion of this course, the students will be able to:

CO1: Demonstrate the fundamentals, architecture, and components of Intelligent Transport Systems.

CO2: Use various sensing, communicationand data collection technologies in ITS.

CO3: Analyse traffic management, traveller informationand safety systems.

CO4: Evaluate ITS applications in public transport systems and freight movement.

CO5: Analyse the challenges, opportunities and future trends in ITS implementation.

CO1: Demonstrate the fundamentals, architecture, and components of Intelligent Transport Systems (ITS) **L:9**

Definition, Objectives, Benefits of ITS – Components of ITS – ITS Architecture (National, Regional, Project levels) – User Services and User Service Bundles – ITS Standards and Policies – Overview of system engineering for ITS.

CO2: Classify various sensing, communication and data collection technologies used in ITS **L:9**

Detection and surveillance technologies: Inductive loop detectors, Video vehicle detectors, Infrared sensors, RADAR, LiDAR – Communication Technologies: DSRC, RFID, GPS, Bluetooth, Cellular communication – Data collection and management methods – Big Data in ITS.

CO3: Analyse traffic management, traveller information and safety systems **L:9**

Traffic signal control systems (Adaptive and Coordinated control) – Ramp metering – Incident Detection and Management – Variable Message Signs (VMS) – Advanced Traveler Information Systems (ATIS) – Smart Parking – Dynamic Route Guidance Systems – Safety applications: Collision avoidance, Speed management.

CO4: Evaluate ITS applications in public transport systems and freight movement **L:9**

Public Transport Management Systems: Automatic Vehicle Location (AVL), Automatic Passenger Counting (APC), Real-time tracking, Electronic Fare Payment Systems – Freight and Commercial Vehicle Operations (CVO): Fleet Management, Electronic Toll Collection, Weigh-in-Motion Systems.

CO5: Analyse the challenges, opportunities, and future trends in ITS implementation **L:9**

Challenges in ITS Deployment: Institutional issues, Interoperability, Privacy concerns – Financial and Policy Issues – Evaluation of ITS projects – Emerging Trends: Connected Vehicles, Autonomous Vehicles, Smart Cities and Mobility as a Service (MaaS) – Selected Case Studies (National and International).

TEXTBOOKS:

1. Asier Perallos & Co - Intelligent Transport Systems: Technologies and Applications, Wiley, 2015.
2. Srinivasa kumar R - Intelligent Transport Systems Universities Press, 2022.

REFERNCES:

1. ITS Handbook 2000: Recommendations from the World Road Association (PIARC), Kan Chen, John C. Miles, Artech House, 2000.
2. Amit Kumar Tyagi, Intelligent Transportation Systems: Theory and Practice, Springer, 2023.
3. Satish Chandra, M.M. Agarwal - Intelligent Transport Systems: Planning, Operations and Evaluation, PHI Learning, 2013.

L: 45; TOTAL: 45 PERIODS

23CE28E	**DIGITAL SURVEYING & PHOTOGRAMMETRY**	**L**	**T**	**P**	**E**	**C**
		3	**0**	**0**	**0**	**3**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO1: Illustrate the concepts for curve designing and tacheometric surveying

CO2: Apply the principles of total station and EDM in distance measurement
CO3: Explain the photogrammetric surveying and photo interpretation
CO4: Explain the concepts of remote sensing
CO5: Utilize GPS in transportation engineering and land use planning

CO1: Illustrate the concepts for curve designingand tacheometric surveying 9
Curve ranging - Horizontal and vertical curves - Simple curves - Setting with chain and Tapes - Horizontal and vertical angle measurements - Temporary and permanent adjustments - Heights and distances - Tacheometer - Stadia Constants - Analytic Lens - Tangential and Stadia Tacheometric surveying

CO2: Apply the principles of total station and EDM in distance measurement 9
Electromagnetic distance measurement (EDM) – Principle of EDM Carrier waves – Types of EDM instruments – Distomat – Total Station – Principle – procedure & surveying using Total Station – precise leveling - Micro-optic theodolite.

CO3: **Explain the photogrammetric surveying and photo interpretation 9**
Photogrammetry – Terrestrial and Aerial Photogrammetry – Horizontal position of a point from photographic measurement – elevation of a point – Determination of focal length of camera - Geometry and scale of vertical photographs – Ground co-ordinates from vertical photographs - Relief displacement – Planimetric mapping from vertical photos – Stereoscopy– Photo interpretation-Drone surveying.

CO4: Explain the concepts of remote sensing 9
Remote sensing – concepts – Idealized remote sensing system – characteristics – Types of remote sensing system – Remote sensing from space – Data interpretation –application of remote sensing - LIDAR – RADAR -SONAR.

CO5: Utilize GPS in transportation engineering and land use planning 9
GPS Basics – system overview – working principle of GPS – Satellite ranging –calculating position – Ranging errors and its correction – GPS surveying Methods – static, Rapid static, DGPS and Kinematic methods – Real time and post processing DGPS – visibility diagram – GAGAN – Geofencing.

TEXT BOOKS

1. Punmia.B.C., Ashok K. Jain and Arun K Jain, Surveying Vol.I,II and III 17th Edition, Lakshmi Publications Private Limited, New Delhi, 2023.
2. Kanetkar T.P.,Surveying and Levelling, Vol.I, United Book Corporation, Pune, 24thReprint, 2022.

REFERENCES

1. Clark D., Plane and Geodetic Surveying, Vols.I, C.B.S. Publishers and Distributors, Delhi, 6th Edition, 2004.
2. James M. Anderson and Edward M.Mikhail,Introduction to Surveying,McGraw-Hill Book Company,7thEdition, 2012.
3. Bannister and S.Raymond, "Surveying", 7th Edition, Longman 2004.

L: 45; TOTAL: 45 PERIODS

23CE29E	**SMART CITIES**	**L**	**T**	**P**	**E**	**C**
		3	**0**	**0**	**0**	**3**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO1:Explain the concept of smart & sustainable city and associated challenges.

CO2:Explain the Infrastructure Planning and Development for smart Cities.

CO3:Explain feasibility analysis of Transportation system for Smart Cities.

CO4:Apply data-driven strategies and modern technologies to improve smart city functions.

CO5: Apply GIS and remote sensing techniques to urban planning and management for smart cities.

CO1 Explain the concept of smart & sustainable city and associated challenges L: 9

Introduction to smart & sustainable cities- Definition, dimensions, scope Smart Cities – Global Standards and Performance Benchmarks, Practice Code, Principal stakeholders, key trends in smartcities developments, Concept of Sustainable cities. Applications of SmartTechnologies in Urban Planning, Case Studies of Smart City Projects, Challenges and Future Trends.Smartcity Mission of India.

CO2 Explain the Infrastructure Planning and Development for smart Cities L: 9

Planning for Urban Infrastructure, Introduction to city planning, key trends in smart cities developments, Sustainable features for smart cities. Role of Planner in the provision of urban networks for different services. Feasibility studies for infrastructure projects, planning for major infrastructure projects, Various Infrastructure Program and policies by MOUD, PPP (DBOOT, BOOT, etc.) in infrastructure projects. Dimension of smart cities, financing smart cities development, Governance of smart cities.

CO3 Explain feasibility analysis of Transportation system for Smart Cities L: 9

Urbanization and urban mobility, urban land use and transport. Concepts of sustainable mobility, public transportation, pedestrians and bicyclists and parking, fundamentals of the intelligent transportation systems (ITS)

CO4 Apply data-driven strategies and modern technologies to improve smart city functions L: 9

Role of Technologies in Smart Cities - Data driven strategies implementation in smart cities**,** leveraging recent technologies in enhancing urban living: internet of things (IoT), ICT services for smart cities, Benefits of employing ICT, ICT system components for smart cities, State of the art in ICT.

CO5 Apply GIS and remote sensing techniques to urban planning and management for smart cities L: 9

Fundamentals of GIS and Remote Sensing, Applications of GIS and Remote Sensing – UrbanPlanning and Management, Smart Cities, Transportation Planning, Environmental Management andSustainability, Case Studies.

REFERENCES

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.
   Binti Singh, ManojParmar, "Smart City in India Urban Laboratory, Paradigm or Trajectory, Routledge India, 2019
3. https://smartcities.gov.in/guidelines#block-habikon-content
4. Stimmel, L., "Building Smart Cities: Analytics, ICT, and Design Thinking," Boca Raton, FL, USA: CRC Press, Taylor & Francis Group, 2016.
5. UN-Habitat; "Inclusive and sustainable urban planning: a guide for municipalities"; Volume 3: Urban Development Planning (2007); United Nations Human Settlements Programme (ISBN: 978- 92-1-132024-4).

L: 45; TOTAL: 45 PERIODS

23CE30E	**ENERGY EFFICIENT BUILDINGS**	**L**	**T**	**P**	**E**	**C**
		3	**0**	**0**	**0**	**3**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO1: Explain Energy Demand and Efficient Systems
CO2: Explain Energy Use Solutions in Building Systems
CO3: Apply Heat Flow Principles and Optimize Glazing and Shading Systems
CO4: Acquire knowledge of ECBC Guidelines and Green Building Strategies
CO5: Explain Energy Economics and Efficient Building Technologies

CO1: Explain Energy Demand and Efficient Systems **9**

Introduction and need for energy efficiency – Overview of energy efficiency in Vernacular buildings - Energy conservation through site planning, design and development-Energy - Past & Present scenario of World; National Energy consumption Data –Environmental aspects associated with energy utilization

CO2: Explain Energy Use Solutions in Building Systems **9**

Factors that affect energy use in buildings - envelope factors, air- conditioning systems factors, Building management systems -Artificial lighting-Day lighting – Sources and concepts Daylight apertures

CO3: Apply Heat Flow Principles and Optimize Glazing and Shading Systems **9**

Introduction to periodic heat flow in building- Glazing types, properties, glass layers, external and internal shading devices-Thermal performance of Building sections – Orientation of buildings

CO4: Acquire knowledge of ECBC Guidelines and Green Building Strategies **9**

Overview of Energy Conservation Building Code (ECBC) -Concepts of green buildings - sustainable site, water efficiency, materials and resources, energy and atmosphere, indoor environmental quality, and innovation in design- case studies and examples. – Green Building Rating System- BREEAM, LEED, IGBC, GRIHA.

CO5: Explain Energy Economics and Efficient Building Technologies **9**

Energy Economics –Net Present Value, Life Cycle Costing –Energy Service Companies ESCO concept- Case studies on the energy efficient techniques and technologies adopted in buildings

TEXT BOOKS

1. Zhai, Z. J. (2023). Energy Efficient Buildings: Fundamentals of Building Science and Thermal Systems. John Wiley & Sons.
2. Tyma, C., & Kolokotroni, M. (2022). Building Services Design for Energy Efficient Buildings. Routledge.
3. IGBC Green new buildings Manual Version 3.0
4. SP72: 2010- National Lighting Code

REFERENCES

1. Roaf, S., & Crichton, D. (2019). Adapting Buildings and Cities for Climate Change: A 21st Century Survival Guide. Routledge.
2. Koenigsberger, O. H., & Ingersoll, T. G. (2013). Manual of Tropical Housing and Building: Climate Design. Hyderabad: Universities Press India Pvt. Ltd.
3. Majumdar, M. (2009). Energy-efficient buildings in India. TERI Press.

L: 45; TOTAL: 45 PERIODS

23CE31E	**SUSTAINABLE CONSTRUCTION MANAGEMENT**	**L**	**T**	**P**	**E**	**C**
		3	**0**	**0**	**0**	**3**

COURSE OUTCOMES

Upon Successful completion of this course, the students will be able to

Theory Component

CO1: Explain sustainable construction management principles, environmental governance, and low-carbon development practices for civil infrastructure.

CO2: Apply life cycle thinking and carbon management concepts to evaluate sustainability in construction projects.

CO3: Analyze sustainable design strategies and resource-efficient approaches for infrastructure development.

CO4: Evaluate digital technologies and sustainable project management practices for improving construction performance.

CO5: Develop sustainable construction management solutions using green assessment frameworks and emerging technologies.

CO1: Explain sustainable construction management principles, environmental governance, and low-carbon development practices for civil infrastructure. **L: 9**

Introduction to Sustainable Construction Management – Sustainable Development Goals (SDGs) – Environmental, Social and Governance (ESG) principles – Climate change and decarbonization – Net-zero construction concepts – Sustainable infrastructure policies – Sustainable urban development – Role of construction managers in sustainable development – Infrastructure case studies..

CO2: Apply life cycle thinking and carbon management concepts to evaluate sustainability in construction projects **L: 9**

Life cycle thinking in construction – Whole Life Carbon concept – Carbon footprint assessment – Carbon reduction strategies – Circular construction principles – Sustainability performance indicators – Introduction to digital carbon assessment tools (OpenLCA and One Click LCA) – Construction project applications.

CO3: Analyze sustainable design strategies and resource-efficient approaches for infrastructure development. **L: 9**

Sustainable building design principles – Passive design strategies – Energy-efficient buildings – Water-sensitive infrastructure – Sustainable site planning – Nature-based solutions – Introduction to building energy simulation tools (Design Builder and Energy Plus) – Sustainable infrastructure case studies.

CO4: Evaluate digital technologies and sustainable project management practices for improving construction performance. **L: 9**

Sustainable project management – Digital technologies for sustainable construction – BIM applications for sustainability – Digital Twin concepts – Artificial Intelligence (AI) applications – Internet of Things (IoT) for infrastructure monitoring – Sustainability performance monitoring – Smart construction management.

CO5: Develop sustainable construction management solutions using green assessment frameworks and emerging technologies **L: 9**

Green building and infrastructure assessment frameworks LEED, IGBC and GRIHA – overview and comparison– ESG reporting concepts – Sustainable asset management – Climate adaptation strategies – Smart city infrastructure – Innovation in sustainable construction – Emerging technologies – Future trends in sustainable construction management.

TEXTBOOKS:

1. Kibert, C.J., Sustainable Construction: Green Building Design and Delivery, 5th Edition, John Wiley & Sons, 2022.
2. Halliday, S., Sustainable Construction, 2nd Edition, Butterworth-Heinemann Publications, 2018.
3. Charles J. Kibert and Jessica R. Calkins, Materials for Sustainable Sites, Wiley Publications, 2021.
4. Yudelson, J., Green Building through Integrated Design, McGraw Hill Education, 2020.

REFERENCES:

1. Chudley, R. and Greeno, R., Building Construction Handbook, 12th Edition, Routledge Publications, 2020.
2. Charles J. Kibert, Sustainable Construction Materials and Technologies, Springer Publications, 2019
3. GRIHA Manual Volume 1 to 5, TERI Publications.
4. Koskela, L., Lean Construction Management, Lean Construction Institute Publications.
5. Eastman, C., Teicholz, P., Sacks, R., and Liston, K., BIM Handbook: A Guide to Building Information Modeling, 3rd Edition, Wiley Publications, 2018.
6. DesignBuilder Software User Guide and Reference Manual.
7. EnergyPlus Documentation, U.S. Department of Energy.
8. ISO 14040 and ISO 14044 Standards on Life Cycle Assessment (LCA).
9. IGBC Green Building Rating System Manuals, Indian Green Building Council Publications.

L: 45; TOTAL: 45 PERIODS

23CE32E	**REMOTE SENSING AND GIS**	**L**	**T**	**P**	**E**	**C**
		3	**0**	**0**	**0**	**3**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO1: Explain the basic principles of remote sensing and spectral signatures
CO2: Classify the types of sensors and image interpretation
CO3: Illustrate the components of GIS

CO4: Interpret the data entry, storage and analysis in GIS
CO5: Apply the techniques of Remote Sensing and GIS in Civil Engineering field

CO1: Illustrate the principles of remote sensing and spectral signatures **9**

Remote Sensing – Principle - Electro-magnetic energy, spectrum - EMR interaction with atmosphere– Atmospheric Windows and its Significance – EMR interaction with Earth Surface Materials – Spectral Signature and Spectral Signature curves for water, soil and Earth Surface.

CO2: Classify the types of sensors and image interpretation **9**

Satellites - Classification – Satellite Sensors – satellite and sensor parameters -Resolution – Types of Remote Sensing - Visual Interpretation of Satellite Images – Digital Image processing – Characteristics of different platforms: Airborne and space borne TIR and microwave sensors, High Resolution Sensors - LIDAR, SAR, MODIS and AMSRE.

CO3: Illustrate the components of GIS **9**

GIS - History of Development - Components of GIS – Hardware, Software and Organizational Context – Data – Spatial and Non-Spatial – Data Input Sources– DBMS – Data Output - Data models - Raster and Vector data structures – Data compression –Raster vs Vector comparison.

CO4: Interpret the data entry, storage and analysis in GIS **9**

Analysis using Raster and Vector data – Operations – Overlaying - Buffering – Modeling in GIS - Digital Terrain Modeling, Analysis and application – Products of DEMs and their uses – Sources of errors in GIS and their elimination.

CO5: Apply the techniques of Remote Sensing and GIS in Civil Engineering field **9**

Applications of Remote Sensing and GIS – Disaster management, Water resource, Land use – Land cover – Urban planning - Intelligent Transport Systems - Development of Resources Information Systems.

TEXT BOOKS

1. Thomas Lilles and, Ralph W.Kiefer, Jonathan Chipman, Remote Sensing and Image Interpretation, January 2015
2. Anji Reddy, M., Remote Sensing and Geographical Information System, BS Publications, Hyderabad, 2005.
3. Burrough P.A. and Rachel A. McDonell, Principles of Geographical Information Systems, Oxford Publication, 2004

REFERENCES

1. Kang-Tsung Chang, "Introduction to Geographic Information Systems", McGraw Hill Publishing, 2nd Edition, 2011.
2. Lo. C.P. and A.K.W.Yeung, Concepts and Techniques of Geographic Information Systems, Prentice-Hall of India Private Limited, New Delhi, Pp: 492, 2002.
3. Peter A.Burrough, Rachael A. McDonnell, Principles of GIS, Oxford University Press, 2000

L: 45; TOTAL: 45 PERIODS

23CE33E	**SUSTAINABLE AND LEAN CONSTRUCTION**	**L**	**T**	**P**	**E**	**C**
		3	**0**	**0**	**0**	**3**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO1 Describe the various sustainable materials used in construction.

CO2 Explain the method of estimating the amount of energy required for building.

CO3 Describe the features of LEED, TERI and GRIHA ratings of buildings.

CO4 Explain the core concepts of lean construction tools and techniques and their importance in achieving better productivity.

CO5 Apply lean tools & techniques to achieve sustainability in construction projects.

CO1: Describe the various sustainable materials used in construction **9**

Introduction to sustainability and its importance – Overview of the Carbon cycle and its role in construction material: concrete and steel, etc. - CO_2 contribution from materials like cement, steel and others. - Recycled and manufactured aggregate - Role of QC and durability inn sustainable construction - Life cycle assessment and sustainability metrics.

CO2:Explain the method of estimating the amount of energy required for building **9**

Components and computation of embodied energy of construction materials - Energy concept and primary energy and operational energy - Embodied energy calculations for conditioned building - Life Cycle energy use and optimization strategies.

CO3: Describe the features of LEED, TERI and GRIHA ratings of buildings. **9**

Strategies for energy conservation in building – Overview of codes and standards: National Building Code (NBC), ECBC and relevant codes from tropical countries –concepts and calculations of OTTV (Overall Thermal Transfer Value) – LEED, TERI–Griha, and their features in green building certification - Role of insulation, thermal properties and moisture content in construction materials –Modeling and Performance evaluation of green buildings - Zero energy building: principles and case study.

CO4: Attains the core knowledge of lean construction and their importance **9**

Introduction to lean principles in construction - Need for Productivity Measurement and improvement in construction industry – Overview of the Productivity Measurement System (PMS).

CO5: Apply lean tools & techniques to achieve sustainability in construction projects **9**

Work Sampling and foreman delay survey - Value Stream and Process Mapping for efficiency improvements – implementation of 5S concepts - Collaborative Planning System (CPS) and Last Planner System (LPS) – Big Room Approach for collaborative working – Integration of IT/BIM with Lean principles – Practical steps for implementing lean tools on Project Site.

TEXTBOOKS

1. Charles J Kibert, Sustainable Construction: Green Building Design & Delivery, 5th Edition, Wiley Publishers, 2022.
2. "Sustainable Building Design: Principles and Practice" (2022) by Miles Keeping and David Shiers.

REFERENCES

1. Craig A. Langston & Grace K.C. Ding, Sustainable Practices in the Built Environment, Butterworth Heinemann Publishers, 2011.
2. Lean Project Delivery and Integrated Practices in Modern Construction (2nd Edition, 2020), Lincoln H. Forbes and Syed M. Ahmed.
3. "Sustainable Lean Construction: Select Proceedings of ILCC 2022" by Dr. Anil Kashyap, Prof. N. Raghavan, Dr. Indrasen Singh, and others.

L: 45; TOTAL: 45 PERIODS

23CE34E REPAIR AND REHABILITATION OF STRUCTURES

L	T	P	E	C
3	0	0	0	3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO1: Demonstrate the importance of maintenance and repair strategies.
CO2: Analyze the strength and durability properties of concrete structures.
CO3: Demonstrate the techniques for repair and protection methods.
CO4: Demonstrate the Repair, rehabilitation and retrofitting of structures.
CO5: Design sustainable rehabilitation strategies.

CO1: Demonstrate the importance of maintenance and repair strategies **L:9**

Maintenance, Repair and Rehabilitation, Facets of Maintenance, importance of Maintenance, Various aspects of Inspection, Assessment procedure for evaluating damaged structure, causes of deterioration

CO2: Analyze the strength and durability properties of concrete structures **L:9**

Quality assurance for concrete–Strength, Durability- Cracks, different types, causes–Effects due to climate, temperature, Sustained elevated temperature, Corrosion.

CO3: Demonstrate the techniques for repair and protection methods. **L:9**

Non-destructive Testing Techniques, Load Test for Stability-Epoxy injection, Shoring, Underpinning, Corrosion protection techniques–Corrosion inhibitors, Corrosion resistant steels, Coatings to reinforcement, Cathodic protection.

CO4: Demonstrate the Repair, rehabilitation and retrofitting of structure **L:9**

Strengthening of Structural elements, Repair of structures distressed due to corrosion, fire, leakage, earthquake–Structural Health Monitoring- demolition techniques-Engineered demolition methods- Case studies.

CO5: Design sustainable rehabilitation strategies **L:9**

Rehabilitation planning and implementation - Maintenance strategies and service life extension - Use of green and recycled materials - Cost-benefit analysis and life-cycle costing

TEXT BOOKS

1. Vidivelli.B, Rehabilitation of Concrete Structures, Standard Publishes Distribution, 1st Edition, Reprint Edition,2021.

2. Dodge Woodson.R, Concrete Structures, Protection, Repair and Rehabilitation, Butterworth-Heinemann, Elsevier, New Delhi, 2009.
3. Varghese.P.C Maintenance Repair and Rehabilitation & Minor works of building, Prentice Hall India Pvt Ltd, 2014.

REFERENCES

1. Ravishankar.K. Krishnamoorthy.T.S, Structural Health Monitoring, Repair And Rehabilitation of Concrete Structures, Allied Publishers, 2004
2. Hand Book on - Repair and Rehabilitation of RCC Buildings–Director General works CPWD, Govt. of India, New Delhi–2002

L: 45, TOTAL: 45 PERIODS

23CE35E	**BIM AND 3D PRINTING APPLICATION**	**L**	**T**	**P**	**E**	**C**
		3	**0**	**0**	**0**	**3**

COURSE OUTCOMES

Upon completion of this course, the students will be able to
CO1: Interpret BIM principles, evolution, and its role in the project life cycle
CO2: Understand and apply the workflows for creation of 3D model
CO3: Demonstrate the basic principles and applications of 3D Printing in Construction
CO4: Classify the different types of 3D printers and its working principles
CO5: Model and select the suitable materials for 3D printed concrete

CO1: Interpret BIM principles, evolution, and its role in the project lifecycle 9

Building Information Modeling (BIM) - Evolution of Engineering from 2D drawings to BIM Model, Isometric view – Examples and Limitation. Introduction & Process, Application of BIM. Design Authoring – Concepts and workflow, Introduction to stages of BIM Modeling process as per ISO19650. Introduction to Revit.

CO2: Understand and apply the workflows for creation of 3D model 9

Revit Architecture – File setup, creating levels and grids, Modeling Architectural elements,Schedulesand Annotation, Sheet creation, Parameter creation.Revit Structure - File setup, creating levels and grids, modeling structural elements,Schedules andAnnotation, Sheet creation, Parameter creation, Remove warnings.

CO3: Demonstrate the basic principles and applications of 3D Printing in Construction 9

History of 3D Printing Construction – Basic Principles– Fundamentals of additive manufacturing processes – Classification of 3D printing technologies – Advantage of 3D Printing in construction – Application and Challenges –Digital fabricated House – Smarter ceiling system – Bridge lattice structure – Sustainable and Affordable housing.

CO4: Classify the different types of 3D printers and its working principles 9

Gantry printers – Delta Printers – Robotic arm printers – Crawler boom printers – Polar printer - Optimal selection of printers – Mechanics of Machine Design – Motion along the axes – Nozzle design – Tank and Pump design – Accessories for 3D printer equipment.

CO5: Model and select the suitable materials for 3D printed concrete **9**

CAD modelling – Software tools for Design, Slicing, Rendering – Structural Design Considerations Architectural system – Printable Design – Economic efficient design aspects – Raw materials – Mix design approaches – Pumping and Extrusion and Intrusion of materials – Buildability – Printability – Bonding effect of layers

TEXT BOOKS

1. Chuck Eastman et al, 'BIM Handbook: A Guide to Building Information Modeling for Owners, Managers, Designers, Engineers and Contractors', John Wiley, 2018 (3rd Edition)
2. Robert S. Wegant, 'BIM Content Development: Standards, Strategies, and Best Practices', John Wiley, 2011.
3. Jay G. Sanjayan, Ali Nazari , Behzad Nematollahi ,3D Concrete Printing Technology: Construction and Building Applications,Butterworth-Heinemann Inc Publishers.(19 February 2019)
4. Arnaud Perrot (Editor)3D Printing of Concrete: State of the Art and Challenges of the Digital Construction Revolution (Civil Engineering and Goemechanics),John Wiley & Sons, 2025.

REFERENCES

1. ISO 19650 Building Information Modelling (BIM)
2. L&T Edu Tech LMS – **E-Resources**
3. Eastman, C., Teicholz, P., Sacks, R., & Liston, C. BIM handbook: A guide to building information modeling for owners, managers, designers, engineers and contractors, John Wiley & Sons, 2012.
4. Hardin, B., & McCool, D., BIM and construction management: proven tools, methods, and workflows, John Wiley & Sons, 2015.
5. Issa, R.R., & OlbinaS., Building Information Modeling Applications and Practices, American Society of Civil Engineers, 2015.
6. Julie W. Daniels, "Building Information Modelling (BIM): Industry Trends, Benefits and Challenges" Nova Science Publishers, 2023.
7. Barbara Rangel, Ana Sofia Guimaraes, 3D Printing for Construction with Alternative Materials,(Digital Innovations in Architecture, Engineering and Construction) 1st ed. 2023 Edition. Springer Publications.
8. Tejwant S. Brar, Mohammad A. Kamal, Shubham Singh,3D Concrete Printing Technology: Configuration with Green and Self-Healing Concrete (Materials Research Foundations #133)
9. Ming Jen Tan, Ming yang Li, Yi Wei Daniel Tay, Teck Neng Wong, Paulo Bartolo Construction 3D Printing Selected Papers from the 4-IC3DcP Conference proceedings © 2024 Springer Cham.

L: 45; TOTAL: 45 PERIODS

23CE36E	**RAILWAYS, AIRPORTS AND HARBOUR ENGINEERING**	**L**	**T**	**P**	**E**	**C**
		3	**0**	**0**	**0**	**3**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO1: Demonstrate the concepts and elements in Planning, Design and construction of Railways

CO2: Use appropriate methods for construction and maintenance of railway tracks and other infrastructures

CO3: Demonstrate the concepts and elements in Planning and selection of site for Airport
CO4:Design the Runway length and evaluate the orientation of runways
CO5: Demonstrate the terminologies, infrastructures in Harbour Engineering and Coastal regulations

CO1: Demonstrate the concepts and elements in Planning, Design and construction of Railways **L:9**

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- Level Crossings - Introduction to metro rail systems.

CO2: Use appropriate methods for construction and maintenance of railway tracks and other infrastructures **L:9**

Earthwork - Stabilization of track on poor soil - Tunneling Methods, drainage and ventilation - Calculation of Materials required for track laying - Construction and maintenance of tracks -Signalling - Railway Station and yards and passenger amenities.

CO3: Demonstrate the concepts and elements in Planning and selection of site for Airport **L:9**

Air transport characteristics-airport classification- site selection, airport planning: objectives, components, layout characteristics, socio-economic characteristics of the Catchment area, typical Airport Layouts, parking and Circulation Area, Terminal area planning- Passenger Facilities and Services.

CO4: Design the Runway length and evaluate the orientation of runways **L:9**

Runway Design: Orientation, Wind Rose Diagram, correction factors as ICAO stipulations Problems on basic and actual Length, Geometric Design, Configuration and Pavement Design Principles - Elements of Taxiway Design - Airport Zones - Runway and Taxiway Markings & Lighting.

CO5: Demonstrate the terminologies, infrastructures in Harbour Engineering and Coastal regulations **L:9**

Definition of Basic Terms: Harbour, Port, Satellite Port, Docks, Waves and Tides - Planning and Design of Harbours: Requirements, Classification, Location and Design Principles – HarbourLayout and Terminal Facilities - Coastal Structures: Piers, Break waters, Wharves, Jetties, Quays, Spring Fenders, Dolphins and Floating Landing Stage - Wave action on Coastal Structures and Coastal Protection Works - Environmental concern of Port Operations- Inland Water Transport.

TEXT BOOKS

1. Subramanian K.P., Highways, Railways, Airport and Harbour Engineering, Scitech Publications (India), Chennai, 2010
2. C.Venkatramaiah., Transportation Engineering-Vol.2 Railways, Airports, Docks and Harbours, Bridges and Tunnels., Universities Press (India) Private Limited, Hyderabad, 2015.
3. Vazirani.V.N and Chandola.S.P, "Transportation Engineering-Vol.II", Khanna Publishers, New Delhi, 2015.

4. Sirinivasa Kumar R Transportation Engineering Railways, Airports, Docks and Harbours. University Press 2014

REFERENCES

1. Khanna.S.K. Arora.M.G and Jain.S.S, Airport Planning and Design, NemachandandBros, Roorkee, 1994
2. Mundrey J S, Railway Track Engineering, McGraw Hill Education (India) Private Ltd, New Delhi, 2013.
3. SaxenaSubhash, C.andSatyapalArora, A Course in Railway Engineering, DhanapatRai and Sons, Delhi, 1998

L: 45; TOTAL: 45 PERIODS

R-2023 B.E. CIVIL ENGINEERING

OPEN ELECTIVES

23CE01N	**DISASTER MANAGEMENT**	**L**	**T**	**P**	**E**	**C**
		3	**0**	**0**	**0**	**3**

COURSE OUTCOMES

Upon Successful completion of this course, the students will be able to

CO1: Illustrate the disaster management framework and cycle

CO2: Interpret various natural and manmade disasters.

CO3: Select the Hazard Assessment procedure.

CO4: Demonstrate the mitigation measures and policies for disaster management.

CO5: Apply Science and Technology in disaster management.

CO1: Illustrate the disaster management framework and cycle L:9

Hazard, risk, vulnerability, disaster significance, nature, importance, dimensions and scope of disaster management - national disaster management frame work- financial arrangements- disaster- management cycle.

CO2: Interpret various natural and manmade disasters. L:9

Natural disasters- significance, nature, types and effects - floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions, heat and cold waves, climatic change - global warming - sea level rise - ozone depletion. Manmade disasters- nuclear, chemical, biological, building fire, coal fire, forest fire, oil fire, air pollution, water pollution,deforestation, industrial waste water pollution, road accidents, rail accidents, air accidents and sea accidents.

CO3: Select the Hazard Assessment procedure. L:9

Factors affecting damage – types, social status, habitation pattern, physiology and climate - Factors affecting mitigation measures - prediction – preparation - communication - area and accessibility - population - physiology and climate - Vulnerability Assessment and seismic strengthening of buildings - Vulnerability Assessment of Buildings procedure - Hazard Assessment-Visual Inspection and Study of Available Documents.

CO4: Demonstrate the mitigation measures and policies for disaster management L:9

Disaster management - efforts to mitigate natural disasters at national and global levels - international strategy for disaster reduction- Rescue, relief And Rehabilitation, Role Of National And International Agencies In Disaster Management-National Disaster Policy Of India (Salient Features).

CO5: Apply Science and Technology in disaster management. L:9

Applications of Science and Technology (RS, GIS, GPS) - Early Warning and Prediction Systems- Earthquake, cyclone, landslides, fire accidents, accidents- case studies

TEXT BOOKS

1. K.Palanivel, Disaster Management, Allied Publishers, 2022.
2. S.K.Singh, S.C.Kundu, Shobha Singh A, Disaster Management, William Publications, New Delhi, 2012.
3. Vinod K Sharma, ―Disaster Management, IIPA, New Delhi, 1995

REFERENCES

1. Annual Report, 2009-10, Ministry of Home Affairs, GOI.
2. Vinod K Sharma, Disaster Management, IIPA, New Delhi, 1995

L: 45; TOTAL: 45 PERIODS

R-2023 B.E. CIVIL ENGINEERING

ONE CREDIT COURSES

23CE01L	**STRUCTURAL HEALTH MONITORING**	**L**	**T**	**P**	**E**	**C**
		1	**0**	**0**	**0**	**1**

COURSE OUTCOMES

Upon Successful completion of this course, the students will be able to

CO1: Develop a systematic plan and apply appropriate techniques for implementing structural health monitoring systems in civil engineering structures.

CO2: Perform and interpret non-destructive testing methods to evaluate and assess the structural integrity and health of civil engineering structures.

CO1: Develop a systematic plan and apply appropriate techniques for implementing structural health monitoring systems in civil engineering structures. 7

Structural Health monitoring: Introduction-Necessity of monitoring health of civil engineering structures- Challenges in implementation of SHM scheme in real time scale- various factors that influence the implementation- issues concerning concrete and steel structures- advantages of SHM along with the long-term and short-term benefits, both in economic and safety perspectives.

CO2: Perform and interpret non-destructive testing methods to evaluate and assess the structural integrity and health of civil engineering structures. 8

Structural Health monitoring Techniques: Application, evaluation and result interpretation strategy of Rebound Hammer Test – Ultrasonic Pulse Velocity test – Half cell potential Study for corrosion of RCC members– Applications of RC cover meter – alkalinity, water soluble chloride and visual Examination of concrete sample.

TEXTBOOKS

1. Vistasp M. Karbhari and Farhad Ansari, Structural health monitoring of civil infrastructure systems, WOODHEAD PUBLISHING LIMITED Oxford Cambridge New Delhi. 2019.

REFERENCES

1. Do, R., 2014, Passive and active sensing technologies for structural health monitoring, University of California, San Diego.

L: 15, TOTAL: 15 PERIODS

23CE02L	**DRONE APPLICATIONS IN CIVIL ENGINEERING**	**L**	**T**	**P**	**E**	**C**
		1	**0**	**0**	**0**	**1**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO1: Apply drone technology in real-world civil engineering applications.

CO1: Apply drone technology in real-world civil engineering applications. 15

Evolution of drones – Types of UAVs – Components and payloads – Principles of flight – Drone classification; DGCA guidelines – UIN, UAOP, and RPAS categories – Flight permissions – Safety protocols – Weather and environmental consideration; Mission planning – Waypoint navigation – Ground control points (GCPs) – Pre-flight checks – Field demonstration; Aerial imaging – Orthomosaic and 3D model generation – Software tools- Land surveying and mapping- Construction progress monitoring- Structural inspection (bridges, towers, buildings)- Disaster assessment and environmental monitoring; Real-world project examples – AI & ML integration – LiDAR drones – Future prospects and challenges

L: 15, TOTAL: 15 PERIODS

TEXT BOOKS

1. Drone Technology in Architecture, Engineering and Construction by Daniel Tal, Jon Altschuld, Revised Edition, 2021
2. Daymion Lawrence, Matilda Kelly ―UAV and Drones: Current Applications, Knowledge Bakers Publications, 2024

REFERENCES

1. Mr. Tej Sai Moturu, Dr.Vinay Kumar Gaddam, ―Drone-tech & applications, AQUA Publications -2025
2. Drone Engineering: A Complete Roadmap for Designing, Building and Flying UAVs by Karthik, 2025
3. AI-Powered Drones: Applications and Challenges, by Arnold Adams, 2023.

23CE03L	BUILDING MARKING	L	T	P	E	C
		0	0	2	0	1

COURSE OUTCOMES

Upon Successful completion of this course, the students will be able to
CO1: Mark the layout of the building structures, plumbing and electrical lines

CO1: Mark the layout of the building structures, plumbing and electrical lines 30

Study of building plan & Contour Maps –Reading of plans and structural drawings-layout of load-bearing and framed structures– Setting out of building — Methods of Marking –Marking of load bearing structures – Marking of framed structures-Marking for plumbing and electrical lines-Marking using Theodolite and Total station.

TEXT BOOKS

1. Arora S.P. and Bindra S.P., Building Construction, Planning Techniques and Method of Construction, Dhanpat Rai and Sons, 1997.
2. Saffron Grant – Setting out for Construction, Costello House Publishing, 2019.

REFERENCES

1. Edward Allen and Joseph Iano, ―Fundamentals of Building Construction‖, John Wiley & sons, 2009.

TOTAL: 30 PERIODS

23CE04L	EARTHQUAKE RISK MITIGATION AND RETROFITTING	L	T	P	E	C
		1	0	0	0	1

COURSE OUTCOMES

Upon Successful completion of this course, the students will be able to
CO1: Illustrate the need for seismic rehabilitation and retrofitting of structures using appropriate strengthening techniques for enhanced seismic performance

CO1: Illustrate the need for seismic rehabilitation and retrofitting of structures using appropriate strengthening techniques for enhanced seismic performance 15

Overview of past Indian earthquakes – Need for rehabilitation and seismic retrofitting of structures – Seismic vulnerability assessment of masonry, RC and steel structures – Retrofitting and rehabilitation techniques for RC, masonry and steel structures: RC jacketing, steel jacketing, FRP wrapping, base isolation, column enlargement, seismic dampers, wall strengthening, diaphragm strengthening, anchoring and bracing systems – Selection of appropriate technique based on structural type and damage severity – Strategies to enhance seismic performance of existing buildings through effective rehabilitation and retrofitting.

TEXT BOOKS

1. Pankaj Agarwal & Manish Shrikhande, Earthquake Resistant Design of Structures, PHI Learning Pvt. Ltd., New Delhi, 2011.
2. Shashikant K. Duggal, Earthquake-Resistant Design of Structures, Oxford University Press, New Delhi, 2013.
3. IS 15988:2013 *"Seismic Evaluation and Strengthening of Existing Reinforced Concrete Buildings"*

REFERENCES

1. Anil K. Chopra, Dynamics of Structures: Theory and Applications to Earthquake Engineering (6th edition), Pearson, 2023

L: 15; TOTAL: 15 PERIODS

23CE05L	**BUILDING BYE LAWS**	**L**	**T**	**P**	**E**	**C**
		1	**0**	**0**	**0**	**1**

COURSE OUTCOMES

Upon completion of this course, the students will be able to
CO1: Interpret and apply the Tamil Nadu Combined Development and Building Rules (2019) in building planning and approval processes.
CO2: Evaluate site, building, and service requirements as per zoning, FSI, setback, and safety norms for different building types.

CO1: Interpret and apply the Tamil Nadu Combined Development and Building Rules (2019) in building planning and approval processes. 8

Need and significance of building bye-laws, legal framework under Town and Country Planning Act, scope and applicability of *Tamil Nadu Combined Development and Building Rules* 2019.Application procedure for building and layout approvals, competent authority, scrutiny fees, plan requirements, validity and renewal of permits.

CO2: Evaluate site, building, and service requirements as per zoning, FSI, setback, and safety norms for different building types. 7

Zoning classifications, setbacks, floor space index (FSI), coverage, height limitations, road width requirements, and open space reservations. Provisions related to structural design, fire safety, sanitation, drainage, energy conservation (solar, rainwater), and quality audit as per NBC. Regulations for high-rise, institutional, and industrial buildings; heritage conservation, tree preservation, completion certificate norms, and exemptions.

REFERENCES

1. Government of Tamil Nadu, *Tamil Nadu Combined Development and Building Rules, 2019*, MAWS Department, G.O.(Ms) No.18, dated 04.02.2019.
2. Bureau of Indian Standards, *National Building Code of India, 2016 (Part 3 & 4)*.

L: 15, TOTAL: 15 PERIODS

23CE06L	**E-WASTE MANAGEMENT**	**L**	**T**	**P**	**E**	**C**
		1	**0**	**0**	**0**	**1**

COURSE OUTCOMES

Upon Successful completion of this course, the students will be able to

CO1: Apply the suitable technology for recycling the E-waste in accordance with the standards of CPCB

CO1: Apply the suitable technology for recycling the E-waste in accordance with the standards of CPCB **15**

Introduction to E-Waste- E-waste generation rate in India and developed countries- Environmental and Health Impacts of E-Waste- E-Waste Recycling Technologies- Legal and Regulatory Framework- Sustainable Practices in E-Waste Management-Extended producer responsibility (EPR) - LCA for E-waste management- E-Waste Disposal and Landfill Considerations-E-waste management rules by CPCB

L: 15; TOTAL: 15 PERIODS

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1. Patrick Schorder, The Circular Economy and the Global South: Sustainable Lifestyles, Decent Work and the Green Economy, Routledge, 2019.
2. E-waste management rules, 2011 & 2016