O. P. JINDAL UNIVERSITY
O. P. Jindal Knowledge Park, Punjipathra, Raigarh-496109

O. P. Jindal University

Raigarh–Chhattisgarh

Scheme and Syllabus
of
B.Tech

School of Engineering
Session- 2025-29

O. P. JINDAL UNIVERSITY

O. P. Jindal Knowledge Park, Punjipathra, Raigarh-496109

PROGRAM OUTCOMES (POS): At graduation, students will be able to: (From AY: 24-25)

(refer next page for WK1 – WK9 (Knowledge and Attitude Profile)

PO-1	**Engineering Knowledge:** Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.
PO-2	**Problem Analysis**: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)
PO-3	**Design/Development of Solutions**: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)
PO-4	**Conduct Investigations**

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O. P. Jindal Knowledge Park, Punjipathra, Raigarh-496109

Knowledge and Attitude Profile (WK)

WK1: A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.

WK2: Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.

WK3: A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.

WK4: Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.

WK5: Knowledge, including efficient resource use, environmental impacts, whole-life cost, re-use of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.

WK6: Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.

WK7: Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.

WK8: Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.

WK9: Ethics, inclusive behavior and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes.

PROGRAM SPECIFIC OUTCOMES - At graduation, students will be able to provide:

PSO1: Applying Mechanical Engineering to Global Challenges

Develop an attitude to meet global challenges and apply the knowledge of mechanical engineering to solve problems related to thermal, design, manufacturing, and interdisciplinary fields.

PSO2: Technology-Driven Solutions for Industry & Society

Demonstrate knowledge and skill for solving social, real industrial problems using modern software and hardware tools.

PSO3: Utilizing Mechanical Engineering for Emerging Technologies

Utilizing the knowledge of Mechanical Engineering to work effectively in cutting edge technologies such as Robotics, Artificial Intelligence, Mechatronics, and Automation.

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Curriculum and Credit Framework for Undergraduate Programme (CCFUP)									
Semester	MAJOR		MINOR	AEC	SEC	Internship/ Apprentice-ship/Project/ Community outreach	VAC	MDC	Total Credits
	DSC	DSE							
I	16			2	2		2		22
II	13			2	2		2	3	22

** Students on exit shall be Awarded Undergraduate Certificate (in the Field of Study/ Discipline) after securing the requisite 44 credits in Semesters I and II and complete one vocational course of 4 credits during the summer*

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AEC: Ability Enhancement Course **SEC: Skill Enhancement Course**

VAC: Value addition Course **MDC: Multidisciplinary Course**

Level of courses: There will be 5 level of courses on the basis of learning outcome and difficulty levels distributed across semesters in ascending order.

Level-1 (0-99), Level-2 (100-199), Level-3 (200-299), Level-4 (300-399), Level-5 (400-499) courses shall be pre-requisite, introductory, intermediate, higher level, and advanced courses respectively.

DEGREE	MAJOR		MINOR	AEC	SEC	INTERNSHIP/ PROJECT	VAC	MDC	TOTAL CREDIT
	CORE	ELECTIVE							
Honors	106	12	24	8	9	8	6	9	182
Honors with Research	94	12	24	8	9	20	6	9	182

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O. P. Jindal Knowledge Park, Punjipathra, Raigarh-496109

Course Structure for B. Tech Program (1st & 2nd Semester)-2025-29 batch

(School of Engineering, Common to all departments)

Year	FIRST SEMESTER (NHEQF Level: 4.5)											
	Sem	Course Code	Course Category	Name of the Course	Hours per week			Scheme of Examination and Marks				Credits : L+ T+ (P/2)
					L	T	P	PRE		ESE	Total	
								MID	TA			
First Year	I st	MAT24-B-MJ111	MAJOR	Engineering Mathematics-I	3	0	0	15	15	70	100	3
		PHY24-B-MJ111	MAJOR	Applied Physics	2	0	0	7.5	7.5	35	50	2
		EE24-B-MJ101	MAJOR	Basic Electrical and Electronics	3	0	0	15	15	70	100	3
		ME24-B-MJ101	MAJOR	Engineering Graphics	2	0	2	15	15	70	100	3
		MME24-B-MJ101	MAJOR	Introduction to Engineering Materials	3	0	0	15	15	70	100	3
			AEC	Choose from the Pool	2	0	0	7.5	7.5	35	50	2
			SEC	Choose from the Pool	2	0	0	7.5	7.5	35	50	2
					0	0	4	-	15	35	50	
			VAC	Choose from the Pool	2	0	0	7.5	7.5	35	50	2
		EE24-B-MJ102	MAJOR	Basic Electrical and Electronics Lab	0	0	2	-	15	35	50	1
		ME24-B-MJ102	MAJOR	Innovation and Skill Development	0	0	2	-	15	35	50	1
												22

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Course Structure for B. Tech Program (1st & 2nd Semester)-2025-29 batch

(School of Engineering, Common to all departments)

Year	SECOND SEMESTER (NHEQF Level: 4.5)											
	SEM	Course Code	Course Category	Name of the Course	Hours per week			Scheme of Examination and Marks				Credits: L+ T+ (P/2)
					L	T	P	PRE		ESE	Total	
								MID	TA			
First Year	IInd	MAT24-B-MJ112	MAJOR	Engineering Mathematics-II	3	0	0	15	15	70	100	3
		CHE24-B-MJ111	MAJOR	Applied Chemistry	2	0	0	7.5	7.5	35	50	2
		ME24-B-MJ103	MAJOR	Fundamentals of Mechanics	3	0	0	15	15	70	100	3
		CSE24-B-MJ101	MAJOR	Python Programming	3	0	0	15	15	70	100	3
			AEC	Choose from the pool	2	0	0	7.5	7.5	35	50	2
			SEC	Choose from the pool	2	0	0	7.5	7.5	35	50	2
					0	0	4	-	15	35		
			VAC	Choose from the pool	2	0	0	7.5	7.5	35	50	2
			MDC	Choose from the pool	3	0	0	15	15	70	100	3
		ME24-B-MJ104	MAJOR	Mechanics Lab	0	0	2	-	15	35	50	1
		CHE24-B-MJ112	MAJOR	Applied Science Lab	0	0	2	-	15	35	50	1
												22

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Exit option to qualify for Undergraduate Certificate (after completion of 1st year)

1. An exit option is available for students those who have earned the total 44 credits at the End of Second Semester.
2. Student who wants to avail the exit option after first year have to earn additional 4 credits from the list of courses shown below.
3. These courses student have to complete within summer vacation after 1st Year.
4. After fulfillment as mentioned in 1 to 3 above, Students can earn U.G Certificate and same will be issued by the University.

List of Exit Courses (Choose Any *TWO* Skill-based Courses)

S. N.	Courses Code	Name of the Courses	L	T	P	Credit	Scheme of Examination and Marks			
							PRE		ESE	Total
							MID	TA		
1	CE24-B-EC101	Computer-Aided Drawing with AutoCAD	0	0	4	2	-	15	35	50
2	CSE24-B-EC101	Basic Computer Skills	0	0	4	2	-	15	35	50
3	CSE24-B-EC102	Computer Hardware Skills	0	0	4	2	-	15	35	50
4	EE24-B-EC101	Electrical Wiring & Testing	0	0	4	2	-	15	35	50
5	ME24-B-EC101	Advanced Mechanical Workshop	0	0	4	2	-	15	35	50

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Program:	B. Tech.	**Semester:**	After 1st Year
Name of the Course:	Advanced Mechanical Workshop	**Course Code:**	ME24-B-EC101
Credits:	2	**No of Hours:**	4 hrs. / week
Max Marks:	50		

Course Descriptions:

This course provides hands-on training and practical exposure to basic manufacturing processes and advanced mechanical workshop practices essential for mechanical and production engineering students. The course is designed to familiarize students with the operation of hand tools, machines, and manufacturing techniques used in fitting, carpentry, welding, foundry, and machining shops. Students will perform a series of structured practical tasks to understand the material properties, working principles, and safety procedures of various fabrication and machining processes. The course aims to build foundational technical skills and promote confidence in handling real-world engineering problems related to fabrication, assembly, and component production.

Course Outcomes:

After Completion of the course, Students will be able to:

CO Number	Course Outcome
CO1	Create wooden components and joints (like mortise and tenon) and develop simple wooden products using carpentry tools.
CO2	Create wooden components and joints (like mortise and tenon) and develop simple wooden products using carpentry tools.
CO3	Perform basic welding operations including butt-joint, lap-joint, and fabrication of components using arc welding and spot-welding techniques.
CO4	Apply the foundry process by preparing molds using patterns and casting non-ferrous metals and complex shapes.
CO5	Operate basic machine tools like lathe, shaper, and milling machines to produce parts with eccentric, dovetail, and pocketing operations.

Experiments to be performed (Minimum Ten experiments)

Fitting Shop

1. Making a V- groove job using fitting tools.
2. Making a step cutting job using fitting tools.
3. Making a male-female joint using fitting tools.

Carpentry Shop

1. Making a two-piece pattern using carpentry tool.
2. Making a mortise and tenon joint using carpentry tools.
3. Making a laptop stand using carpentry tools (Combined job).

Welding Shop

1. Making a Butt-Joint using virtual welding 2.O.
2. Making a Lap-joint using spot welding.
3. Fabricating a steel chair using electric arc welding (Combined Job).

Foundry Shop

1. Preparing a mold using a two-piece pattern.
2. Casting of a non-ferrous metals using two-piece pattern.
3. Casting of a sculpture using metal pattern (Combined job).

Machine Shop

1. Preparing an eccentric job on a lathe machine.
2. Performing dovetail cutting operation on a shaper machine.
3. Performing circular pocketing operation on a milling machine.

List of Tools/Equipment/Machines Required:

1. Fitting tools.
2. Carpentry tools
3. Welding machines (MMAW/Virtual 2.0/Spot) and equipment.
4. Muffle furnace.
5. Lathe Machine.
6. Shaper Machine.
7. Milling Machine.

CO, PO, & PSO Correlation

CO Number	Program Outcome											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	2	3	1	2	1	1	2	2	1	2	3	2	-
CO2	3	2	3	1	2	1	1	2	2	1	2	3	2	-
CO3	3	2	3	2	3	2	1	2	2	2	2	3	3	-
CO4	3	2	3	3	3	2	2	2	2	2	2	3	3	-
CO5	3	3	3	3	3	2	2	2	2	2	2	3	3	-

Note: 1: Low 2: Moderate 3: High

OP Jindal University

Raigarh-Chhattisgarh

Scheme and Syllabus

of

B. Tech.

Civil Engineering

Batch: 2024-28

PROGRAM OUTCOMES (POS): At graduation, student will be able to:
(From AY: 24-25)(refer next page for WK1 – WK9 (Knowledge and Attitude Profile)

PO-1	**Engineering Knowledge:** Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.
PO-2	**Problem Analysis**: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)
PO-3	**Design/Development of Solutions**: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)
PO-4	**Conduct Investigations of Complex Problems**: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8)
PO-5	**Engineering Tool Usage**: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)
PO-6	**The Engineer and The World**: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7)
PO-7	**Ethics**: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)
PO-8	**Individual and Collaborative Team work**: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
PO-9	**Communication**: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences
PO-10	**Project Management and Finance**: 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.
PO-11	**Life-Long Learning**: 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. (WK8)

Knowledge and Attitude Profile (WK)

WK1: A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.

WK2: Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.

WK3: A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.

WK4: Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.

WK5: Knowledge, including efficient resource use, environmental impacts, whole-life cost, re-use of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.

WK6: Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.

WK7: Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.

WK8: Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.

WK9: Ethics, inclusive behavior and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding andrespect, and of inclusive attitudes.

PROGRAM SPECIFIC OUTCOMES - At graduation, student will be able to:

PSO1: Advanced Design and Analysis

Utilize advanced tools and software for comprehensive civil engineering design and analysis, ensuring safety, quality, and compliance with regulatory standards in infrastructure projects.

PSO2: Modern Surveying and Project Management

Apply modern techniques in surveying, water supply, project planning and management, incorporating GIS and BIM for optimal resource management and efficient project execution in civil engineering.

PSO3: Sustainable Engineering Solutions

Develop sustainable materials and resilient engineering solutions to address challenges in environmental, geotechnical, hydrology and transportation fields, leveraging modern technologies while considering societal and environmental impacts.

Curriculum and Credit Framework for Undergraduate Programme (CCFUP)

Semester	MAJOR		MINOR	AEC	SEC	Internship/ Apprentice-ship/Project/ Community outreach	VAC	MDC	Total Credits
	DSC	DSE							
I	16			2	2		2		**22**
II	13			2	2		2	3	**22**
** Students on exit shall be Awarded Undergraduate Certificate (in the Field of Study/ Discipline) after securing the requisite 44 credits in Semesters I and II and complete one vocational course of 4 credits during the summer vacation of First Year*									
III	11		4	2	2		2	3	**24**
IV	14		4	2	3			3	**26**
*** Students on exit shall be Awarded Undergraduate Diploma (in the Field of Study/ Discipline) after securing the requisite 92 credits on completion of Semester IV and complete one vocational course of 4 credits during the summer vacation of Second Year.*									
V	15	3	4			2			**24**
VI	14	3	4						**21**
Students on exit shall be Awarded Bachelor of Voc [B-Voc] (in the Field of Study/Discipline) (Major and Minor) (3 years) after securing the requisite 137 credits on completion of Semester VI									
VIII	11	3	4			6			**24**
VII (Honors)	12	3	4						**19**
VIII (Honors with Research)		3	4			12			
									182
Students on exit shall be Awarded Bachelor of (in the Field of Study/Discipline) (Honours) or (Honours with Research) after securing the requisite 180 credits on completion of Semester VIII.									

AEC: Ability Enhancement Course **SEC: Skill Enhancement Course**

VAC: Value addition Course **MDC: Multidisciplinary Course**

Level of courses: There will be 5 level of courses on the basis of learning outcome and difficulty levels distributed across semesters in ascending order.

Level-1 (0-99), Level-2 (100-199), Level-3 (200-299), Level-4 (300-399), Level-5 (400-499) courses shall be pre-requisite, introductory, intermediate, higher level, and advanced courses respectively.

DEGREE	MAJOR		MINOR	AEC	SEC	INTERNSHIP/ PROJECT	VAC	MDC	TOTAL CREDIT
	CORE	ELECTIVE							
Honors	**106**	**12**	**24**	**8**	**9**	**8**	**6**	**9**	**182**
Honors with Research	**94**	**12**	**24**	**8**	**9**	**20**	**6**	**9**	**182**

COURSE STRUCTURE (I & II Sem common for All Branches)

FIRST SEMESTER											
SEM	Course Code	Course Category	Name of the Course	Hours per week			Scheme of Examination and Marks				Credits: L+ T+ (P/2)
				L	T	P	PRE		End Sem	Total	
							Mid Sem	TA			
1st	MAT24-B-MJ111	MAJOR	Engineering Mathematics-I	3	0	0	15	15	70	100	3
	PHY24-B-MJ111	MAJOR	Applied Physics	2	0	0		15	35	50	2
	EE24-B-MJ101	MAJOR	Basic Electrical and Electronics	3	0	0	15	15	70	100	3
	ME24-B-MJ101	MAJOR	Engineering Graphics	3	0	0	15	15	70	100	3
	MME24-B-MJ101	MAJOR	Introduction to Engineering Materials	3	0	0	15	15	70	100	3
		AEC	Choose from Pool	2	0	0		15	35	50	2
		SEC	Choose from Pool	2	0	0		15	35	50	2
				0	0	4					
		VAC	Choose from the Pool	2	0	0		15	35	50	2
	EE24-B-MJ102	MAJOR	Basic Electrical and Electronics Lab	0	0	2		15	35	50	1
	ME24-B-MJ104	MAJOR	Innovation and Skill Development	0	0	2		50		50	1
											22

SECOND SEMESTER											
SEM	Course Code	Course Category	Name of the Course	Hours per week			Scheme of Examination and Marks				Credits: L+ T+ (P/2)
				L	T	P	PRE		End Sem	Total	
							Mid Sem	TA			
2nd	MAT24-B-MJ112	MAJOR	Engineering Mathematics-II	3	0	0	15	15	70	100	3
	CHE24-B-MJ111	MAJOR	Applied Chemistry	2	0	0	-	15	35	50	2
	ME24-B-MJ102	MAJOR	Fundamentals of Mechanics	3	0	0	15	15	70	100	3
	CSE24-B-MJ101	MAJOR	Python Programming	3	0	0	15	15	70	100	3
		AEC	Choose from pool	2	0	0	-	15	35	50	2
		SEC	Choose from Pool	2	0	0	-	15	35	50	2
				0	0	4	-				
		VAC	Choose from the pool	2	0	0	-	15	35	50	2
		MDC	Choose from the pool	3	0	0	15	15	70	100	3
	ME24-B-MJ103	MAJOR	Mechanics Lab	0	0	2	-	15	35	50	1
	CHE24-B-MJ112	MAJOR	Applied Science Lab	0	0	2	-	15	35	50	1
											22

Exit option to qualify for Undergraduate Certificate (after completion of 1st year)

1. An exit option is available for students those who have earned the total 44 credits at the End of Second Semester.
2. Student who wants to avail the exit option after first year have to earn additional 4 credits from the list of courses shown below.
3. These courses student have to complete within summer vacation after 1st Year.

4. After fulfillment as mentioned in 1 to 3 above, Students can earn U.G Certificate and same will be issued by the University.

List of Exit Courses (Choose Any *TWO* Skill-based Course)

						Scheme of Examination and Marks			
		Hours per week				**PRE**		**End Sem**	**Total**
Courses Code	**Name of the Courses**	**L**	**T**	**P**	**Credit**	**Mid Sem**	**TA**		
CE24-B-EC101	Computer Aided Drawing with AutoCAD	0	0	4	2	-	15	35	50
CSE24-B-EC101	Basic Computer Skills	0	0	4	2	-	15	35	50
CSE24-B-EC102	Computer Hardware Skills	0	0	4	2	-	15	35	50
EE24-B-EC101	Electrical Wiring & Testing	0	0	4	2	-	15	35	50
ME24-B-EC101	Advanced Mechanical Workshop	0	0	4	2	-	15	35	50

THIRD SEMESTER											
SEM	Course Code	Course Category	Name of the Course	Hours per week			Scheme of Examination and Marks				Credits: L+ T+ (P/2)
							PRE		End Sem	Total	
				L	T	P	Mid Sem	TA			
3rd	CE24-B-MJ201	MAJOR	Strength of Materials	2	0	0	7.5	7.5	35	50	2
	CE24-B-MJ202	MAJOR	Civil Engineering Materials	2	0	0	7.5	7.5	35	50	2
	MAT 24-B-MJ221	MAJOR	Engineering Mathematics-III	3	0	0	15	15	70	100	3
	CE24-B-MJ203	MAJOR	Surveying I	3	0	0	15	15	70	100	3
	CE24-B-MN201	MINOR	Choose from pool	4	0	0	15	15	70	100	4
		AEC	Choose from pool Environmental Impact Assessment	2	0	0	7.5	7.5	35	50	2
		SEC	Choose from pool Civil Engineering Drawing (Auto CAD)	1	0	2	0	15	35	50	2
		VAC	Choose from pool	2	0	0	7.5	7.5	35	50	2
		MDC	Choose from pool	3	0	0	15	15	70	100	3
	CE24-B-MJ204	MAJOR	Surveying I Lab	0	0	2	-	15	35	50	1
											24

FOURTH SEMESTER											
SEM	Course Code	Course Category	Name of the Course	Hours per week			Scheme of Examination and Marks				Credits: L+ T+ (P/2)
							PRE		End Sem	Total	
				L	T	P	Mid Sem	TA			
4th	CE24-B-MJ205	MAJOR	Transportation Engineering I	3	0	0	15	15	70	100	3
	CE24-B-MJ206	MAJOR	Concrete Technology	2	0	0	7.5	7.5	35	50	2
	CE24-B-MJ207	MAJOR	Fluid Mechanics	3	0	0	15	15	70	100	3
	CE24-B-MJ208	MAJOR	IKS:Architecture and Town Planning	4	0	0	15	15	70	100	4
	CE24-B-MN202	MINOR	Choose from pool	4	0	0	15	15	70	100	4
		AEC	Choose from the pool	2	0	0	7.5	7.5	35	50	2
		SEC	Choose from the pool (BIM)	3	0	0	15	15	70	100	3
		MDC	Choose from the pool	3	0	0	15	15	70	100	3
	CE24-B-MJ209	MAJOR	Fluid Mechanics Lab	0	0	2	-	15	35	50	1
	CE24-B-MJ210	MAJOR	Concrete Technology Lab	0	0	2	-	15	35	50	1
											26

Exit option to qualify for Undergraduate Diploma: (after completion of 2nd year)

1. An Exit option is available for students those who have earned the total 94 credits at the end of Fourth Semester.
2. Student who wants to avail the exit option after second year have to earn additional 4 credits from the list of courses shown below.
3. These courses student have to complete within summer vacation after 2nd Year.
4. After fulfilment as mentioned in 1 to 3 above, Students can earn U.G Diploma and same will be issued by the University.

List of Exit Courses (Choose Any *TWO* Skill-based Course)

Course Code	Course Name	L	T	P	Credit
CE24-B-EC201	Mini Project	0	0	4	2
CE24-B-EC2202	Industrial Training	0	0	4	2
CE24-B-EC203	Road profile levelling mini project	0	0	4	2
CE24-B-EC204	Auto CAD building drawing mini project	0	0	4	2

FIFTH SEMESTER												
SEM	Course Code	Course Category	Name of the Course	Hours per week			Scheme of Examination and Marks				Credits: L+ T+ (P/2)
							PRE		End Sem	Total	
				L	T	P	Mid Sem	TA			
5th	CE24-B-MJ301	MAJOR	Theory of Structures-I	3	0	0	15	15	70	100	3
	CE24-B-MJ302	MAJOR	Structural Engineering Design- I	3	0	0	15	15	70	100	3
	CE24-B-MJ303	MAJOR	Geotechnical Engineering-I	3	0	0	15	15	70	100	3
	CE24-B-MJ304	MAJOR	Construction Planning and Management	3	0	0	15	15	70	100	3
	CE24-B-MJ305	MAJOR (ELE-I)	Choose from Elective (Transportation Engg-II)	3	0	0	15	15	70	100	3
	CE24-B-MN301	MINOR	Choose from Pool	4	0	0	15	15	70	100	4
	CE24-B-MJ306	MAJOR	Theory of Structures-I Lab (STAD Pro.)	0	0	2	-	15	35	50	1
	CE24-B-MJ307	MAJOR	Geotechnical Engineering-I Lab	0	0	2	-	15	35	50	1
	CE24-B-MJ308	MAJOR	Transport Engineering-I Lab	0	0	2	-	15	35	50	1
	CE24-B-MJ309	Internship	Industrial Training & Seminar	0	0	4	-	15	35	50	2
											24

SIXTH SEMESTER											
SEM	Course Code	Course Category	Name of the Course	Hours per week			Scheme of Examination and Marks				Credits: L+ T+ (P/2)
							PRE		End Sem	Total	
				L	T	P	Mid Sem	TA			
6th	CE24-B-MJ310	MAJOR	Theory of Structures-II	3	0	0	15	15	70	100	3
	CE24-B-MJ311	MAJOR	Environmental Engineering	2	0	0	7.5	7.5	35	50	2
	CE24-B-MJ312	MAJOR	Structural Engineering Design- II	3	0	0	15	15	70	100	3
	CE24-B-MJ313	MAJOR	Geotechnical Engineering-II	3	0	0	15	15	70	100	3
	CE24-B-MJ314	MAJOR (ELE-II)	Choose from Elective	3	0	0	15	15	70	100	3
	CE24-B-MN302	MINOR	Choose from pool	4	0	0	15	15	70	100	4
	CE24-B-MJ315	MAJOR	Geotechnical Engineering-II Lab	0	0	2	-	15	35	50	1
	CE24-B-MJ316	MAJOR	Environmental Engineering Lab	0	0	2	-	15	35	50	1
	CE24-B-MJ317	MAJOR	Structural Engineering Design- II Lab	0	0	2	-	15	35	50	1
											21

SEVENTH SEMESTER											
SEM	**Course Code**	**Course Category**	**Name of the Course**	**Hours per week**			**Scheme of Examination and Marks**				**Credits: L+ T+ (P/2)**
							PRE		**End Sem**	**Total**	
				L	**T**	**P**	**Mid Sem**	**TA**			
7th	**CE24-B-MJ401**	**MAJOR**	Structural Engineering Design- III	**3**	**0**	**0**	**15**	**15**	**70**	**100**	**3**
	CE24-B-MJ402	**MAJOR**	Water Resource Engineering I	**3**	**0**	**0**	**15**	**15**	**70**	**100**	**3**
	CE24-B-MJ403	**MAJOR**	Estimating Costing and Valuation	**3**	**0**	**0**	**15**	**15**	**70**	**100**	**3**
	CE24-B-MJ404	**MAJOR (ELE-III)**	Choose from Electives (..)	**3**	**0**	**0**	**15**	**15**	**70**	**100**	**3**
	CE24-B-MN401	**MINOR**	Choose from Pool	**4**	**0**	**0**	**15**	**15**	**70**	**100**	**4**
	CE24-B-MJ405	**MAJOR**	Structural Engineering Design- III Lab	**0**	**0**	**2**	**-**	**15**	**35**	**50**	**1**
	CE24-B-MJ406	**MAJOR**	Estimating Costing and Valuation Lab	**0**	**0**	**2**	**-**	**15**	**35**	**50**	**1**
	CE24-B-MJ407	**Internship**	Long Term Internship	**0**	**0**	**12**	**-**	**60**	**140**	**200**	**6**
											24

EIGTH SEMESTER

SEM	Course Code	Course Category	Name of the Course	Hours per week			Scheme of Examination and Marks				Credits: L+ T+ (P/2)
							PRE		End Sem	Total	
				L	T	P	Mid Sem	TA			
8th	CE24-B-MJ408	MAJOR	Earthquake Engineering and Seismology	4	0	0	15	15	70	100	4
	CE24-B-MJ409	MAJOR	Water Resource Engineering I	3	0	0	15	15	70	100	3
	CE24-B-MJ410	MAJOR	Safety in Construction Industry	3	0	0	15	15	70	100	3
	CE24-B-MJ411	MAJOR (ELE-IV)	Choose from Elective ( )	3	0	0	15	15	70	100	3
	CE24-B-MJ412	MAJOR	Computer-Aided Design Lab(ETAB)	0	0	4	-	15	35	50	2
											19

EIGHTH SEMESTER (HONOURS WITH RESEARCH)											
SEM	Course Code	Course Category	Name of the Course	Hours per week			Scheme of Examination and Marks				Credits: L+ T+ (P/2)
				L	T	P	PRE		End Sem	Total	
							Mid Sem	TA			
8th	CE24-B-MJ411	MAJOR (ELE-IV)	Choose from Elective ()	3	0	0	15	15	70	100	3
	CE24-B-MN402	MINOR	Choose from pool	4	0	0	15	15	70	100	4
	CE24-B-MJ413	RESEARCH PROJECT	Project Work	0	0	24	-	120	280	400	12
											19

Elective I (Semester V)

Name of the Course	Hours per week			Scheme of Examination and Marks				Credits: L+ T+ (P/2)
	L	T	P	PRE		End Sem	Total	
				Mid Sem	TA			
Transportation Engineering-II	3	0	0	15	15	70	100	3
Traffic Engineering	3	0	0	15	15	70	100	3

Elective II (Semester VI)

Name of the Course	Hours per week			Scheme of Examination and Marks				Credits: L+ T+ (P/2)
	L	T	P	PRE		End Sem	Total	
				Mid Sem	TA			
Modern Construction Methods and Materials	3	0	0	15	15	70	100	3
Maintenance Repair Rehabilitation of Civil	3	0	0	15	15	70	100	3
Advanced RCC	3	0	0	15	15	70	100	3

Solid Waste Management	**3**	**0**	**0**	**15**	**15**	**70**	**100**	**3**
Industrial Waste Management	**3**	**0**	**0**	**15**	**15**	**70**	**100**	**3**
Air Pollution. & Control	**3**	**0**	**0**	**15**	**15**	**70**	**100**	**3**
Urban Infrastructure	**3**	**0**	**0**	**15**	**15**	**70**	**100**	**3**
Town Planning	**3**	**0**	**0**	**15**	**15**	**70**	**100**	**3**

Elective III (Semester VII)

Name of the Course	**Hours per week**			**Scheme of Examination and Marks**				**Credits:**
	L	**T**	**P**	**PRE**		**End Sem**	**Total**	**L+ T+ (P/2)**
				Mid Sem	**TA**			
Design of Earthquake Resistant Buildings	**3**	**0**	**0**	**15**	**15**	**70**	**100**	**3**
Transportation Planning and Management	**3**	**0**	**0**	**15**	**15**	**70**	**100**	**3**
Foundation Engineering	**3**	**0**	**0**	**15**	**15**	**70**	**100**	**3**
Bridge Engineering	**3**	**0**	**0**	**15**	**15**	**70**	**100**	**3**
Engineering economics	**3**	**0**	**0**	**15**	**15**	**70**	**100**	**3**

Elective IV (Semester VIII)

Name of the Course	**Hours per week**			**Scheme of Examination and Marks**				**Credits:**
	L	**T**	**P**	**PRE**		**End Sem**	**Total**	**L+ T+ (P/2)**
				Mid Sem	**TA**			
Quality Control and Assurance in Construction	**3**	**0**	**0**	**15**	**15**	**70**	**100**	**3**
Ecology and Sustainable Development	**3**	**0**	**0**	**15**	**15**	**70**	**100**	**3**
Remote Sensing & GIS	**3**	**0**	**0**	**15**	**15**	**70**	**100**	**3**

List of Minor Courses

Sem.	Course Code	Name of the Course	Hours per week			Scheme of Examination and Marks				Credits: L+ T+ (P/2)
			L	T	P	PRE		End Sem	Total	
						Mid Sem	TA			
1	CE24-B-MN201	Construction Materials and	**3**	**0**	**2**	**15**	**15**	**70**	**100**	**4**
2	CE24-B-MN202	Intelligent Transportation	**4**	**0**	**0**	**15**	**15**	**70**	**100**	**4**
3	CE24-B-MN301	Concrete Technology	**3**	**0**	**2**	**15**	**15**	**70**	**100**	**4**
4	CE24-B-MN302	Environmental Engineering	**3**	**0**	**2**	**15**	**15**	**70**	**100**	**4**
5	CE24-B-MN401	Constriction Equipment and	**4**	**0**	**0**	**15**	**15**	**70**	**100**	**4**
6	CE24-B-MN402	Safety in Construction	**4**	**0**	**0**	**15**	**15**	**70**	**100**	**4**

DEATAILED SYLLABUS

3RD SEM B TECH CIVIL ENGINEERING

Programme :	**B.Tech.**	**Semester :**	**3**
Name of the Course :	**Strength of Materials**	**Course Code:**	**CE24-B-MJ201**
Credits :	**2**	**No of Hours :**	**2 Hrs/Week**
Max Marks :	**50**		

Course Description:

The subject of strength of materials involves analytical methods for determining the internal resistance offered by the materials by virtue of their different properties like stiffness, elasticity, rigidity and stability against various loads. A thorough understanding of the underlying principles is useful to civil engineers with several applications.

Course Outcomes:

At the end of this course, the student will be able to:

CO Number	Course Outcome
CO1	The maximum allowable stresses in tension, compression, bending etc. for engineering materials.
CO2	Evaluation of the stresses and strains in the members subjected to axial, bending and torsional loads.
CO3	Computation of bending stress and shear stress for cross sections.
CO4	Determination of bending moments and shear force at any cross section of the beam easily with the help of BMD and SFD.
CO5	Analysis of dams and retaining walls, the stresses at different points of dam and retaining walls.

Syllabus:

UNIT I

Simple Stress and Strains: Introduction, concept of stress and strain, stress-strain curves for ductile, brittle materials, generalized Hooke's law, stress-strain diagram of ductile and brittle material, compound and composite bars, thermal stresses. Elastic constants, poisons ratio, relations between various elastic constants and its use, lateral strain, volumetric strain, stress and strains in thin cylinders subjected to internal pressures.

UNIT II

Complex Stress and Strains: Introduction, normal stress, tangential stress, rectangular block subjected to normal stress along and across two planes, combination of normal and tangential

stress, concept of principal stress and its computation, Mohr's circle, principal strains, computation of principal stresses from the principal strains.

UNIT III

Shear Force and Bending Moment Diagrams: Introduction to the concept of reaction diagrams**,** shear force and bending moment, sign conventions, types of load, beams, supports, shear force and bending moment diagrams: simply supported, overhang and cantilever beams subjected to various combination of point loads, uniformly distributed and varying load, and moment; relationship between load, shear force and bending moment; different methods for plotting a bending moment and shear force diagrams.

UNIT IV

Bending of Beams: Theory of simple bending, limitations, bending stresses in beams of different cross sections, beams of uniform strength, and beams of two materials, shear stresses in symmetrical elastic beams transmitting both shear and bending moment.

UNIT V

Columns and Combined Stresses: Stability of columns, buckling load of an axially loaded columns with various end conditions, Euler's and Rankine's formula, columns under eccentric load, lateral load, Kern of rectangular sections, middle third rule, stability of gravity dams and retaining walls.

Text Books

1. Mechanics of materials, F. P. Beer, E. R. Johnston, J. T. DeWolf, D. F. Mazurek, (2014), McGraw-Hill, Seventh Edition.
2. Strength of Materials, R. K. Rajput, (2006), S. Chand Publishing, Sixth Edition.
3. Mechanics of Materials, B.C. Punmia, A. K. Jain, A. K. Jain, (2017), Laxmi Publications.

Reference Books

1. Mechanics of Structures Vol. 1, H. J. Shah, S. B. Junnarkar, (2016), Charotar Publications, Thirty-second Edition.
2. Strength of Materials: Elementary Theory and Problems - Vol. 1, S. Timoshenko, (2002), CBS Publishers, Third Edition.
3. Introductions to Solid Mechanics, I. H. Shames, J. M. Pitarresi, (1999), Pearson, Third Edition.
4. Engineering Mechanics of Solid, E. P. Popov, (2002), Prentice Hall India Learning Private Limited, Second Edition.
5. Strength of Materials, A. Pytel, F. L. Singer, (1990), Longman, Fourth Edition.

Program:	**B.Tech.**	**Semester :**	**III**
Name of the Course :	**Civil Engineering Materials**	**Course Code:**	**CE24-B-MJ 202**
Credits :	**2**	**No of Hours:**	**2 Hours/week**
Max Marks :	**50**		

Course Description:

This course emphasizes on the basics of highway elements and their design including practical applications. Further, it gives an idea of materials being used in the modern road construction techniques and practices. It also covers the transportation planning, traffic studies and airport planning.

Course Outcomes:

At the end of this course, the student will be able to:

CO Number	Course Outcome
CO 1	Understand basic civil materials
CO 2	Understand the concrete making
CO 3	Understand bricks, bonds and ceramic materials.
CO 4	Know about timber, plywood,
CO 5	know paints and glass materials

Syllabus:

UNIT-I

Cement: Raw materials, Types of Cement, Hydration of cement, tests on properties of cement, types and manufacturing process of cements, consistency of cement, Initial and final setting times.

Aggregate: Coarse and fine aggregates and their characteristics. Classification of Aggregates (Coarse and Fine) and their properties, tests on aggregates. Classification of Pozzolanas and applications.

UNIT-II

Concrete - Properties of concrete in fresh and hardened state, water cement ratio, Modulus of elasticity, factors affecting strength of concrete and durability, mixing, transporting, placing, compacting and curing concrete, variables in proportioning concrete mixes, admixtures in concrete, tests on concrete.

UNIT- III

Masonry Materials: Types and characteristics of burnt clay and fly ash bricks, AAC blocks, paver blocks; various bonds in masonry.

Ceramic Materials- Introduction to ceramics, types of ceramic products, commercially available varieties of ceramics, properties of ceramics, ceramic building products, manufacturing of ceramic products.

UNIT-IV

Timber and Plywood - Characteristics of good timber, seasoning and preservation, names of timber producing trees and their relative market value.

Types and uses of plywood, veneers and hardboards. Low-cost materials for construction – System concepts, cost effective materials, industrial wastes, agricultural wastes, methods needed for propagation of new technologies from laboratory to field.

UNIT-V

Paints, Glass - glass and their uses, types of tiles, method of manufacturing and tests for suitability. Uses of Plastics and PVC. Composition and use of paints, varnishes and distempers. Composite materials, types and uses.

Text Books:

1. Building Materials – S.K. Duggal (New Age Publication).
2. Building Materials – S. C. Rangwala (Charotar Publication)
3. Building Materials – M.L. Gambhir, NehaJamwal (Mc. Grawhill)

References Books:

1. Concrete Technology – A.M. Neville & J.J. Brooks (Pearson Education)
2. Concrete Technology – M.S. Shetty (S. Chand & Co.)
3. Engineering Materials – Surendra Singh (Laxmi Publication)
4. Construction Engineering and Management – S. Seetharaman (Umesh Publication)
5. Building Materials – Gurucharan Singh (Standard Publishers, Delhi)

Assessment:

Assessment will be based on a combination of attendance, class work, tutorials, assignments and exams.

Course Code	Name of the Course	Periods per week			Scheme of Examination and Marks				Credits: L+ T+ (P/2)
		L	T	P	PRE		End Sem.	Total	
					Mid Sem.	TA			
MAT24-B-MJ221	Engineering Mathematics-III	**3**	**0**	**0**	**15**	**15**	**70**	**100**	**3**

Course Description:

Most engineering programs require courses related Integral Transforms, Partial Differential equation, probability, statistics and numerical methods. These courses are prerequisites for upper-division civil engineering courses. Measuring and analysing risk is a key skill in engineering, and most civil engineering programs require students take courses in probability and statistics to develop the skills and knowledge to quantify risk and safety in their designs.

Course Outcomes:

At the end of this course, the student will be able to:

CO Number	Course Outcome
CO1	Learn different types of integral transforms.
CO2	Solve partial differential equation and integral equation.
CO3	Identify the type of data and present the data in various forms and summarize it using descriptive statistics.
CO4	Understand and apply the concept of probability distribution.
CO5	Fit the linear and nonlinear curves to the tabulated data and Understand and apply correlation, and regression analysis and infer its results

Syllabus

Unit I: Fourier Transform and Laplace Transform

Fourier Series, Orthogonality and Fourier Coefficient, Fourier Transforms, Discrete and Fast Fourier Transforms, Laplace Transform, inverse Laplace Transform and properties, Solving ODE by Laplace Transform

Unit II: Partial Differential Equations

Introduction, First-Order PDEs, Classification of Second-Order PDEs, Classic PDEs, Solution Techniques: Separation of Variables, Laplace Transform, Similarity Solution Integral Equations: Fredholm and Volterra Integral Equations, Solutions of Integral Equations

Unit III: Statistics & Probability

Descriptive measures: Measures of central tendency; Measures of dispersion; Measures of Skewness and Measures of Kurtosis

Random Variables (Discrete and Continuous), Expectation; Variance, Binomial and Poisson Distributions, Gaussian Distribution

Unit IV: Curve Fitting, Regression and Correlation

Curve fitting by method of least squares and method of group averages, Correlation, types of correlation and correlation coefficient, Simple linear regression, Multiple regression, Logistic regression

Unit V: Numerical Solution of Algebraic and Transcendental equation:

(i) Errors, Bisection Method, Regula Falsi Method, Secant Method, Newton Raphson Method, Order of convergence

(ii) Direct Method: Gauss Elimination Method, Gauss Jordan Method, Decomposition Method

(iii) Iterative Method and its convergence: Jacobi Method, Gauss Seidel Method, Successive over relaxation method.

Text Books:

1. Mathematics for Civil Engineers: Xin-She Yang, Dunedin Academic Press Ltd, Scotland
2. Advanced Engineering Mathematics: B S Grewal
3. Higher engineering Mathematics: H K Dass
4. John E. Freund's Mathematical Statistics with Applications, Irwin Miller and Marylees Miller, (8^{th}Edition), Pearson, Asia, 2014.
5. Statistical Methods: N G Das

Recommended Text Books

1. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Publication
2. Higher Engineering Mathematics, B. Ramana, (2017), McGraw Hill Education, First Edition.
3. Irwin Miller and Marylees Miller, John E. Freund's Mathematical Statistics with Applications (8th Edition), Pearson, Asia, 2014.
4. Probability, Statistics, and Decision for Civil Engineers, J.R Benjamin, C.A. Cornell, (2014), DOVER Publication, Reprint edition.
5. Applied Linear Regression, Sanford Weisberg, (2019), Wiley Interscience, Third edition.
6. Statistical Methods, Rudolf Freund and William Wilson, (2015), Academic Press Elsevier, Third edition.
7. Practical Business Statistics, A.F. Siegel, (2016), Academic Press Elsevier, Seventh edition.

Programme :	**B.Tech.**	**Semester :**	**3**
Name of the Course :	**Surveying-I**	**Course Code:**	**CE24-B-MJ203**
Credits :	**3**	**No of Hours :**	**3 Hrs/Week**
Max Marks :	**100**		

Course Description:

Surveying is a fundamental subject in Civil Engineering that deals with the principles, methods, and instruments used for measuring and mapping the Earth's surface. This course introduces basic surveying techniques, linear and angular measurements, leveling, theodolite surveying, and modern surveying techniques with a special focus on Total Station.

Course Outcomes (COs):

After completing this course, students will be able to:

CO No.	Course Outcome Description
CO1	Understand the basic principles and methods of surveying.
CO2	Conduct linear and angular measurements using different instruments.
CO3	Perform leveling operations and contour mapping.
CO4	Execute theodolite surveying for precise angle measurements.
CO5	Apply modern surveying techniques, including Total Station operations.

Syllabus

Unit 1: Introduction to Surveying

- Definition, Objectives, and Importance of Surveying
- Classification of Surveys
- Principles of Surveying
- Measurement Techniques and Errors in Surveying
- Scales and Map Projections

Unit 2: Linear and Angular Measurements

- Chain and Tape Surveying: Principles, Instruments, and Procedures
- Errors in Linear Measurements and their Adjustments
- Compass Surveying: Types of Compasses, Bearings, and Local Attraction
- Plane Table Surveying: Methods and Instruments

Unit 3: Leveling and Contouring

- Basic Terminology in Leveling
- Types of Levels and Leveling Staff
- Methods of Leveling: Differential, Reciprocal, and Profile Leveling
- Contour Mapping: Characteristics and Uses
- Errors in Leveling and their Adjustments

Unit 4: Theodolite Surveying

- Theodolite: Types, Components, and Uses
- Measurement of Horizontal and Vertical Angles
- Traversing and Computation of Coordinates
- Omitted Measurements and Adjustments

Unit 5: Modern Surveying Techniques – Total Station

- Introduction to Total Station
- Components and Working Principles of Total Station
- Data Collection and Processing
- Applications of Total Station in Civil Engineering
- Advantages and Limitations of Total Station

Textbooks:

1. **B.C. Punmia, Ashok K. Jain, and Arun K. Jain**, *Surveying Vol. 1*, Laxmi Publications.
2. **S.K. Duggal**, *Surveying Vol. 1*, McGraw Hill Education.

Reference Books:

1. **R. Subramanian**, *Surveying and Levelling*, Oxford University Press.
2. **Kanetkar and Kulkarni**, *Surveying and Leveling*, Pune Vidyarthi Griha Prakashan.
3. **Arora K.R.**, *Surveying Vol. 1*, Standard Book House.

Programme :	**B.Tech.**	**Semester :**	**3**
Name of the Course :	**Surveying I Lab**	**Course Code:**	**CE24-B-MJ204**
Credits :	**1**	**No of Hours :**	**2 Hrs/Week**
Max Marks :	**50**		

Course Description

Surveying I Lab is designed to provide hands-on experience in fundamental surveying techniques essential for civil engineering applications. The course covers basic measurement methods, use of surveying instruments, field data collection, and error analysis. The practical skills gained in this lab will prepare students for advanced surveying and construction layout work.

Course Outcomes (COs)

CO No.	Course Outcome
CO1	Demonstrate proficiency in handling basic surveying instruments.
CO2	Perform linear and angular measurements with accuracy.
CO3	Apply concepts of leveling and contouring in real-world applications.
CO4	Analyze and interpret survey data for engineering projects.
CO5	Develop teamwork and problem-solving skills in field survey exercises.

List of Experiments

1. **Introduction to Surveying Instruments** – Study and handling of chain, tape, compass, level, and theodolite.
2. **Chain and Tape Surveying** – Measurement of distances, ranging, and offsetting.
3. **Compass Surveying** – Use of prismatic compass for measuring bearings and plotting.
4. **Plane Table Surveying** – Orientation, radiation, and intersection methods.
5. **Levelling – Simple and Differential Levelling** – Determination of reduced levels using a dumpy level.
6. **Profile Levelling and Cross-sectioning** – Plotting of longitudinal and cross-sections.
7. **Contour Surveying** – Preparation of contour maps using leveling instruments.
8. **Theodolite Surveying – Measurement of Horizontal Angles** – Repetition and reiteration methods.

9. **Theodolite Surveying – Measurement of Vertical Angles** – Determination of heights.
10. **Traversing with Theodolite** – Computation of coordinates and plotting of traverse.
11. **Tacheometric Surveying** – Determination of horizontal and vertical distances.
12. **Total Station Surveying** – Basics of electronic distance measurement and data processing.

Textbooks:

1. B.C. Punmia, *Surveying Vol. 1*, Laxmi Publications.
2. S.K. Duggal, *Surveying Vol. 1*, McGraw Hill Education.

Reference Books:

1. R. Subramanian, *Surveying and Leveling*, Oxford University Press.
2. C.L. Kochher, *A Textbook of Surveying*, Dhanpat Rai & Sons.
3. James M. Anderson and Edward M. Mikhail, *Surveying: Theory and Practice*, McGraw Hill.

Course Description:

Integrated Approach of Planning of Buildings, salient features of a building, site integration, and benefits of building. Line plan and its development, elevation, section. Building rules and bye-laws (as per National Building Code of India). The necessity of building rules and bye-laws, plot sizes, road widths, open spaces, floor area ratio (FAR), floor space index (FSI).

Program:	**B.Tech.**	**Semester :**	**III**
Name of the Course :	**Civil Engineering Drawing Lab**	**Course Code:**	**CE24-B-SE 201**
Credits :	**2**	**No of Hours:**	**2 Hours/week**
Max Marks :	**50**		

Course Outcomes:

At the end of this course, the student will be able to:

CO Number	Course Outcome
CO 1	The planning process of building and bye-laws.
CO 2	Detailing of building drawing.
CO 3	Implementation of building drawing in AutoCAD.
CO 4	Principles of perspective drawings.

Syllabus

(The students are required to complete any two exercises from each lab work using Auto CAD).

Lab Work I

Introduction: Civil engineering drawing and its importance.

Doors and Windows: Definition of technical terms, installation of doors and window frames, and their size specifications, fixtures, and fastenings.

1. To draw section and elevation of the flush shutter, panelled shutter doors and windows.
2. To draw section and elevation of fully glazed, half glazed, half glazed and half paneled doors and windows.
3. To draw section and elevation of M.S. collapsible door, rolling steel shutter.

Lab Work II

(Anyone one from Foundation and staircase each)

Foundation: Types of foundation, detailing of foundation components.

1. To draw different types of footing.
2. To draw the foundation details of internal and external walls.

Staircase: Types and details of the stair case.

1. To draw detailing of Dog-Legged staircase.
2. To draw detailing of the Straight staircase.

Lab Work III

Residential Buildings: Aspects, Prospects, Circulation, Grouping, Roominess, Economy, Elegance, Furniture requirements, Flexibility, Privacy. Municipal and national building code regulations and Bye-laws for residential buildings.

1. To draw the working plan, elevation, and section of the single storey residential building (Load Bearing Structure).
2. To draw the working plan, elevation and section of single-storey residential building (Framed Structure).
3. To draw the working plan, elevation and section of double-storey residential building (Framed Structure).

Lab Work IV

Public Buildings: Site selection and requirements of different public buildings drawing typical line plans of such public buildings.

1. To draw the line plan of a primary school building.
2. To draw the line plan of a hostel building.
3. To draw the line plan of a hospital building.

Lab Work V

Perspective: Elements of Perspective Drawing (single and double point)

General activities

1. To draw the perspective view of simple blocks and combinations.
2. Collection and interpretation of brochures/information/literature for housing schemes.
3. To draw the perspective view of the building.

Text Books:

1. A course in Civil Engineering Drawing, V.B. Sikka, S.K. Kataria and Sons, (2015), 11th Edition.
2. Civil Engineering Drawing and Design, D.N. Ghose, CBS Publisher, (2015), 2nd Edition.
3. AutoCAD Release 2012 2D and 3D Design - A. Yarwood. (Pearson Educations).

Reference Books:

1. Building Construction, Sushil Kumar, Standard Publisher and Distributors, (2010), 10th Edition.
2. Building Construction, Punmia B.C, Jain, Ashok Kumar and Jain, Arun Kumar, Laxmi Publications, (2008), 10th Edition.
3. National Building Code, BIS, New Delhi.
4. Building Drawing, Shah M.H, and Kale C.M, Tata McGraw Hill New Delhi, (2001), 4th Edition.
5. Planning and Designing Building, Y.S.Sane, Poona, Allied Book Stall, (1975), 3rd Edition.

Program:	**B.Tech.**	**Semester :**	**III**
Name of the Course :	**Environmental Impact Assessment (EIA)**	**Course Code:**	**CE24-B-AE 201**
Credits :	**2**	**No of Hours :**	**2 Hours/week**
Max Marks :	**50**		

Course Description

Environmental Impact Assessment (EIA) is a critical process for evaluating the environmental consequences of proposed projects before they are carried out. This course provides engineering students with fundamental knowledge of EIA methodologies, legal frameworks, and practical applications. Students will learn to analyze environmental impacts, assess mitigation measures, and prepare EIA reports.

Course Outcomes:

At the end of this course, the student will be able to:

CO Number	Course Outcome
CO1	Understand the principles, concepts, and significance of Environmental Impact Assessment (EIA).
CO2	Apply various methodologies and techniques to conduct environmental assessments for projects.
CO3	Analyze the legal and institutional framework governing EIA processes.
CO4	Assess potential environmental impacts and propose effective mitigation strategies.
CO5	Develop and evaluate Environmental Management Plans (EMP) and prepare EIA reports

Syllabus

UNIT 1: Introduction to Environmental Impact Assessment

- Definition, Scope, and Importance of EIA
- Evolution of EIA – Global and Indian Perspective
- Environmental Policies and Regulations
- Environmental Clearance Procedures

UNIT 2: EIA Process and Methodologies

- Screening and Scoping in EIA
- Baseline Environmental Data Collection
- Impact Prediction and Evaluation Techniques
- Public Participation and Stakeholder Engagement

UNIT 3: Environmental Laws and Regulations

- Environmental Protection Act, 1986
- Air and Water (Prevention and Control of Pollution) Acts
- Wildlife Protection Act, 1972
- Forest Conservation Act, 1980
- International Environmental Conventions and Protocols

UNIT 4: Environmental Impact Mitigation and Management

- Environmental Management Plan (EMP)
- Mitigation Strategies for Air, Water, Land, and Noise Pollution
- Risk Assessment and Disaster Management
- Case Studies on Successful EIA Implementation

UNIT 5: EIA Report Preparation and Case Studies

- Structure of an EIA Report
- Best Practices in EIA Report Writing
- Review of EIA Reports
- Sector-Specific EIA Studies (Infrastructure, Mining, Industry, etc.)

Textbooks

1. Canter, L.W., "Environmental Impact Assessment", McGraw Hill, Latest Edition.

2. Glasson, J., Therivel, R., Chadwick, A., "Introduction to Environmental Impact Assessment", Routledge, Latest Edition.
3. Jain, R.K., Urban, L.V., Stacey, G.S., "Environmental Impact Analysis: A Process and Methods", Springer, Latest Edition.

Reference Books

1. Morris, P., Therivel, R., "Methods of Environmental Impact Assessment", Routledge, Latest Edition.
2. Petts, J., "Handbook of Environmental Impact Assessment", Vol. 1 & 2, Blackwell Science.
3. Wathern, P., "Environmental Impact Assessment: Theory and Practice", Routledge.
4. World Bank Group, "Environmental Assessment Sourcebook", World Bank Publications.
5. UNDP & UNEP, "Environmental Impact Assessment Training Resource Manual".

DEATAILED SYLLABUS

4TH SEM B TECH CIVIL ENGINEERING

Programme:	**B. Tech.**	**Semester :**	**IV**
Name of the Course:	**Transportation Engineering-I**	**Course Code:**	**CE24-B-MJ 205**
Credits :	**3**	**No of Hours :**	**3 Hrs/week**
Max Marks:	**100**		

Course Description:
This course emphasizes on the basics of highway elements and their design including practical applications. Further, it gives an idea of materials being used in the modern road construction techniques and practices. It also covers the transportation planning, traffic studies and airport planning.

Course Outcomes:
Students will be able to understand

CO Number	Course Outcome
CO 1	Highway planning and design.
CO 2	Different aspects of traffic engineering.
CO 3	Application of highway construction material.
CO 4	Design of pavements.
CO 5	The planning process of airport.

SYLLABUS

UNIT I
Principles of Highway Planning: Elements of transportation engineering, different modes of transportation, road development and planning in India, requirements of highway alignment, engineering surveys for highway location, maps and drawing.
Geometric Design: Cross section elements of horizontal and vertical alignment. Highway drainage, surface and subsoil drainage, geometry of hill roads, curve layout.

UNIT II
Pavement Construction Techniques and Quality Control: Types of Pavements water bound macadam, bituminous and cement concrete pavements. Joints in cement concrete pavements, pavement failures. Innovative materials in pavements.

UNIT III
Pavement Design: Study of flexible and rigid pavements, basic concepts of pavement analysis and design. Stresses in rigid pavements. I.R.C. recommendations, ideal pavement or perpetual pavement design method.

UNIT IV
Traffic Engineering: Introduction to traffic flow theory, PIEV theory, speed-density, speed-flow and flow-density relation, data collection techniques for traffic parameters and delay studies, parking facilities and their uses. Traffic control devices, prevention of road accidents, rotary intersection, highway lighting,

Highway Materials: Behavior of highway materials, properties of sub grade and pavement component materials. Tests on sub grade soil, aggregate and bituminous materials, I.R.C. recommendations, MoRTH recommendations.

UNIT V

Airport Planning: Definition of terms related to airport engineering, factors affecting site, selection, obstructions, various surveys for site selection, zoning laws. Classification of obstructions runways orientation, basic runway length and its corrections. Geometric design of runway, runway configuration, taxiways layout, exit taxiways.

Airport Engineering: Brief history of air transport: Aircraft characteristics. Imaginary surfaces, Approach zone and turning zone. Airport capacity, factors controlling taxiway layout, geometric design standards for taxiway holding aprons, Wind- rose diagram.

Text Books:

4. Principle and Practices of Highway Engineering, Kadiyali, (2005), Khanna Publishers, Delhi, Tenth Edition.
5. Highway Engineering, S. K. Khanna and C.E.G. Justo, (2015), Khanna Publishers, Delhi, Tenth Edition.
6. Air-port planning and Design, Khanna and Arora, (2017), Khanna Publishers, Delhi, Sixth Edition.
7. Principles of Transportation Engineering, Partha Chakroborty and Animesh Das, (2011), Prentice Hall India Learning Private Limited, Sixth Edition.

References Books:

6. Highway Engineering, Rangawala S.C, (2017), Charotar Publishers, Eleventh Edition.
7. Standard Specifications and Code of Practice for Road Bridges, Section I – General Features of Design, IRC6, (2017), Eight Revision.
8. Specifications for Road and Bridge Works, Transport and Highways (MORTH, formerly MOST), Published by Indian Roads Congress, Fifth Edition.
9. Manual for Survey, Investigation and Preparation of Road Projects Published (Rights of Publication and of Translation Reserved), IRC Publication2001.
10. Traffic and Highway Engineering, Nicholas J. Garber and Lester A. Hoel, (2002), Bill Stenquist, Third Edition.

Program:	**B.Tech.**	**Semester :**	**IV**
Name of the Course :	**Concrete Technology**	**Course Code:**	**CE24-B-MJ 206**
Credits :	**2**	**No of Hours:**	**2 Hours/week**
Max Marks :	**50**		

Course Description:

This course covers the basics of fresh concreate, their test, and applications in the field. Workability of fresh concrete, strength of the hard concrete, sieve analysis of sand, mix design by IS code method of concrete.

Course Outcomes:

At the end of this course, the student will be able to:

CO Number	Course Outcome
CO 1	Measure quality of concrete making materials.
CO 2	Understanding the process of selection of materials and testing, uses of admixtures, professional practices in ready mix concrete
CO 3	Understanding field requirements of various types of concrete.
CO 4	Design concrete mixes according to IS code methods.

UNIT I

Concrete Making Materials: Hydration of cement, Structure of hydrated cement, General Purpose cements, Types of cement, Classification of Aggregates, Properties, Grading requirements, Test on fine and coarse aggregate, of combining aggregates, Quality of mixing and curing water.

UNIT II

Admixtures: Chemical admixtures – Functions of Admixtures, Classification of Admixtures, Mineral Additives, effects on concrete properties.

Fresh Concrete: Workability, Factors affecting workability, Measurement of Workability, Requirements of Workability, Segregation, Bleeding.

UNIT III

Hardened Concrete and Durability: Compressive strength and parameters affecting it, Maturity Concept, Elasticity, Creep and shrinkage, Permeability of Concrete, Durability of Concrete, relation between durability and permeability, corrosion of steel rebars.

UNIT IV

Concrete Mix Design and tests: Principles of concrete mix design, Concrete mix design steps as per Indian, destructive and non-destructive tests on concrete.

UNIT V

Special Concrete & Concreting Methods: Need of special concrete, Fiber reinforced concrete, Polymer Concrete, self-compacted concrete, High performance concrete, Ready mix concrete, Vacuum dewatering - underwater concrete, special from work.

Text Books:

1. Concrete Technology Theory and Practice, M. S. Shetty, 2018, S. Chand and Company Ltd. Delhi, Eighth Edition.
2. Concrete Technology, M.L. Gambhir, 2017, Tata McGraw Hill, Fifth Edition.

Reference Books:

1. Concrete Technology, A. M. Neville and J. J. Brooks, 2019, Pearson Education India; Second edition.
2. Design of concrete Mixes, N. K. Raju, 2018, CBS, Fifth edition
3. Light Weight Concrete Academic Kiado, Rudhani G., Publishing Home of Hungarian Academy of Sciences.
4. Concrete Technology, R.S. Varshney, Oxford, IBH Publishers.

Program:	**B.Tech.**	**Semester :**	**IV**
Name of the Course :	**Concrete Technology Lab**	**Course Code:**	**CE24-B-MJ 210**
Credits :	**1**	**No of Hours:**	**2 Hours/week**
Max Marks :	**50**		

Course Description:

This course covers the basics of fresh concreate, their test, and applications in the field. Workability of fresh concrete, strength of the hard concrete, sieve analysis of sand, mix design by IS code method of concrete.

Course Outcomes:

At the end of this course, the student will be able to:

CO Number	Course Outcome
CO 1	Prepare and test the fresh concrete.
CO 2	Design concrete mix of desired grade.
CO 3	Test hardened concrete with destructive and nondestructive testing instruments.
CO 4	Get acquainted to concrete handling equipment's and different special concrete types.

Syllabus

List of Experiments

(At least ten experiments are to be performed by every student)

1. Determine the Fineness modulus by sieve analysis of fine aggregate.
2. Determine the Fineness modulus by sieve analysis of sand.
3. Determination of Soundness test on aggregate
4. Determine water absorption test of aggregate.
5. Determine the Mix Design by I.S. Code method (with PPC /PCC Cement)
6. Determine the Workability of concrete by slump test,
7. Determine the Workability of concrete compaction factor,
8. Determine the Workability of concrete Vee Bee test,
9. Determine the Workability of concrete Flow table test

10. Determine the Compressive strength test of concrete by crushing
11. Determine the Flexural strength of hardened concrete
12. Determine the tensile strength of concrete (Split Tensile Test).
13. Determine the Compressive strength test of concrete by non-destructive test - Rebound hammer.
14. Study Mix Design by I.S. Code method (by partial replacement of fine or coarse aggregate)
15. Industrial Visit.

Reference Books:

6. Building Construction, Sushil Kumar, Standard Publisher and Distributors, (2010), 10th Edition.

7. Building Construction, Punmia B.C, Jain, Ashok Kumar and Jain, Arun Kumar, Laxmi Publications, (2008), 10th Edition.

8. National Building Code, BIS, New Delhi.

9. Building Drawing, Shah M.H, and Kale C.M, Tata McGraw Hill New Delhi, (2001), 4th Edition.

10. Planning and Designing Building, Y.S.Sane, Poona, Allied Book Stall, (1975), 3rd Edition.

Programme :	**B.Tech.**	**Semester :**	**4**
Name of the Course :	**Fluid Mechanics**	**Course Code:**	**CE24-B-MJ207**
Credits :	**3**	**No of Hours :**	**3 Hrs/Week**
Max Marks :	**100**		

Course Description

This course provides a comprehensive understanding of fluid mechanics and hydraulics, covering both theoretical and practical aspects. It begins with the properties of fluids, pressure measurement, and buoyancy principles. Students learn fluid kinematics and dynamics, including the application of Euler's and Bernoulli's equations. The course explores flow in pipes and pipe networks, focusing on laminar and turbulent flow, head losses, and boundary layer theory. It also covers channel hydraulics, including open channel flow, specific energy, and hydraulic jump analysis. Finally, the course addresses dimensional analysis, similitude, and flow measurement techniques for both pipes and open channels.

Course Objectives

Students will be able to:

Course Outcomes:	**Course Outcomes:**
CO1	Understand the fundamental properties of fluids and apply fluid statics principles, including pressure measurement and stability analysis of floating and submerged bodies.
CO2	Apply fluid kinematics and dynamics concepts to analyze fluid flow, derive and utilize continuity, momentum, and energy equations, and interpret Bernoulli's equation in real-world applications.
CO3	Analyze flow through pipes and pipe networks, considering laminar and turbulent flow characteristics, head losses, and boundary layer effects.
CO4	Comprehend channel hydraulics, including energy-depth relationships, gradually varied flow, and hydraulic jump, and perform related computations.
CO5	Utilize dimensional analysis and similitude principles in

	experimental investigations and apply flow measurement techniques for pipes and open channels.

Syllabus

UNIT I

Properties of Fluids and Fluid Statics: Density, specific weight, specific gravity, viscosity, compressibility, surface tension, capillarity, bulk modulus, specific volume, Classification of fluids, Pascal's law, pressure variation for incompressible fluids, Atmospheric pressure, Absolute pressure, Gauge pressure and Vacuum pressure, Simple and differential manometers, pressure measurement, Pressure variation in fluids, Buoyancy and Stability: Buoyant force, metacentric height, stability of floating and submerged bodies.

UNIT II

Fluid Kinematics and Dynamics: Introduction, description of fluid flow, classification of fluid flow, flow rate and continuity equation, Continuity Equation, Euler's equation, Momentum and Energy Equations, Euler's equation, Bernoulli's equation and its applications, Potential Flow: Basic concepts, velocity potential, stream function, flow nets,

UNIT III

Flow Through Pipes and Pipe Networks: Laminar and turbulent flow, Reynolds number, and critical velocity, characteristics of laminar and turbulent flows, Flow in Pipes: Equation for head loss, Major and minor losses in pipes, Pipe Networks: Series and parallel pipes, equivalent pipes, Hardy-Cross method, Boundary Layer Theory: Boundary layer growth, displacement thickness, momentum thickness, and energy thickness, Lift and Drag: Concept and applications on immersed bodies.

UNIT IV

Channel Hydraulics: Flow in Open Channels: Characteristics, types of flow (uniform, non-uniform, critical), and energy-depth relationship. Specific Energy and Critical Flow: Specific energy diagram, critical depth, Froude number, and flow regimes. Uniform Flow: Manning's and Chezy's equations, velocity distribution, and hydraulic radius. Gradually Varied Flow (GVF): Classification of water surface profiles. Computation of GVF profiles. Hydraulic Jump: Concept, characteristics, and applications.

UNIT V

Dimensional Analysis, Similitude, and Flow Measurement: Dimension reasoning, dimensional homogeneity, Buckingham π-theorem, Dimensionless numbers (Reynolds, Froude, Mach, Weber, Euler), Significance and use of dimensionless numbers in experimental investigation, Hydraulic similitude and model laws. **Flow Measurement**: Flow measurement in pipes: Venturimeter, orifice meter, nozzle meter. Flow measurement in open channels: Notches (triangular, rectangular) and weirs. Forces on Immersed Bodies: Drag and lift forces, applications in hydraulic engineering.

Text Books:

1. Hydraulics and Fluid Mechanics Including Hydraulic Machines (22nd ed.), Modi, P. N., & Seth, S. M. (2019), Standard Book House.
2. A Textbook of Fluid Mechanics and Hydraulic Machines: (in S.I. Units), Bansal, R. K. (2005), Laxmi Publications, New Delhi, Print.
3. Flow in Open Channels (4th ed.). Subramanya, K. (2017), Tata McGraw-Hill Education.
4. Fluid Mechanics: Including Hydraulic Machines, Jain, A. K. (2016), (10th ed.). Khanna Publishers.

Reference Books:

1. Text Book of Fluid Mechanics and Hydraulic Machinery, Rajput, R. K. (2005), S. Chand & Company, Ltd.
2. Fluid Mechanics: Fundamentals and Applications (4th ed.). Cengel, Y. A., & Cimbala, J. M. (2018) McGraw-Hill Education.
3. Fluid Mechanics (9th ed.). White, F. M. (2020), McGraw-Hill Education.
4. Fundamentals of Fluid Mechanics, Munson, B. R.m Young, D. F. and Okiishi, T. H. (2006), Hoboken, NJ: J. Wiley & Sons, Print.
5. Fluid Mechanics (9th ed.). Fox, R. W., McDonald, A. T., Pritchard, P. J., & Leylegian, J. C. (2019), Wiley.
6. Fluid Mechanics for Engineers (3rd ed.), Rouse, H. (2020), Dover Publications.

Program:	**B.Tech.**	**Semester :**	**IV**
Name of the Course :	**Architecture and Town Planning**	**Course Code:**	**CE24-B-MJ 208**
Credits :	**4**	**No of Hours:**	**4 Hours/week**
Max Marks :	**100**		

Course Description

This course provides an introduction to the fundamental concepts of architecture and town planning. It explores the principles of building design, aesthetics, urban planning, and sustainable development. The course aims to equip students with the knowledge and skills required to analyze, plan, and design efficient and sustainable built environments.

Course Objectives (COs)

CO No.	Course Objective
CO1	Understand the basic principles of architecture, design elements, and their role in construction.
CO2	Learn about the historical evolution and modern trends in town planning.
CO3	Develop skills in planning residential, commercial, and industrial areas with sustainability considerations.
CO4	Analyze zoning regulations, land use, and environmental aspects in urban planning.
CO5	Integrate architectural aesthetics with engineering functionality in building design.

Course Units

Unit 1: Introduction to Architecture

- Definition and scope of architecture

- Basic architectural elements and principles
- Importance of aesthetics and functionality in design
- Introduction to building materials and construction techniques

Unit 2: Fundamentals of Town Planning

- Evolution and history of town planning
- Planning concepts: Zoning, land use patterns, and urban sprawl
- Sustainable urban development
- Modern trends in urban planning

Unit 3: Building Planning and Design

- Principles of building planning
- Orientation, ventilation, and lighting
- Space utilization and circulation
- Building codes and regulations

Unit 4: Environmental and Sustainable Planning

- Green buildings and energy-efficient designs
- Environmental impact assessment (EIA)
- Waste management and eco-friendly materials
- Smart cities and sustainable urban mobility

Unit 5: Urban Infrastructure and Regulations

- Road networks and transportation planning
- Water supply, drainage, and waste disposal systems
- Government policies and town planning acts
- Case studies of successful urban planning projects

Textbooks & Reference Books

Textbooks:

1. **Bansal, S.K.** – *Textbook of Town Planning*
2. **Sharma, S.** – *Architecture and Planning*
3. **Gallion, Arthur B.** – *The Urban Pattern: City Planning and Design*

Reference Books:

1. **Kevin Lynch** – *The Image of the City*
2. **Frederick Gibberd** – *Town Design*
3. **Christopher Alexander** – *A Pattern Language*
4. **Edmund Bacon** – *Design of Cities*
5. **SP 7: National Building Code of India**

Program:	**B.Tech.**	**Semester :**	**IV**
Name of the Course :	**Intelligent Transportation Systems**	**Course Code:**	**CE24-B-MN 202**
Credits :	**4**	**No of Hours:**	**4 Hours/week**
Max Marks :	**100**		

Course Description:

This course provides an introduction to Intelligent Transportation Systems (ITS), which leverage technology to enhance the efficiency, safety, and sustainability of transportation networks. The course covers key ITS components, applications, and challenges, integrating concepts from civil engineering, electrical engineering, and computer science. Students will learn about advanced traffic management, smart mobility solutions, sensor technologies, data analytics, and communication systems for modern transportation networks.

Course Outcomes (COs)

CO No.	Course Outcome Description
CO1	Understand the fundamental concepts and need for Intelligent Transportation Systems.
CO2	Analyze various ITS technologies, including sensors, communication systems, and data processing.
CO3	Apply ITS strategies for traffic management, public transportation, and smart mobility.
CO4	Evaluate the impact of ITS on safety, congestion reduction, and environmental sustainability.
CO5	Explore emerging trends in ITS, such as autonomous vehicles, connected infrastructure, and AI-based transportation solutions.

Course Units

UNIT 1: Introduction to Intelligent Transportation Systems

- Definition, need, and benefits of ITS
- Components and architecture of ITS
- ITS user services and applications
- Global and national ITS initiatives

UNIT 2: ITS Technologies and Communication Systems

- Sensors and data collection technologies
- Communication systems: V2V, V2I, and V2X
- GPS, GIS, and remote sensing in ITS
- ITS data processing and analytics

UNIT 3: Advanced Traffic Management Systems (ATMS)

- Traffic flow theory and control mechanisms
- Adaptive traffic signal control
- Incident management and congestion mitigation
- Intelligent traffic monitoring and enforcement

UNIT 4: Smart Mobility and Public Transport Systems

- Role of ITS in public transportation
- Automated fare collection and smart ticketing
- Transit scheduling and optimization
- Ride-sharing, demand-responsive transit, and mobility-as-a-service (MaaS)

UNIT 5: Emerging Trends and Future of ITS

- Connected and autonomous vehicles (CAVs)
- Artificial Intelligence (AI) and Machine Learning in ITS
- Cybersecurity and privacy concerns in ITS
- Sustainable and green transportation solutions

Textbooks:

1. Sussman, J. M. *Introduction to Intelligent Transportation Systems*. Artech House.

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2. McQueen, B., & McQueen, S. *Intelligent Transport Systems Standards*. Artech House.

Reference Books:

1. Papacostas, C. S., & Prevedouros, P. D. *Transportation Engineering and Planning*. Pearson.
2. ITE *Traffic Engineering Handbook*. Institute of Transportation Engineers.
3. Kan Chen & John Miles. *ITS Handbook 2000: Recommendations from the World Road Association (PIARC)*. Artech House.

Programme :	**B.Tech.**	**Semester :**	**IV**
Name of the Course :	**Fluid Mechanics Lab**	**Course Code:**	**CE-24-BMJ209**
Credits :	**1**	**No of Hours :**	**2 Hrs/Week**
Max Marks :	**50**		

Course Description

The course covers different pressure measuring devices, metacentric height, verification of Bernoulli's Theorem, pitot tube, venturi meter, orifice meter, impact of jet through nozzle, coefficient of discharge through triangular notch and rectangular notch, Reynolds's experiment, friction factor for different pipes, loss coefficients for different pipe fittings, viscosity of fluid by viscometer, efficiency of centrifugal/reciprocating pump and efficiency of impulse/reaction turbine.

Course Objectives

1. To provide basic knowledge for application of different pressure measuring devices.
2. To gain the knowledge of determination of metacentric height and applications of different theorems.
3. To develop the skill for the application of pitot tube, venturimeter, orifice meter and jet through nozzle.
4. To develop the skill for the applications of different hydraulic machines like pump and turbines.

List of laboratory experiments:

(At least ten experiments are required to be performed by each student**).**

1. To measure pressure with the help of different pressure measuring devices.
2. To determine metacentric height of floating body.
3. To verify Bernoulli's theorem experimentally.
4. To measure the velocity of flow using pitot tube.
5. To determine the coefficient of discharge of venturimeter.
6. To determine the coefficient of discharge of orifice meter.
7. To determine the impact of jet through nozzle.

8. To determine the coefficient of discharge through open channel flow over a triangular notch.
9. To determine the coefficient of discharge through open channel flow over a rectangular notch.
10. To determine the different types of flow patterns by Reynolds's experiment.
11. To determine the friction factor for different pipes.
12. To determine the loss coefficients for different pipe fittings.
13. To determine the viscosity of fluid by viscometer (Redwood or Saybolt).
14. To determine efficiency of centrifugal/reciprocating pump.
15. To determine efficiency of impulse/reaction turbine.

Equipment/Machines/Instruments/Tools/Software Required:

1. Bourden's tube pressure gauge, manometers.
2. Bernoulli's theorem apparatus.
3. Various notches, orifices, mouthpieces.
4. Model of ship.
5. Turbines and pumps.

Recommended Books:

1. Hydraulics: Laboratory Manual, S.K. Likhi, (1995), New Age International, Delhi Wiley Eastern, reprint.
2. Hydraulics and Fluid Mechanics including Hydraulic Machine. P.N. Modi, S.M.Seth, (2013), Standard Book House, New Delhi, 20th edition.

Course Outcomes

Students will be able to:

1. Use of different pressure measuring devices.
2. Determine of metacentric height and applications of various principles.

3. Know the application of pitot tube, venturimeter, orifice meter and jet through nozzle.
4. Know the application of different hydraulic machines like pumps and turbines.

OP Jindal University

Raigarh-Chhattisgarh

Scheme and Syllabus

of

B. Tech.

Civil Engineering

Batch: 2023-27

Programme Outcome (PO)

1. **Engineering Knowledge and Problem Analysis**: Apply the knowledge of engineering domain with adequate amalgamation of science, mathematics, and management to Identify, formulate, and critically analyze complex civil engineering problems.
2. **Modern tools and techniques for investigating complex problems** – Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
3. **Design and development of innovative systems**: Ability to provide design solutions for civil engineering problems and ability to design the processes that meet the needs regarding day to day working of Civil Engineering industry.
4. **Communication and Teamwork -** Develop skills to communicate effectively to diverse platforms and contribute meaningfully to different capacities as a leader, team member or individual.
5. **Project management and finance**: Develop and apply knowledge of engineering, management, and finance principles to handle a project in a multidisciplinary environment.
6. **Life-long learning**: Acquire fundamental knowledge for lifelong learning to participate in the extensive context of socio-technological change in civil engineering as a self-directed member and a leader.
7. **Ethics and citizenship**: Apply ethical principles and commit to professional ethics, norms, and responsibilities of the engineering practice; and act with informed awareness to participate in civic life activities.
8. **Society, Sustainability and Environment**: Understand the impact of various solutions in the context of societal, economical, health, safety legal and environmental impact for sustainable development.

Programme Specific Outcome (PSO)

PSO_1: Design and develop infrastructural facility using concepts of Mathematics, Civil Engineering and other related disciplines to meet end users' objectives.

PSO_2: Test and analyze the quality of various civil engineering materials and to integrate the same to assure quality in construction.

PSO_3: Ensure the holistic growth through the awareness of effective communication, ethical responsibilities and physical/mental fitness.

PSO_4: Build a solid foundation in the domain of Civil Engineering for developing analytical, technical, professional & management skills

Course Structure for B.Tech Civil Engineering (Session 2023-27)

Credit Distribution

Semester	Credit
1st	20
2nd	21
3rd	22
4th	22
5th	21
6th	21
7th	21
8th	21
Total	169

SCHEME

I SEM B Tech CIVIL

Sample Subject Code	Type of Course	Name of Course	L	T	P	MSE	TA	ESE	Total	Credits
SOS-B-MAT-23-101	CC	Engineering Mathematics-1	3	0	0	30	20	50	100	3
SOS-B-PHY-23-102	CC	Applied Physics	2	0	0	30	20	50	100	2
SOE-B-EE-23-103	CC	Basic Electrical and Electronics Engineering	3	0	0	30	20	50	100	3
SOE-B-CSE-23-104	CC	Basic Computation Skills (C-Programming)	2	0	0	30	20	50	100	2
SOE-B-ME-23-101	CC	Engineering Graphics	2	2	0	30	20	50	100	3
SOS-B-HUM-23-106	AECC	Communicative English	2	0	0	30	20	50	100	2
SOE-B-CE-23-107	AECC	Environmental Science	2	0	0	30	20	50	100	2
SOE-B-EE-23-108	CC	Basic Electrical and Electronics Engineering Lab	0	0	2	0	30	20	50	1
SOE-B-CSE-23-109	CC	Basic Computation skills (C-Programming) Lab	0	0	2	0	30	20	50	1
SOS-B-PHY-23-110	CC	Applied Physics Lab	0	0	2	0	30	20	50	1
			16	0	6	230	200	410	850	20

SCHEME
II SEM B Tech CIVIL

S. No.	Subject Code	Type of Course	Board of Study	SUBJECT	Periods per week			Scheme of Examination and Marks				Credit L+(T+P) /2
					L	T	P	PRE**		ESE*	Total Marks	
								Mid Sem	TA			
1	SOS-B-MAT-23-201	CC	MATH	Engineering Mathematics-II	3	0	0	30	20	50	100	3
2	SOS-B-CHEM-23-202	CC	CHEM	Applied Chemistry	3	0	0	30	20	50	100	3
3	SOE-B-ME-23-201	CC	ME	Engineering Mechanics	3	0	0	30	20	50	100	3
4	SOE-B-ME-23-202	CC	ME	Workshop Practices	0	0	4	0	30	20	50	2
5	SOE-B-CSE-23-205	SEC	CSE	Python Programming	2	0	0	15	10	25	50	2
6	SOS-B-HUM-23-206	GEC 1	HUMANITIES	GEC I:Indian Knowledge System (IKS) **(Annexure II)**	3	0	0	30	20	50	100	3
7	SOM-B-MBA-23-201	SEC	SOM	Problem Solving & Design Thinking	2	0	0	15	10	25	50	2
8	SOE-B-CHEM-23-208	CC	CHEM	Applied Chemistry Lab	0	0	2	0	30	20	50	1
9	SOE-B-CSE-23-209	CC	CSE	Python Programming Lab	0	0	2	0	30	20	50	1
10	SOE-B-ME-23-203	CC	ME	Engineering Mechanics Lab	0	0	2	0	30	20	50	1
TOTAL					**16**	**0**	**10**	**150**	**220**	330	**700**	**21**

Syllabus Scheme B. Tech in Civil Engineering (III-Semester)

S. No.	Subject Code	Type of Course	Board of Studies	SUBJECT	Periods per week			Scheme of Examination and Marks				Credit L+(T+P) /2
					L	P	T	PRE**		ESE*	Total Marks	
								Mid Sem	TA			
1	SOS-B-MAT-23-301	CC	MATH	Engineering Mathematics-III	3	0	0	30	20	50	100	3
2	SOE-B-CE-23-301	CC	CIVIL	Strength of Materials	3	0	0	30	20	50	100	3
3	SOE-B-CE-23-302	CC	CIVIL	Civil Engineering Materials	3	0	0	30	20	50	100	3
4	SOE-B-CE-23-303	CC	CIVIL	Surveying I	3	0	0	30	20	50	100	3
5	SOE-B-CE-23-304	GEC 2	CIVIL	GEC II: Industrial Safety **(Annexure II)**	3	0	0	30	20	50	100	3
6	SOE-B-CE-23-305	AEC C	CIVIL	Disaster Management	2	0	0	15	10	25	50	2
7	SOE-B-CE-23-306	SEC	CIVIL	Civil Engineering Drawing (Auto CAD)	0	4	0	0	30	20	50	2
8	SOE-B-CE-23-307	CC	CIVIL	Surveying I Lab	0	2	0	0	30	20	50	1
9	SOE-B-CE-23-308	CC	CIVIL	Material Testing Lab	0	2	0	0	30	20	50	1
10	SOS-B-HUM-23-301	VAC	HUM	Health Wellness Yoga and Sports	1	0	0	0	25	25	50	1
TOTAL					**18**	**8**	**0**	**165**	**225**	**360**	**750**	**22**

Syllabus Scheme B. Tech in Civil Engineering (IV-Semester)

S. No.	Subject Code	Type of Course	Board of Studies	SUBJECT	Periods per week			Scheme of Examination and Marks				Credit L+(T+P)/2
					L	P	T	PRE**		ESE*	Total Marks	
								Mid Sem	TA			
1	SOE-B-CE-23-401	CC	CIVIL	Surveying II	3	0	0	30	20	50	100	3
2	SOE-B-CE-23-402	CC	CIVIL	Concrete Technology	3	0	0	30	20	50	100	3
3	SOE-B-CE-23-403	CC	CIVIL	Fluid Mechanics	3	0	0	30	20	50	100	3
4	SOE-B-CE-23-404	CC	CIVIL	Engineering Hydrology	3	0	0	30	20	50	100	3
5	SOE-B-CE-23-405	CC	CIVIL	Transportation Engineering-I	3	0	0	30	20	50	100	3
6	SOE-B-CE-23-406	CC	CIVIL	Fluid Mechanics Lab	0	2	0	0	30	20	50	1
7	SOE-B-CE-23-407	CC	CIVIL	Transport Engineering-I Lab	0	2	0	0	30	20	50	1
8	SOE-B-CE-23-408	CC	CIVIL	Concrete Technology Lab	0	2	0	0	30	20	50	1
9	SOE-B-CE-23-409	CC	CIVIL	*Certificate Coarse on MOOCs/NPTEL	1	0	0	0	20	30	50	1
10	SOS-B-HUM-23-401	VAC	HUM	Universal Human Values-II	3	0	0	30	20	50	100	3
TOTAL					**20**	**6**	**0**	**180**	**230**	**390**	**800**	**22**

*Certificate Coarse on MOOCs/NPTEL: Students required to enroll for the course (Minimum 4 weeks) approved by department of civil engineering and submit the certificate of completion. The students who failed to score the desired marks as per minimum passing criteria of MOOC/NPTEL shall be required to appear for end sem examination of the course conducted by OPJU. for backlog students in this course examination will be conducted by OPJU.

Syllabus Scheme B. Tech in Civil Engineering (V-Semester)

S. No.	Subject Code	Type of Course	Board of Studies	SUBJECT	Periods per week			Scheme of Examination and Marks				Credit L+(T+P)/2
					L	T	P	PRE**		ESE*	Total Marks	
								Mid Sem	TA			
1	SOE-B-CE-23-501	CC	CIVIL	Theory of Structures-I	4	0	0	30	20	50	100	4
2	SOE-B-CE-23-502	CC	CIVIL	Structural Engineering Design- I	3	0	0	30	20	50	100	3
3	SOE-B-CE-23-503	CC	CIVIL	Geotechnical Engineering-I	3	0	0	30	20	50	100	3
4	SOE-B-CE-23-504	CC	CIVIL	Construction Planning and Management	3	0	0	30	20	50	100	3
5	SOE-B-CE-23-505	CC	CIVIL	Transportation Engineering-II	3	0	0	30	20	50	100	3
6	SOE-B-CE-23-506	VAC	CIVIL	M S Project	1	0	2	0	30	20	50	2
7	SOE-B-CE-23-507	CC	CIVIL	Theory of Structures-I Lab (STAD Pro.)	0	0	2	0	30	20	50	1
8	SOE-B-CE-23-508	CC	CIVIL	Geotechnical Engineering-I Lab	0	0	2	0	30	20	50	1
9	SOE-B-CE-23-509	CC	CIVIL	Certificate Coarse on MOOCs/NPTEL	1	0	0	0	20	30	50	1
TOTAL					**18**	**4**	**0**	**165**	**190**	**345**	**700**	**20**

*Certificate Coarse on MOOCs/NPTEL: Students required to enroll for the course (Minimum 4 weeks) approved by department of civil engineering and submit the certificate of completion. The students who failed to score the desired marks as per minimum passing criteria of MOOC/NPTEL shall be required to appear for end sem examination of the course conducted by OPJU. for backlog students in this course examination will be conducted by OPJU.

Syllabus Scheme B. Tech in Civil Engineering (VI-Semester)

S. No.	Subject Code	Type of Course	Board of Studies	SUBJECT	Periods per week			Scheme of Examination and Marks				Credit L+(T+P)/2
								PRE**		ESE*	Total Marks	
					L	P	T	Mid Sem	TA			
1	SOE-B-CE-23-601	CC	CIVIL	Theory of Structures-II	3	0	0	30	20	50	100	3
2	SOE-B-CE-23-602	CC	CIVIL	Structural Engineering Design- II	3	0	0	30	20	50	100	3
3	SOE-B-CE-23-603	CC	CIVIL	Geotechnical Engineering-II	3	0	0	30	20	50	100	3
4	SOE-B-CE-23-604	GEC-3	CIVIL	GE-III: Engineering Economics	3	0	0	30	20	50	100	3
5	SOE-B-CE-23-605	CC	CIVIL	Environmental Engineering	3	0	0	30	20	50	100	3
6	SOE-B-CE-23-606	DSE-I	CIVIL	DSE-I **(Annexure I)**	3	0	0	30	20	50	100	3
7	SOE-B-CE-23-607	CC	CIVIL	Geotechnical Engineering-II Lab	0	2	0	0	30	20	50	1
8	SOE-B-CE-23-608	CC	CIVIL	Structural Engineering Design- II Lab	0	2	0	0	30	20	50	1
9	SOE-B-CE-23-609	CC	CIVIL	Environmental Engineering Lab	0	2	0	0	30	20	50	1
TOTAL					**18**	**6**	**0**	**180**	**210**	**360**	**750**	**21**

Annexure-I

S. No.	Subject Code	Board of Studies	SUBJECT
1	SOE-B-CE-23-604 (01)	CIVIL	Modern Construction Methods and Materials
2	SOE-B-CE-23-604(02)	CIVIL	Maintenance Repair Rehabilitation of Civil Engineering Structure(MRRCES)
3	SOE-B-CE-23-604(03)	CIVIL	Advanced RCC
4	SOE-B-CE-23-604 (04)	CIVIL	Solid Waste Management
5	SOE-B-CE-23-604(05)	CIVIL	Industrial Waste Management
6	SOE-B-CE-23-604(06)	CIVIL	Air Pollution. & Control
7	SOE-B-CE-23-604 (07)	CIVIL	Remote Sensing & GIS
8	SOE-B-CE-23-604(08)	CIVIL	Urban Infrastructure
9	SOE-B-CE-23-604(09)	CIVIL	Town Planning

B. Tech in Civil Engineering (VII & VIII- Semester) (Proposed)

B. Tech in Civil Engineering (VII- Semester)

S. No.	Subject Code	Board of Study	SUBJECT	Periods per week			Scheme of Examination and Marks				Credit L+(T+P)/2
							PRE		ESE	Total Marks	
				L	T	P	Mid Sem	TA			
1	SOE-B-CE-23-701	Civil	Pre-stressed Concrete Structures	3	0	0	30	20	50	100	3
2	SOE-B-CE-23-702	Civil	Water Resources Engineering I	3	0	0	30	20	50	100	3
3	SOE-B-CE-23-703	Civil	Software application for civil engineering	1	0	2	0	30	20	50	2
4	SOE-B-CE-23-704	Civil	Research Internship /Industry Internship (12- 14 Weeks)	0	0	20	0	125	125	250	10
5	SOE-B-CE-23-705	Civil	Professional Elective II	2	0	0	15	10	25	50	2
6	SOE-B-CE-23-706	Civil	Noncredit mandatory course(MOOCS)	-	-	-	-	-	-	-	-
7	SOE-B-HUM-23-701	HUM	Professional Development	0	0	2	30	15	10	25	1
			TOTAL	**9**	**0**	**22**	**90**	**190**	**270**	**550**	**21**

Professional Elective- II (Annexure-II)

S.N	Subject Code	Courses
1.	SOE-B-CE-23-705(8)	Air Pollution & Control
2.	SOE-B-CE-23-705 (9)	Ecology and Sustainable Development
3.	SOE-B-CE-23-705 (10)	Safety in Construction Industry

B. Tech in Civil Engineering (VIII- Semester)

S. No.	Subject Code	Board of Study	SUBJECT	Periods per week			Scheme of Examination and Marks				Credit L+(T+P)/2
				L	T	P	PRE		ESE	Total Marks	
							Mid Sem	TA			
1	SOE-B-CE-23-801	Civil	Water Resources Engineering II	3	0	0	30	20	50	100	3
2	SOE-B-CE-23-802	Civil	Professional Practice	4	0	0	30	20	50	100	4
3	SOE-B-CE-23-803(1-7)	Civil	Professional Elective III (Annexure – III)	4	0	0	30	20	50	100	4
4	SOE-B-CE-23-804	Civil	Major Project	0	0	20	0	150	100	250	10
			TOTAL	**11**	**0**	**20**	**90**	**210**	**200**	**500**	**21**

Professional Elective- III(Annexure-III)

S.N	Subject Code	Courses
1.	SOE-B-CE-23-803 (1)	Design of Earthquake Resistant Buildings
2.	SOE-B-CE-23-803 (2)	Transportation Planning and Management
3.	SOE-B-CE-23-803 (3)	Quality Control and Assurance in Construction
4.	SOE-B-CE-23-803 (4)	Modern Construction Materials & Methods
5.	SOE-B-CE-23-803 (5)	Advanced Reinforced Concrete Design
6.	SOE-B-CE-23-803 (6)	Industrial Waste Management
7.	SOE-B-CE-23-803 (7)	Foundation Engineering

V-Semester

Detail Syllabus B. Tech in Civil Engineering

Programme:	**B. Tech**	**Semester :**	**V**
Name of the Course:	**Theory of Structures - I**	**Course Code:**	**SOE-B-CE-23-501**
Credits :	**4**	**No of Hours :**	**4 Hrs/week**
Max Marks:	**100**		

Course Description:

This course aims to provide students with a comprehensive understanding of structural analysis concepts. It covers the fundamentals of determinate and indeterminate structures, including static and kinematic indeterminacy, and the analysis of trusses using equilibrium equations. Students will learn to evaluate fixed and continuous beams under various loading conditions, apply slope and deflection methods, and interpret influence lines for rolling loads. The course also introduces strain energy methods, including Castigliano's theorems and Maxwell's reciprocal theorem, for calculating deflections in beams, trusses, and rigid frames. Emphasis is placed on practical applications in structural engineering.

Course Outcome:

Students will be able to:

Course Outcomes:	Course Outcomes:
CO1	Analyze determinate structures by calculating static and internal indeterminacy and solving plane trusses using the method of joints and sections.
CO2	Evaluate the fixed and continuous beams under various loading conditions, considering support sinking, temperature effects, and the behavior of cables and three-hinged arches.
CO3	Determine slopes and deflections of statically determinate beams using double integration, Macaulay's method, moment area method, and conjugate beam method.
CO4	Interpret and apply influence lines for reactions, shear forces, and bending moments in simply supported beams and trusses under different rolling loads, including stiffening girders and arches.
CO5	Calculate deflections using the strain energy method, applying Castigliano's theorems, Betti's law, and Maxwell's reciprocal deflection theorem for beams, trusses, and rigid frames.

Syllabus:

UNIT I

Determinate Structures: Introduction to determinate and indeterminate structures, Static and kinematic indeterminacy: external and internal indeterminacy, Rules for determining the degree of indeterminacy, Analysis of pin-jointed determinate plane trusses: method of joints and method of sections, Application of equilibrium equations to simple trusses.

UNIT II

Fixed and continuous beams: Statement and application of Clapeyron's theorem of three moments. Analysis of fixed and continuous beams under various loading conditions. Effect of support sinking and temperature changes on fixed and continuous beams. Cables: cables subjected to concentrated load, uniformly distributed load, and own weight, Arches: Introduction, Analysis of Three-hinged arches for static load and bending moment.

UNIT III

Slope and Deflection: Moment-curvature relationship and the elastic curve, Relation between loadings, shear force (SF), bending moment (BM), slope, and deflection, Deflection and slopes of statically determinate beams using: Double integration method, Macaulay's method, Moment area method and conjugate beam method.

UNIT IV

Rolling Loads and Influence Lines: Introduction to rolling loads and their effects, Concept and construction of influence lines, Influence lines for reactions, shear force, and bending moment in simply supported beams, Influence lines for forces in trusses, Analysis of different types of rolling loads: Single concentrated load, Multiple concentrated loads and Uniformly distributed loads (UDL) shorter and longer than the span, Determination of absolute maximum bending moment, Influence lines for stiffening girder and arches.

UNIT V

Strain Energy Method: Strain energy due to axial load, bending, shear and torsion, Castigliano's theorems for deflection, Betti's law and Maxwell's theorem of reciprocal deflections, Unit load and strain energy methods for determining deflections of: Statically determinate beams, Pin-jointed trusses and Rigid determinate frames.

Text Books:

1. Basic Structural Analysis, Reddy, C. S., Third Edition, Tata McGraw Hill
2. Structural Analysis, Hibbeler, R. C., Ninth Edition in SI units, Parson Education.
3. Theory of Structures, Punmia, B.C., Jain, A. K. and Jain, A. K., Laxmi Publication.

4. Structural Analysis- I & II, Bhavikatti, S. S., Fifth Edition, Vikas Publishing House.

Reference Books:

1. Theory & Analysis of Structures (Vol. – I & II), Jain, O.P. and Jain B.K., Nem Chan.
2. Structural Analysis, Ghali, A. and Neville, M., Chapman & Hall Publication.
3. Structural Analysis, Negi L.S. and Jangid R.S., Tata McGraw Hill.
4. Theory of Structures, Ramamrutham S. & Narayan R., Dhanpat Rai Publications.

Programme :	**B.Tech.**	**Semester :**	**V**
Name of the Course :	**SED I**	**Course Code:**	**SOE-B-CE-23-502**
Credits :	**3**	**No of Hours :**	**3 Hrs/Week**
Max Marks :	**100**		

Course description:

This course on Structural Engineering Design-I aim at understanding Basic designing in the framed structure. The new introduction is the Limit State Method which recently used in the designing and covers all overcomes and makes structure safe from all the loads. Based on the Limit State method there are list of designs like, singly reinforced beam, doubly reinforced beam, slab (one-way and two-way), staircase etc. this all designing is purely based on the Limit state Method which involves safety factors use of the various IS code the practice and the drawing detailing.

Course Outcomes:

At the end of this course, the student will be able to:

CO Number	Course Outcome
CO1	To understand conceptually the difference between Ultimate load theory method & Limit state Design method. Design the beams based on same.
CO2	To design two-way slab & one-way simply supported slabs.
CO3	To design columns with various loads aspects.
CO4	To design the dog-legged and open well staircase.
CO5	To design isolated footings for eccentric loads.
CO6	To design combined footings.

Syllabus

UNIT I

Flexural Member - Introduction to limit state method, characteristic loads, partial safety factor, limit state of flexure – assumptions, stress block parameters, neutral axis, analysis and design of singly and doubly reinforced section, shear in beams, bond and development length.

UNIT II

T-Beam - Properties of T-section, moment of resistance and design of singly reinforced T-beam.

Slabs - Design of one-way slab and two-way slabs.

UNIT III

Columns - Axially loaded short columns, minimum eccentricity, longitudinal and transverse reinforcement, and effective length of column, safe load on columns, circular columns, Pu – Mu interaction curves, combined axial load and uni-axial bending, combined axial load and bi-axial bending.

UNIT IV

Column Footings - General principle of design of reinforced concrete footing, proportioning of footings, edge thickness, depth of footing, design of isolated column footings – square and rectangular footings.

UNIT V

combined footing – Combined footing, Strap beam

Staircases – Types of staircases, Design of stairs – dog legged and open well staircase.

Text Books:

1. Reinforced Concrete Design, S. U. Pillai and D. Menon, 2017, Tata McGraw, Third Edition.
2. Limit State Theory and Design of Reinforced Concrete (IS:456-2000), V. L. Shah and S. R. Karve,2017, Structures Publications, Pune, Eight Edition.
3. Relevant IS codes IS: 456:2000, IS 875, Part 1, 2.
4. Design Aids for Reinforced Concrete to I.S.-456-1978 (SP-16), 1980, Bureau of Indian Standards, New Delhi.
5. Limit State Design of Reinforced concrete, P. C.Varghese, 2008, PHI Learning.

Reference Books:

1. Illustrated Reinforced Concrete Design, Dr. V.L.Shah and Dr. S.R. Karve ,2018, Structures Publications Pune, Ninth Edition.
2. Reinforced Concrete Limit State Design, A. K. Jain, 2012, Nem Chand and Bros. Roorkee, Seventh Edition.
3. Fundamentals of Reinforced Concrete Design, M. L. Gambhir, 2008, PHI Learning.
4. Limit State Design of Reinforced Concrete, B. C. Punmia, A. K. Jain and A. K. Jain, 2016, Laxmi Publications.
5. Design of Reinforced Concrete, B. C. Punmia and A. K. Jain, Laxmi Publications.

Programme :	**B.Tech.**	**Semester :**	**V**
Name of the Course :	**Geotechnical Engineering-I**	**Course Code:**	**SOE-B-CE-23-503**
Credits :	**3**	**No of Hours :**	**3 Hrs/Week**
Max Marks :	**100**		

Course description:

This course provides a comprehensive understanding of fundamental soil mechanics principles, covering soil formation, structure, classification, and physical properties. It delves into permeability and seepage concepts, including Darcy's law, flow nets, and piping criteria. Compaction principles and their impact on soil behavior are explored alongside compressibility and consolidation theories, with a focus on settlement analysis. Shear strength fundamentals, Mohr-Coulomb failure criteria, and various shear testing methods are discussed. Stress distribution theories and their applications are introduced, along with field exploration techniques, undisturbed soil sampling, and modern electronic site characterization methods.

Course Outcomes:

At the end of this course, the student will be able to:

CO Number	Course Outcome
CO1	Soil formation, structure, clay mineralogy, phase relationships, index properties, and classification systems, enabling them to analyze soil behavior effectively
CO2	Soil permeability, Darcy's law, seepage forces, total and effective stress, flow nets, uplift pressure, piping, and filtration criteria for analyzing groundwater flow and stability.
CO3	Soil compaction, consolidation, and settlement analysis for geotechnical applications.
CO4	Shear strength principles, failure criteria, testing methods, stress paths, and shear behavior of clays and sands for geotechnical analysis.
CO5	Stress distribution theories, soil exploration methods, undisturbed sampling techniques, and field testing for effective geotechnical site characterization.

Syllabus

UNIT I

Physical Properties: Overview of soil formation, soil structure, clay mineralogy, soil phase relationships, index properties of granular and fine-grained soils, and soil classification systems.

UNIT II

Permeability and Seepage: Permeability of soils, Darcy's law, equivalent permeability in stratified soils, in-situ and laboratory permeability tests, seepage forces and types of heads, total and effective stress, two-dimensional Laplace's equation, flow nets, uplift pressure, exit gradient, piping, and filter design criteria.

UNIT III

Compaction: Principles of compaction, factors affecting compaction, standard and modified Proctor tests, effects of compaction on engineering properties, and field compaction techniques.

Compressibility and Consolidation: Components of total settlement, compressibility of granular and fine-grained soils, Terzaghi's one-dimensional consolidation theory, consolidation tests, determination of preconsolidation stress, overconsolidation ratio, settlement computation, and secondary consolidation.

UNIT IV

Shear Strength: Mechanism of shear resistance, Mohr-Coulomb failure criterion, measurement of shear strength through direct shear test, unconfined compression test, vane shear test, and triaxial shear test (CD, CU, UU), pore-pressure parameters, stress path, and shear strength behavior of clays and sands.

UNIT V

Stress Distribution: Boussinesq's equation, vertical stress due to line load, strip load, and uniformly loaded circular area, Westergaard's approach, pressure bulb concept, and approximate methods.

Soil Exploration: Methods of field exploration, undisturbed soil sampling techniques and equipment, field tests including static and dynamic penetration tests, field vane shear test, and modern electronic methods for site characterization.

Text Books:

6. Ranjan, G., & Rao, A. S. R. (2016). Basic and Applied Soil Mechanics (3rd ed.). New Age International Publishers, India.
7. Arora, K. R. (2020). Soil Mechanics and Foundation Engineering – Geotechnical Engineering. Standard Publishers Distributors.
8. Murthy, V. N. S. (2006). Geotechnical Engineering. Marcel Dekker Inc., New York, USA.

Reference Books:

1. Lambe, T. W., & Whitman, R. V. (1991). Soil Mechanics. John Wiley & Sons.
2. Budhu, M. (2010). Soil Mechanics and Foundations. John Wiley & Sons.

3. Gulhati, S. K., & Datta, M. (2005). Geotechnical Engineering. Tata McGraw-Hill Publishing Company Limited, New Delhi.

IVProgramme :	**B.Tech.**	**Semester :**	**V**
Name of the Course :	**Construction Planning and Managment**	**Course Code:**	**SOE-B-CE-23-504**
Credits :	**3**	**No of Hours :**	**3 Hrs/Week**
Max Marks :	**100**		

Course description:

This course equips students with proficiency in tools of civil engineering focusing on effective construction management practices, modern construction materials and techniques. The program trains enrolled candidates in the specialized field of construction of special structures towards accomplishing critical projects within a given schedule and budget.

Course Outcomes:

At the end of this course, the student will be able to:

CO Number	Course Outcome
CO1	The students identify, analyze and implement suitable planning and management techniques
CO2	Create network, calculate project duration and optimize the time and minimize the cost
CO3	Implement resource allocation and control techniques
CO4	Plan and implement quality and safety management

Syllabus

UNIT I

Introduction: Objectives and functions of construction management, stages in construction, stages of planning, bar charts and milestone charts, project feasibility reports, scheduling, job layout and line of Balance applications.

UNIT II

Construction Scheduling: Necessity for good scheduling, Elements of Network, Development of Network, PERT: Time estimates, Time computation, Network Analysis – slack, Critical path

UNIT III

Construction Scheduling: CPM- Steps in CPM Project Planning, Network Analysis, Activity times, Floats & its type, Critical activities, Critical Path Determination, Difference between CPM & PERT

UNIT IV

Cost Control & Resource Allocation: Cost control in construction-importance, objectives of cost control, cost control systems, Economic analysis of engineering projects, economic studies, Resources levelling, Project updating, Construction cost monitoring.

UNIT V

Construction Safety and Quality Control: Causes of Accidents, Safety measures, Responsibility for safety, Safety benefits to various parties, Safety contract, Safety policy, Safety hazards. Elements of Quality, Quality Assurance Techniques, Quality Control Circles

Text Books:

1. Construction Project Management Planning, Scheduling and Control – Chitkara, K.K. (Tata McGraw Hill Publishing Co., New Delhi, 1998)
2. Project Mangement: A systems Approach to Planning, Scheduling and Controlling – Harold Kerzner (CBS Publishers & Distributors, Delhi, 1988)

Reference Books:

1. Project management for Construction: Fundamental Concepts for owners, Engineers, Architects and Builders – Chris Hendrickson and Tung Au, (Prentice Hall, Pitsburgh, 2000)
2. Construction Project Management – Frederick E.Gould (Wentworth Institute of Technology, Vary E.Joyce, Massachusetts Institute of Technology, 2000)
3. Project Management – Choudhury, S. (Tata McGraw Hill Publishing Co., New Delhi, 1988)
4. Applied project Engineering and Management – Ernest E. Ludwig (Gulf Publishing Co., Houstan, Texas, 1988)

Programme:	**B. Tech.**	**Semester :**	**V**
Name of the Course:	**Transportation Engineering – II**	**Course Code:**	**SOE-B-CE-23-505**
Credits :	**3**	**No of Hours :**	**3Hrs/week**
Max Marks:	**100**		

Course Description:

This course gives Introduction to different modes of transportation .It is principally aimed to introduce the students about various elements of railway track, railway bridges, ports, harbor and airport. It makes student aware about the concepts of Geometric design of Railway Engineering, Tunnel, Bridges and Harbor. It also emphasized on the safe, efficient and economical design of some major elements of the infrastructure required for above mentioned mode of transportation.

Course Outcome:

Students will be able to:

CO	Course Outcomes:
CO1	Understand different means of Transportation Engineering.
CO2	Make safe geometric design for railway track with high speed.
CO3	Understand methods of construction of Tunnel, Bridges
CO4	Understand importance of docks and harbor.

Syllabus:

UNIT I

Railway Engineering: Historical background of Railways in India. Railway track cross-section, coning of wheels, rail cross-section, weight of rail, length of rail, wear of rails, creep of rails, rail joints and welding of rail.

Sleepers: Functions and requirements of sleepers, classification of sleepers, timber, metal and concrete sleeper, comparison of different types of sleepers, spacing of sleepers and sleeper density.

Ballast: Function and requirements of ballast, types, comparison of ballast materials.

UNIT II

Geometric Design of railway track: alignment, horizontal curves, super elevation, equilibrium, cant and cant deficiency, length of transition curve, gradients and grade compensation, Negative super elevation, transition curves, widening of gauges on curves. Point and crossing, design of turn outs various types of track junctions, signaling and interlocking, signals, and control on movements of trains.

UNIT III

Tunnel Engineering: Consideration in tunneling shape and size, methods of tunnel, constructions, tunneling in soft soil and rocks, lining of tunnels, ventilation, drainage of tunnels.

UNIT IV

Bridge Engineering: Bridge site investigation and planning, selection of bridge site, alignment, collection of bridge design data, forces acting on bridge structure, case study of bridge structure failure.

UNIT V

Harbor & Dock Engineering: Harbor layout, harbor works, break water, jetties, wharves, piers and berthing facilities, navigational aids, port facilities, docks; Dry and Wet docks, transit sheds and ware houses, general layout of a port.

Text Books:

1. Railway Engineering – S.C. Saxena and S.P. Arora, "A textbook of Railway Engineering", (Dhanpat Rai Publications)
2. Railway Engineering – S.C. Rangwala, "Railway Engineering", (Charotar Publishing House Pvt. Ltd.)
3. Bridge Engineering – S.P. Bindra, "Principles and practice of bridge engineering", (Dhanpat Rai Publications)
4. Tunnel Engineering – S.C. Saxena (Dhanpat Rai Publications)
5. Harbour Engineering – R. Srinivasan (Charotar Publishing House Pvt. Ltd

Reference Books:

1.Tunnel and Harbour – Seetharaman S. (Umesh Publication)

Programme :	**B.Tech.**	**Semester :**	**V**
Name of the Course:	**Microsoft Project**	**Course Code:**	**SOE-B-CE-23-506**
Credits :	**2**	**No of Hours :**	**3 Hrs/Week**
Max Marks :	**50**		

Course Description

Microsoft Project 2019 is a project management application that gives managers the ability to track tasks, resources, reports and timelines for small and enterprise projects. Just one mistake during project management can destroy project budgets and deadlines. MS Project helps student avoid common pitfalls by giving a complete overview of every component of a project, and this course explains each one of these components to get started.

This course starts with basic project setup. A new Project file starts as a template, and the project manager must then fill out worksheets to define resources and tasks. This course takes you step-by-step through each part of configuring a new task and creating resources to work on those tasks. We then show you how to assign each resource to a task to ensure that it gets completed.

Course Outcomes

The students should be able –

Course Outcomes:	**Course Outcomes:**
CO1	Describe what MS Project is and what are its capabilities.
CO2	Demonstrate defining and creating projects
CO3	Demonstrate entering and scheduling tasks
CO4	Describe calendar and how to organize tasks
CO5	Define resources and resource management
CO6	Demonstrate consolidating projects and resources
CO7	Describe what MS Project is and what are its capabilities.

Syllabus

UNIT- I

Basics of Project Management: About Project, Project Attributes, Triple Constraints, Project Management, 5 Stages of Project, Project Life Cycle, Scheduling, Linking, Baseline setup, Logical Relationship of task, Activities listing. Milestone, Work Break Down structure, Float, Forward Pass, Backward Pass, Gantt chart, Network Diagram, Critical Path Method, PERT, Project Monitoring, Project Tracking, S-Curve Analysis.

UNIT- II

Introduction to MS Project: Background, Getting Started in MS Project 2019. Defining and Creating Projects, Entering and Scheduling Tasks, Project 2019 Views, Defining Calendar.

UNIT- III

Defining Activities and Task: Organizing Tasks, Working with Task Duration, Constraints, and Deadlines, Introducing Dependencies, Logical Relationship setup, Assigning Durations, Actual Start, Schedule Task.

UNIT- IV

Resources and Tracking: Types of Resources, Working with Resources, Resource Management, Tracking Work in Project 2019, Communication and Progress Updates, Using Baselines,

UNIT- V

Reports: Customizing and Formatting Your Project, Running Reports, Consolidating Projects and Resources, Printing Project Information

Course Materials

All course material will be provided in the lessons and net links. There are no required materials to purchase before taking the class.

Programme:	**B. Tech**	**Semester :**	**V**
Name of the Course:	**Theory of Structures–I Lab**	**Course Code:**	**SOE-B-CE-23-507**
Credits :	**1**	**No of Hours :**	**2 Hrs/week**
Max Marks:	**50**		

Course Description:

The course covers flexural rigidity of beams, verification of Maxwell's theorem, deflection of curved beams, analysis of determinates and indeterminate beams, determinate pin-jointed frames, determinate rigid frames and multistoried rigid frame using STAAD Pro.

Course Outcome:

Students will be able to:

Course Outcomes:	Course Outcomes:
CO1	Study the concept of flexural rigidity of beams and Maxwell's theorem.
CO2	Determine deflections of curved bars.
CO3	Analyze determinate and indeterminate beams.
CO4	Analyze determinate pin-jointed frames, determinate rigid frames and multistoried rigid frame.

List of Experiments:
(At least ten experiments are to be performed by each student)

1. To determine the flexural rigidity (EI) for a given beam.
2. To verify the Maxwell's theorem of reciprocal deflection.
3. To determine the vertical deflections of a variety of curved bars.
4. Analysis of determinate beams on a standard structural analysis package such as STAAD Pro V8i.
5. Analysis of indeterminate beams on a standard structural analysis package such as STAAD Pro V8i.
6. Analysis of determinate pin-jointed frames on a standard structural analysis package such as STAAD Pro V8i.
7. Analysis of indeterminate pin-jointed frames on latest version of a standard structural analysis package such as STAAD Pro V8i.
8. Analysis of determinate rigid frames on latest version of a Standard Structural Analysis package such as STAAD Pro V8i.
9. Analysis of indeterminate rigid frames on latest version of a standard structural analysis package such as STAAD Pro V8i.

10. Analysis of multistoried rigid frame on latest version of a standard structural analysis package such as STAAD Pro V8i.
11. Analysis of multistoried pin-jointed frame on latest version of a standard structural analysis package such as STAAD Pro V8i.
12. Analysis of industrial structure on latest version of a standard structural analysis package such as STAAD Pro V8i.
13. Analysis of composite structure on latest version of a standard structural analysis package such as STAAD Pro V8i.

Equipment/Machines/Instruments/Tools/Software Required:

1. Elastic properties of beam apparatus.
2. Maxwell's law of reciprocal deflection apparatus.
3. Universal frame with variety of curved bars.
4. Dial gauges for measuring deflections.
5. Weights and hangers to apply loads.
6. Latest release of software Package STAAD Pro

Assessment:
Assessment includes attendance, performance, record work and exams.

Recommended Books:

1. Structural Analysis- I & II, Bhavikatti, S. S., Fifth Edition, Vikas Publishing House.
2. Verification Manual of STAAD Pro Software.

Programme :	**B.Tech.**	**Semester :**	**V**
Name of the Course :	**Geotechnical Engineering-I-Lab**	**Course Code:**	**SOE-B-CE-23-508**
Credits :	**1**	**No of Hours :**	**2 Hrs/Week**
Max Marks :	**50**		

Course description:

This laboratory course provides practical training in fundamental soil testing methods. Students will conduct experiments to determine water content, specific gravity, grain size distribution, field density, consistency limits, shrinkage limit, compaction characteristics, and permeability. The course emphasizes standard testing procedures and their applications in geotechnical engineering, enhancing students' understanding of soil behavior and properties.

Course Outcomes: At the end of this course, the student will be able to:

CO Number	Course Outcome
CO1	Perform standard soil tests to determine physical and engineering properties such as water content, specific gravity, grain size distribution, and field density.
CO2	Conduct compaction and permeability tests to evaluate soil behavior under different conditions and interpret the results for geotechnical applications.
CO3	Apply laboratory test data to analyze soil properties, supporting foundation design and other geotechnical engineering practices.

List of Experiments

1. Determination of Water Content – Oven drying method and Pycnometer method.
2. Determination of Specific Gravity – Using Pycnometer or Density Bottle.
3. Grain Size Analysis – Sieve analysis.
4. Grain Size Analysis – Hydrometer analysis.
5. Determination of Field Density – Core Cutter method.
6. Determination of Field Density – Sand Replacement method.
7. Consistency Limits – Determination of Liquid Limit and Plastic Limit.
8. Shrinkage Limit Test – Determination of shrinkage limit of soil.

9. Compaction Tests – Standard Proctor Test (IS Light Compaction Test).

10. Compaction Tests – Modified Proctor Test (IS Heavy Compaction Test).

11. Permeability Tests – Falling head permeability test.

12. Permeability Tests – Constant head permeability test

Recommended Books:

1. Respective Bureau of Indian Standard/ International Standard Codes of Practices.

2. Bowles, J.E. (2012). Engineering Properties of Soil and their Measurement, 4th Edition, McGraw Hill (India) Publishers.

3. Mandal, J.N. and Divshikar, D.G. (1994). Soil Testing in Civil Engineering, Oxford & IBH Publishing Company Pvt. Ltd., New Delhi, India.

4. Sivakugan, N., Arulrajah, A. and Bo, M.W. (2011). Laboratory Testing of Soils, Rocks and Aggregates.

VI-Semester

Detail Syllabus B. Tech in Civil Engineering

Programme:	**B. Tech**	**Semester :**	**VI**
Name of the Course:	**Theory of Structures -II**	**Course Code:**	**SOE-B-CE-23-601**
Credits :	**03**	**No of Hours :**	**3 Hrs/week**
Max Marks:	**100**		

Course Description:

This course aims to equip students with advanced structural analysis techniques for indeterminate structures. It covers the moment distribution and three-moment methods for analyzing beams and frames with and without sway. Students will learn the force method with strain energy principles and apply slope deflection and column analogy methods to beams and frames. The course introduces matrix methods for structural transformations and concludes with the stiffness method, enabling the analysis of trusses, beams, and frames using global stiffness matrices.

Course Outcome:

Students will be able to:

Course Outcomes:	Course Outcomes:
CO1	Analyze indeterminate beams and frames using moment distribution and three-moment methods, considering sway and non-sway conditions.
CO2	Apply the force method with strain energy concepts to solve statically indeterminate beams and frames, accounting for lack of fit.
CO3	Use slope deflection and column analogy methods to analyze indeterminate structures and influence lines based on Müller-Breslau principle.
CO4	Implement matrix methods to transform forces, displacements, and stiffness/flexibility matrices in structural analysis.
CO5	Apply the stiffness method to solve trusses, beams, and plane frames, forming global stiffness matrices.

Syllabus:

UNIT- I

Method of Moment Distribution and Three Moments - Moment distribution method, Application to indeterminate beams and rigid frames, Analysis of structures without sway and with sway problems. Analysis of indeterminate beams using the method of three moments. Principle of superposition.

UNIT-II

Force Method of Analysis using Strain Energy Concept - Strain energy theorems for the analysis of statically indeterminate structures, Application to beams and frames, Analysis considering lack of fit.

UNIT- III

Slope Deflection Method and Influence Lines - Slope deflection method: Application to indeterminate beams and rigid frames with and without sway. Basics of column analogy method, Application of column analogy for fixed beams.

Qualitative and quantitative influence lines for indeterminate beams using Müller-Breslau principle and its applications.

UNIT-IV

Matrix Method of Structural Analysis - Fundamentals of matrix method of analysis, System Forces to Element Forces, System Displacements to Element Displacements, Element to System Flexibility and Stiffness Matrix, General Force and Displacement Transformation, Coordinate Transformation, Fundamentals of flexibility (force) method of analysis: Application to statically determinate structures.

UNIT-V

Stiffness (Displacement) Method of Analysis - Introduction, Development of stiffness matrix, Application of stiffness method for the analysis of pin-jointed trusses, beam and plane frame, Formation of global stiffness matrix.

Text Books:

5. Structural Analysis, Hibbeler, R. C., Ninth Edition in SI units, Parson Education.
6. Basic Structural Analysis, Reddy, C. S., Third Edition, Tata McGraw Hill
7. Structural Analysis - A Matrix Approach, Pandit, G and Gupta, S., Second Edition, McGraw Hill Education.
8. Analysis of Structures Vol-II (Theory, Design & Details of Structures), Vazirani, V. N., Ratwani, M. M., and Duggal, S. K., Sixteenth Edition, Khanna Publishers.

Reference Books:

1. Intermediate Structural Analysis, Wang, C. K., First (Indian) Edition, McGraw Hill Education
2. Indeterminate Structural Analysis, Vijayanand, M., Muthu, K. U., and Narendra, H., and Janardhana, M., Dreamtech Press
3. Fundamentals of Structural Analysis, West, H. H. and Geschwindner, L. F., Second Ediiton, Wiley.
4. Matrix Methods of Structural Analysis, Bhavikatti, S. S., Dreamtech Press.
5. Structural Analysis- I & II, Bhavikatti, S. S., Fifth Edition, Vikas Publishing House.
6. Mechanics of Structures (Strength of Materials), Shah, H. J., and Junarkar, S. B., Thirty-Second Edition, Charotar Publishing House Pvt. Ltd.

Programme:	**B. Tech.**	**Semester :**	**VI**
Name of the Course:	**Structural Engineering Design-II**	**Course Code:**	**SOE-B-CE-23-602**
Credits :	**3**	**No of Hours**	**45**
Max Marks:	**100**		

Course Description

This course gives Introduction to different methods of design of elements of steel structure, principally aimed to introduce the students about various elements of steel structure and their behavior under applied load. It makes student aware about the concepts of selection of cross section to transmit design load without risk of failure. It also emphasized on the safe, efficient and economical design of some major elements of the infrastructure which are made up of steel material.

Course Outcomes

The students will be able -

Course Outcomes:	Course Outcomes:
CO1	To develop ability to select adequate shape and grade of structural steel.
CO2	To understand the basis of economical and safe design of steel structures.
CO3	To develop ability of choosing proper fastener for a particular joint.
CO4	To Make use of knowledge of analysis in structural planning and design of various components of buildings.

Syllabus:

UNIT- I

Methods of Design (Working stress and Limit state) - Types of Structural Steel, Advantages of steel as a structural material, Rolled Sections - Tapered Flange and Parallel Flange, Built up sections, Convention for Member Axes. Plastic Theory, Shape factor, Methods of design, Limitations of Working stress and Plastic design methods, Advantages of Limit State Design, Limit States of Strength and Serviceability, Partial Safety Factors, Loads and Load Combinations, Maximum effective slenderness ratio.

UNIT-II

Riveted/Bolted & Welded Connection - Location details of fasteners, Bearing type bolts, Friction Grip type Bolting, Welds and Welding, Advantages and Disadvantages of Welded Connections, Lap and Butt Joints, Truss Joint Connections by bolts and welds.

UNIT- III

Tension Members - Design Strength due to Yielding of cross Section, Rupture of Critical Section, Block Shear, Design of Axially Loaded Steel Angles Tension Members.

UNIT-IV

Compression Members - Design Strength, Effective length of compression members, Design of Axially loaded Steel Angles compression members, Design of Column bases under axial load, Laced Columns, Battened columns.

UNIT-V

Beams (Flexural Members) - Design Strength in Bending (Flexure), Effective length for lateral torsional buckling, Shear, Design of Laterally Supported and Laterally Unsupported Beams with unstiffened webs.

Text Books:

1. Design of Steel Structures - N. Subramanian (Oxford University Press)
2. Limit State Design of Steel Structures – S. K. Duggal (Tata McGraw Hill)
3. Design of Steel Structures - Negi, B.S. (Tata McGraw Hill India)

Reference Books:

1. Indian Standard – General Construction in Steel –Code of Practice (3rd Revision) (IS:800 – 2007)
2. Design of Steel Structures – K. S. Sai Ram (Pearson Education)
3. Structural Steel Design : LRFD Method – J. C. McCormac, J. K. Nelson (Pearson Education)
4. Limit State design in Structural Steel – M. R. Shiyekar (PHI Learning)
5. Limit State Design of Steel Structures (IS:800-2007) – V. L. Shah, V. Gore (Structures Publications)

Programme :	**B.Tech.**	**Semester :**	**VI**
Name of the Course :	**Geotechnical Engineering-II**	**Course Code:**	**SOE-B-CE-23-603**
Credits :	**3**	**No of Hours :**	**3 Hrs/Week**
Max Marks :	**100**		

Course description:

This course covers the analysis and design of geotechnical structures, including slope stability, earth pressures, bearing capacity, and foundation systems. It explores slope stability methods, earth pressure theories, retaining wall stability, and shallow and deep foundation design. Topics include pile foundations, well foundations, and machine foundations, with a focus on construction methods, load-carrying capacity, and settlement analysis. Special considerations for expansive and contaminated soils are also discussed, ensuring a comprehensive understanding of geotechnical engineering principles for safe and efficient foundation design.

Course Outcomes:

At the end of this course, the student will be able to know:

CO Number	Course Outcome
CO1	Slope stability analysis methods for different conditions using analytical and graphical approaches.
CO2	Earth pressure theories, active and passive pressures, retaining structures, and stability considerations for gravity and cantilever retaining walls.
CO3	Bearing capacity theories, footing design, foundation types, and settlement analysis considering groundwater effects.
CO4	Pile classification, load-carrying capacity, construction methods, pile group behavior, settlement analysis, load tests, and negative skin friction effects.
CO5	Well foundation construction, machine foundation design, vibration analysis, IS code recommendations, and foundation considerations for expansive and contaminated soils.

Syllabus

UNIT I

Stability of Slopes: Stability analysis of infinite and finite slopes, methods of slope stability analysis including Swedish circle method, friction circle method, Bishop's method, and Taylor's stability number with charts; stability analysis of earth dam slopes under different loading conditions.

UNIT II

Earth Pressures: Theories of lateral earth pressure, active and passive earth pressures in cohesionless and cohesive soils, Rankine's and Coulomb's earth pressure theories, types of retaining structures, and stability analysis of gravity and cantilever retaining walls.

UNIT III

Bearing Capacity: Terzaghi's bearing capacity theory, computation of bearing capacity for different soil types, bearing capacity of square, rectangular, circular, and continuous footings, Meyerhof's and Skempton's methods, and the effect of groundwater table on bearing capacity.

Foundations: Types and depth of foundations, design of shallow foundations based on laboratory and field test data, and settlement analysis of footings.

UNIT IV

Pile Foundation: Classification of piles, load-carrying capacity, types and construction methods, estimation of pile capacity using static and dynamic formulae, group action of piles, capacity and settlement analysis of pile groups, pile load tests, and effects of negative skin friction.

UNIT V

Well Foundation: Types and components of well foundations, construction methods, causes of tilts and shifts, and remedial measures.
Machine Foundation: Introduction to machine foundations, types of machines and their foundations, design criteria, field methods for determining design parameters, block vibration test, response of block foundations under vertical vibrations, and IS code recommendations.
Foundation on Expansive Soil: Identification and characteristics of expansive and contaminated soils, associated geotechnical problems, and design considerations for foundations on expansive soils.

Text Books:

9. Ranjan, G., & Rao, A. S. R. (2016). Basic and Applied Soil Mechanics (3rd ed.). New Age International Publishers, India.
10. Arora, K. R. (2020). Soil Mechanics and Foundation Engineering – Geotechnical Engineering. Standard Publishers Distributors.
11. Murthy, V. N. S. (2006). Geotechnical Engineering. Marcel Dekker Inc., New York, USA.

Reference Books:

4. Lambe, T. W., & Whitman, R. V. (1991). Soil Mechanics. John Wiley & Sons.
5. Budhu, M. (2010). Soil Mechanics and Foundations. John Wiley & Sons.
6. Gulhati, S. K., & Datta, M. (2005). Geotechnical Engineering. Tata McGraw-Hill Publishing Company Limited, New Delhi.
7. Das, B.M. (2011). Principle of Foundation Engineering, 7th Edition, Cengage Learning, USA.

Programme :	**B.Tech.**	**Semester :**	**VI**
Name of the Course :	**Engineering Economics**	**Course Code:**	**SOE-B-CE-23-606**
Credits :	**3**	**No of Hours :**	**3 Hrs/Week**
Max Marks :	**100**		

Course description:

This course equips students with the ability to make informed economic choices in engineering, ensuring optimal financial performance, resource efficiency, and ethical responsibility in their professional careers.

Course Outcomes:

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

CO Number	Course Outcome
CO1	Apply fundamental economic concepts such as cost, demand, supply, and market equilibrium in engineering decision-making.
CO2	Differentiate between various types of costs and apply cost estimation techniques..
CO3	Assess the impact of inflation, risk, and uncertainty in investment decisions.
CO4	Interpret financial statements and analyze the financial health of engineering projects.
CO5	Apply ethical principles and professional responsibility in engineering economic decisions.

Syllabus

UNIT 1: Introduction to Engineering Economics

- Definition, Scope, and Importance of Engineering Economics
- Basic Concepts: Cost, Demand, Supply, and Market Equilibrium
- Types of Goods and Services
- Time Value of Money: Simple and Compound Interest, Present and Future Worth
- Economic Decision-Making Process

UNIT 2: Cost Analysis and Estimation

- Types of Costs: Fixed, Variable, Sunk, Opportunity, and Incremental Costs
- Break-Even Analysis: Graphical and Analytical Methods
- Cost-Benefit Analysis
- Depreciation: Types and Methods (Straight-Line, Declining Balance, Sum-of-Years-Digits)
- Estimation of Capital and Operating Costs

UNIT 3: Investment Decision Analysis

- Methods for Evaluating Engineering Projects:
  - Net Present Value (NPV)
  - Internal Rate of Return (IRR)
  - Benefit-Cost Ratio (BCR)
  - Payback Period and Accounting Rate of Return (ARR)
- Inflation and its Impact on Economic Decisions
- Risk and Uncertainty in Investment Decisions

UNIT 4: Financial Management and Accounting

- Introduction to Financial Statements: Balance Sheet, Income Statement, and Cash Flow Statement
- Sources of Finance: Equity, Debt, and Working Capital Management
- Capital Budgeting Techniques
- Basics of Inventory Management
- Engineering Contracts and Tendering Process

UNIT 5: Economic Aspects of Engineering and Ethics

- Public Sector vs. Private Sector Projects
- Economic Analysis of Large Infrastructure Projects
- Environmental Economics and Sustainability
- Engineering Ethics and Professional Responsibility
- Case Studies in Engineering Economics

Text Books:

1. **R. Panneerselvam,** *Engineering Economics, Prentice Hall India, Latest Edition.*
2. **Sullivan, Wicks, and Koelling,** *Engineering Economy, Pearson Education, Latest Edition.*
3. **Chan S. Park,** *Contemporary Engineering Economics, Pearson, Latest Edition.*
4. **Leland Blank & Anthony Tarquin**, *Engineering Economy, McGraw-Hill, Latest Edition.*

Reference Books:

1. **Degarmo, Sullivan, and Bontadelli**, *Engineering Economy*, Macmillan Publishing Company.
2. **Mik Wisniewski,** *Quantitative Methods for Decision Makers*, Pearson Education.
3. **James Riggs, David Bedworth, and Sabah Randhawa,** *Engg Economics*, Tata McGraw Hill.
4. **Thuesen & Fabrycky,** *Engineering Economy*, Pearson.

Programme :	**B.Tech.**	**Semester :**	**VI**
Name of the Course :	**Environmental Engineering**	**Course Code:**	**SOE-B-CE-23-605**
Credits :	**3**	**No of Hours :**	**3 Hrs/Week**
Max Marks :	**100**		

Course description:

This course provides an in-depth understanding of **water supply engineering, wastewater treatment, and air pollution control.** It covers **water sources, water quality, treatment processes, and distribution systems.** The course also explores **wastewater characteristics, primary and secondary treatment methods, sludge management, and effluent standards.** Additionally, it introduces **air pollution sources, monitoring techniques, meteorological aspects, and pollution control strategies.** By integrating theoretical concepts with practical applications, students will develop the skills required for environmental management and sustainable engineering solutions.

Course Outcomes:

At the end of this course, the student will be able to:

CO Number	Course Outcome
CO1	Evaluate water demand factors and their impact on consumption.
CO2	Explain the principles of screening, sedimentation, coagulation, filtration, and disinfection.
CO3	Differentiate between primary, secondary, and tertiary treatment methods.
CO4	Explore sludge treatment and disposal methods.
CO5	Classify air pollutants and their effects on human health and the environment.

Syllabus

UNIT I: Water Supply Engineering

- Sources of water: Surface and groundwater sources
- Water demand and factors affecting water consumption
- Quality of water: Physical, chemical, and biological characteristics

UNIT II: Water treatment processes:

- Screening, sedimentation, coagulation, filtration, disinfection
- Advanced water treatment: Reverse osmosis, desalination, ion exchange
- Distribution system: Components, layout, and design considerations

UNIT III: Wastewater Engineering

- Sources and characteristics of wastewater
- Primary, secondary, and tertiary treatment of wastewater

UNIT IV: Biological treatment processes:

- Activated sludge process, trickling filters, oxidation ponds
- Sludge treatment and disposal
- Effluent standards and disposal methods

UNIT III: Air Pollution and Control

- Sources and classification of air pollutants
- Effects of air pollution on human health, environment, and materials
- Meteorological aspects of air pollution
- Air pollution measurement and monitoring techniques
- Air pollution control methods: Control of particulate and gaseous pollutants

Text Books:

1. "**Environmental Engineering – Vol. 1 & 2**" – Howard S. Peavy, Donald R. Rowe, George Tchobanoglous
2. "**Water Supply and Sanitary Engineering**" – G.S. Birdie and J.S. Birdie
3. "**Environmental Engineering**" – Davis and Cornwell
4. "**Wastewater Engineering: Treatment and Reuse**" – Metcalf & Eddy
5. "**Solid Waste Management**" – Tchobanoglous, Theisen & Vigil
6. "**Air Pollution Control Engineering**" – Noel de Nevers
7. "**Environmental Pollution Control Engineering**" – C.S. Rao
8. "**Environmental Engineering**" – A.K. Chatterjee

Reference Books:

1. "**Introduction to Environmental Engineering and Science**" – Gilbert M. Masters
2. "**Principles of Environmental Engineering and Science**" – Mackenzie L. Davis
3. "**Environmental Impact Assessment**" – Larry W. Canter
4. "**Handbook of Solid Waste Management**" – Frank Kreith, George Tchobanoglous
5. "**Air Quality**" – Thad Godish
6. "**Water and Wastewater Technology**" – Mark J. Hammer
7. "**Handbook of Water and Wastewater Treatment Technologies**" –

Programme:	**B. Tech.**	**Semester :**	**VI**
Name of the Course:	**Structural Engineering Design-II Lab**	**Course Code:**	**SOE-B-CE-23-608**
Credits:	**2**	**No of Hours:**	**2 Hrs/week**
Max Marks:	**100**		

Course Description

Structural Engineering Design–II Lab emphasized on the safe, efficient and economical design of some major elements of the infrastructure which are made up of steel and RCC material.

This course gives Introduction to different methods of design of elements of steel and RCC structure, principally aimed to introduce the students about various elements of steel and RCC structure and their behavior under applied load. It makes student aware about the concepts of selection of cross section to transmit design load without risk of failure.

Course Outcomes

The students should be able –

Course Outcomes:	**Course Outcomes:**
CO1	To develop ability to select adequate shape and grade of structural steel.
CO2	To understand the basis of economical and safe design of steel structures.
CO3	To develop ability of choosing proper fastener for a particular joint.
CO4	To make use of knowledge of analysis in structural planning and design of various components of buildings.

Syllabus:

By using latest version of a Standard Structural Engineering Design Package such as STAAD Pro.

RCC DESIGN:

1. Introduction
2. Geometrical Modelling of RCC
3. Modelling of loads and load combinations on RCC Frame
4. Analysis and Interpretation of Results of Analysis of RCC Frame
5. Design of RCC Frame
6. Interpretation of Results of Design of RCC Frame

STEEL DESIGN:

1. Geometrical Modelling of Steel Frame
2. Modelling of loads and load combinations on Steel Frame
3. Analysis and Interpretation of Results of Analysis of Steel Frame
4. Design of Steel Frame

5. Interpretation of Results of Design of Steel Frame

CASE STUDY:

1. Case Study of design of a RCC Multistorey Building
2. Case Study of design of a Steel Industrial Building

List of Equipment's / Machine Required:

1. Latest Release of Software Package STAAD Pro (Research Engineers International, Kolkata)
2. Latest Release of Software Package STAAD.etc (Research Engineers International, Kolkata)

Recommended Books:

1. Reference Manual for Respective Software
2. Verification Manual of Respective Software

Programme :	**B.Tech.**	**Semester :**	**VI**
Name of the Course :	**Modern Construction Materials and Methods**	**Course Code:**	**SOE-B-CE-23-606 (01)**
Credits :	**3**	**No of Hours :**	**3 Hrs/Week**
Max Marks :	**100**		

Course description:

This course gives Introduction about various properties of modern construction materials and methods.

Course Outcomes:

At the end of this course, the student will be able to:

CO Number	Course Outcome
CO1	To know the importance and areas of application of modern construction materials and methods

Syllabus:

UNIT I

Concretes: High strength and High performance Concrete-Fiber Reinforced concrete. Composites: Plastics-Reinforced polymers-FRP-Celular cores.

UNIT II

Other Materials: Water proofing compounds-Non -weathering Materials-Flooring and Facade Materials.

UNIT III

Smart and Intelligent Materials: Brief outline and uses.

UNIT IV

Sub-structure Construction Techniques Box jacking -Pipe Jacking-Under Water Construction of diaphragm walls and basement caisson-sinking cofferdam-cable anchoring and grouting-driving diaphragm walls, sheet piles-laying operations for built up offshore system-shoring for deep cutting-Large reservoir, well points Dewatering and stand by Plant equipment for underground open excavation

UNIT V

Super Structure Construction Vacuum Dewatering of concrete Flooring-Concrete Paving Technology-Techniques of construction for continuous concreting operation in Tall buildings of various shapes and Varying Sections-Launching Techniques-Suspended from work-erection techniques of tall

structures, Large span Structures-Launching techniques for heavy decks in situ prestressing in high rise structures.

Text Books:

1. Civil Engineering Materials (2nd Edition) – Shan Somayaji (Prentice Hall Inc., 2001)
2. Materials for Civil and Construction Engineers – Mamlouk, M.S. and Zaniewski, J.P. (Prentice Hall Inc., 1999)

Reference Books:

1. Materials for Civil and Highway Engineers (4th Edition) – Derucher, K.Korfiatis. G. and Ezeldin, S. (Prentice Hall Inc., 1999)
2. High Performance Concrete – Aitkens (McGraw Hill, 1999)

Programme :	**B.Tech.**	**Semester :**	**VI**
Name of the Course :	**Maintenance, Repair and Rehabilitation of Civil Engineering Structures (MRCES)**	**Course Code:**	**SOE-B-CE-23-606(02)**
Credits :	**3**	**No of Hours :**	**3 Hrs/Week**
Max Marks :	**100**		

Course description:

This course gives the knowledge of various methods of repairing and testing of various structures. Introduction to different methods of design of elements of RCC. And steel structures. This course gives also idea about Damage assessment and Evaluation, Damage testing methods. It also emphasized on the safe, efficient and economical Maintenance, Repair and Rehabilitation of Civil Engineering Structures.

Course Outcomes:

At the end of this course, the student will be able to:

CO Number	Course Outcome
CO1	Comprehend the factors affecting the performance and durability of structures
CO2	Learn various damage assessment models and evaluation techniques.
CO3	Familiarize with IS codes and standards related to structural repair
CO4	Explore various rehabilitation techniques such as grouting and detailing.
CO5	Analyze Real-World Case Studies

Syllabus:

UNIT I

Performance of structures
Need for rehabilitation
Aging of structures
Distress in concrete steel structures

UNIT II

Damage assessment and Evaluation models
Damage testing methods – NDT, Core samples – Methods of repairs - Repair and maintenance of buildings

UNIT III
IS standards - Bridge repairs - Seismic strengthening
UNIT IV
Rehabilitation methods - grouting – detailing
Imbalance of structural stability

UNIT V
Case Study1: Residential Building
Case Study 2: Industrial Building.

Text Books:

1. Repair and Rehabilitation of Concrete Structures by Poonam I. Modi. And Chirag N. Patel
2. Maintenance, Repair & Rehabilitation & Minor Works of Buildings by Varghese

Reference Books:

1. RN Raikar, "Diagnosis and treatment of Structures in Distress", R and D Centre, Structural Designers and Consultants, New Bombay, India,1994.
2. VK Raina, "Concrete Bridge Practice Construction, Maintenance and Rehabilitation", 2nd Edition, Shroff Publishers and Distributors, August, 2010.
3. WH Ransom, "Building Failures, Diagnosis and Avoidance", 2nd Edition, E and F.N. Spon Publishers, December 1987.

Programme :	**B.Tech.**	**Semester :**	**VI**
Name of the Course:	**Advance Reinforced Design**	**Course Code:**	**SOE-B-CE-23-606(03)**
Credits :	**3**	**No of Hours :**	**3 Hrs/Week**
Max Marks :	**100**		

Course Description

This course designed to provide a comprehensive understanding of advanced reinforced concrete structures and its design.

Course Outcomes:

Students will be able to

CO Number	Course Outcome
CO1	Understand Effective span, bending moments and shear forces of span and Design criteria.
CO2	Understand curved Beams, torsional moments, and its design.
CO3	Understand different types of water tanks and its design.
CO4	Understand Analysis of multi-storey frames and its design.
CO5	Design deep beams.

Syllabus:

UNIT I:

Introduction, Effective span, Span/depth ratio, Bending moments and shear forces, Design examples.

Unit-II:

Curved Beams: Analysis of bending and torsional moments in circular beams, Moment in semi-circular beams supported on three columns, Design example.

Unit III

Types of overhead water tanks, Intz type tank, Design example of intz type of water tank, Conical or funnel shaped tank. Design example of funnel shaped over head tank.

Unit-IV:

Analysis of multi-storey frames, Methods of substitute frames, design examples, bending moments in column, Analysis of multi-storey frames subjected to horizontal forces, Design examples.

Unit-V:

Deep Beams: General features, Parameters influence design, Flexural bending stress, Shear stress in deep beams, I.S. Code provisions, Design examples.

Text Books:

1. Raju, K.N., 2016. Advanced Reinforced Concrete Design.
2. Varghese, P.C., 2010, Advanced Reinforced Concrete Design.

Reference Books:

1. Dayaratnam, P. and Sarah, P. 2017. Design of Reinforced Concrete Structure

Programme :	**B. Tech.**	**Semester :**	**VI**
Name of the Course :	**Solid Waste Management**	**Course Code:**	**SOE-B-CE-23-606(04)**
Credits :	**3**	**No of Hours :**	**3 Hrs/Week**
Max Marks :	**100**		

Course Description:

This course covers engineering and scientific concepts and principles applied to the management of municipal solid waste (MSW) to protect human health and the environment and the conservation of limited resources through resource recovery and recycling of waste material. Topics include regulatory aspects and hierarchy of integrated solid waste management; characterization and properties of MSW. Municipal solid waste collection, transfer, and transportation, separation, processing, combustion, composting, and recycling of waste material; and the landfill method of solid waste disposal.

Course Outcomes:

At the end of this course, the student will be able to:

CO Number	Course Outcome
CO1	Identify the sources and characteristics (physical, chemical, and biological) of solid waste.
CO2	Understand integrated solid waste management and methods for waste quantification.
CO3	Understand the role of transfer stations, their types, site selection, and maintenance.
CO4	Study biological and chemical methods for resource and energy recovery from waste.
CO5	Learn landfill site selection criteria, layout, and design considerations.

Syllabus:

UNIT I

SOLID WASTE

Definition of solid wastes, types of solid wastes, sources of solid wastes, characteristics of solid wastes, physical, chemical and biological characterization, methods of sampling, factors affecting

the generation of solid waste, effects of improper disposal of solid waste - public health effects, impact on environmental health, future challenges and opportunities.

UNIT II

SOLID WASTE MANAGEMENT

Principle of solid waste management, hierarchy of waste management options, integrated solid waste management, physical and chemical composition of municipal solid waste, different methods for generation rates, quantity assessment of solid wastes. Storage- movable bins, fixed bins. Collection- home to home collection, community bin system. Theory and design of hauled container system, stationary container system.

UNIT III

TRANSFER AND PROCESSING TECHNIQUES

Transfer stations-types and selection of location, operation and maintenance, labeling and handling of different solid wastes-hazardous waste, biomedical wastes, radioactive waste, E-wastes. Transport means- handcart, tri-cycle, animal cart, tripper truck, dumper placer, bulk refuse carrier, railroad transport. Engineering system for on-site handling and processing of solid waste- separators, size reduction equipment's, screening equipment's, densification, baling, cubing, pelleting equipment's.

UNIT IV

COMPOSTING

Biological and chemical techniques for energy and other resource recovery: composting, types of composting, process description, design and operational consideration of anaerobic composting, vermin composting, termiradation, fermentation, incineration and pyrolsis system- theory and types, its by-products.

UNIT V

LANDFILLING

Dumping of solid waste, site selection criteria, landfill layout, landfill sections, occurrence of gases and leachate in landfills- composition and characteristics and its control, control of contamination

of ground water. Solid waste management rules, status of solid waste management in India, cost economics of solid waste management.

Text Books:

1. Tchobanoglous, G., Theisen, H., & Vigil, S.A; Integrated Solid Waste Management: McGraw Hill, New York
2. Bhide, A.D., B.B. Sundaresan, Solid Waste Management in developing countries

References:

1. CPHEEO, Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organization, Government of India, New Delhi, 2000.
2. Datta, M; Waste Disposal in Engineered Landfills, Narosa Publishers, Delhi.

Programme :	**B. Tech.**	**Semester :**	**VI**
Name of the Course :	**Industrial Waste management**	**Course Code:**	**SOE-B-CE-23-606(05)**
Credits :	**3**	**No of Hours :**	**3 Hrs/Week**
Max Marks :	**100**		

Course Description:

This course provides a comprehensive understanding of industrial waste management, focusing on the sources, classification, treatment, and disposal methods of industrial wastes. The course emphasizes pollution prevention, resource recovery, and sustainable management strategies. Topics include environmental regulations, industrial waste characterization, physical, chemical, and biological treatment technologies, hazardous waste management, and waste minimization techniques.

Course Outcomes:

At the end of this course, the student will be able to:

CO Number	Course Outcome
CO1	Identify various sources and types of industrial waste.
CO2	Understand waste characterization and regulatory aspects.
CO3	Learn different treatment and disposal techniques for industrial waste.
CO4	Study the role of recycling and resource recovery in waste management.
CO5	Analyze case studies and industrial best practices for waste minimization.

Syllabus:

UNIT I: INTRODUCTION TO INDUSTRIAL WASTE MANAGEMENT:

Definition of industrial waste, sources and classification, hazardous and non-hazardous wastes, characterization of industrial wastes, physical, chemical, and biological properties. Effects of improper waste disposal on human health and the environment. Overview of industrial waste regulations and guidelines.

UNIT II: WASTE GENERATION AND CHARACTERIZATION

Types of industrial waste – liquid, solid, gaseous, hazardous and non-hazardous. Waste quantification methods. Industrial waste audit and monitoring. Standards for effluent discharge and air emissions. Case studies of industrial sectors generating significant waste.

UNIT III: INDUSTRIAL WASTE TREATMENT TECHNOLOGIES

Overview of treatment methods – physical (screening, sedimentation, filtration), chemical (neutralization, coagulation, precipitation), and biological (aerobic and anaerobic digestion, biofilters). Advanced treatment methods – membrane separation, adsorption, oxidation. Handling and disposal of sludge. Case studies on treatment technologies in industries.

UNIT IV: WASTE MINIMIZATION AND RESOURCE RECOVERY

Principles of waste minimization. Cleaner production and pollution prevention strategies. Resource recovery techniques – reuse, recycling, energy recovery. Industrial symbiosis and circular economy approach. Life cycle assessment (LCA) of industrial waste. Case studies on sustainable industrial waste management practices.

UNIT V: DISPOSAL AND MANAGEMENT OF HAZARDOUS WASTE

Hazardous waste classification, handling, and transportation. Landfill disposal: site selection, design considerations, and leachate management. Secure landfills and hazardous waste incineration. Bioremediation and phytoremediation techniques. Industrial waste management policies and status in India. Cost analysis of industrial waste management systems.

Text Books:

Rao, M.N. & Datta, A.K., Waste Disposal in Engineering Landfills, Narosa Publishing House.

Eckenfelder, W.W., Industrial Water Pollution Control, McGraw Hill.

References:

CPHEEO, Manual on Hazardous Waste Management, Government of India.

Tchobanoglous, G., & Kreith, F., Handbook of Solid Waste Management, McGraw Hill.

Programme :	**B.Tech.**	**Semester :**	**V**
Name of the Course :	**Air Pollution and Control**	**Course Code:**	**SOE-B-CE-23-606(06)**
Credits :	**3**	**No of Hours :**	**3 Hrs/Week**
Max Marks :	**100**		

Course description:

This course designed to provide a comprehensive understanding of the causes and effects of air pollution, and the management measures and engineering technologies available for its control.

Course Outcomes:

At the end of this course, the student will be able to:

CO Number	Course Outcome
CO1	Identify various air pollutants and their sources.
CO2	Understand principles and techniques for air pollution control, including source control methods.
CO3	Understand the fundamentals of air quality modeling and its applications.
CO4	Analyze the effects of indoor pollutants on human health and indoor environments.
CO5	Understand Global Air Pollution Issues and Their Impacts

Syllabus:

UNIT I:

History of air pollution, Air pollution definition and types, Air pollutant, Ambient Air Pollution Monitoring, Stack Monitoring, Techniques & instrumentation, Experimental analysis, Gaseous & particulates, Standards & limits.

Unit-II:

Air pollution effects: On living and non-living beings, Principles of controls, Source control, Air pollution meterology.

Unit III

Air quality modelling, Fundamentals of air quality modelling, Deterministic approach, Gaussian Plume Dispersion Model, Deterministic models, Statistical models, Physical models, Limitation of models.

Unit-IV:

Indoor air pollution, Sources of indoor air pollution, Type and effect of indoor air pollution, Indoor air quality modelling. Types of modelling.

Unit-V:

Problems of air pollution, Global Warming, Greenhouse effect, Effects of Global Warming, Photochemical Smog, Effects on human health, Ozone Layer Depletion, Acid Rain.

Text Books:

1. Rao, M.N. and Rao, H. V. N., 1993. Air Pollution, Tata Mc-Graw Hill, New Delhi.
2. Murty, B. P., 2004. Environmental Meteorology, I.K. International Pvt. Ltd., New Delhi.
3. Nevers, N.D. 2000. Air Pollution Control Engineering, Second Edition, Pub., McGraw Hill, New York.
4. Cheremisinoff, N.P., 2002. Handbook of Air Pollution Prevention and Control, Pub., Butterworth-Heinemann, Elsevier Science, USA.

Reference Books:

1. C. D. Cooper and F.C. Alley, Air Pollution Control: A Design Approach, McGraw Hill
2. L. K. Wang, Air pollution control Engineering, Humana Press Inc., U.S.; 2Rev Ed edition, 2004

Programme:	**B. Tech.**	**Semester :**	**VI**
Name of the Course:	**Remote Sensing and GIS**	**Course Code:**	**SOE-B-CE-23-604(7)**
Credits :	**3**	**No of Hours :**	**3 Hrs/week**
Max Marks:	**100**		

Course Description

This course illustrates the fundamental concepts of GIS and remote sensing technologies in the context of environmental engineering. Topics include the physical basis for remote sensing, remote sensing systems, digital image processing, data structures, database design, and spatial data analysis.

Course Outcomes

The students should be able –

Course Outcomes:	Course Outcomes:
CO1	To know the importance and areas of application of GIS.

CO2	Use GIS to identify, explore, understand, and solve spatial problems c.
CO3	Demonstrate GIS modeling skills d. Demonstrate critical thinking skills in solving geospatial problems.
CO4	Design and implement a GIS project.

Syllabus:

UNIT- I

Basic Concept of GIS - Introduction, Information systems, spatial and non-spatial information, Geographical concepts and terminology, Advantages of GIS, Basic components of GIS, Organization of data in GIS, Hardware & Software.

UNIT-II

GIS Data - Input data, Field data, Statistical data, Maps, Aerial photographs, Satellite data, Points, lines and areas features, Vector and Raster data, Advantages and Disadvantages, Data entry through keyboard, digitizers and scanners, Digital data, GIS data formats and standards. Data Management, Data Base Management System (DBMS), various data Models, Run – length encoding, Quadtrees, Data Analysis – Data layers, analysis of spatial and non-spatial data, Data overlay and modelling, smart features of DBMS.

UNIT III

Applications of GIS - Applications of GIS in Map Revision, Land use, Agriculture, Forestry, Archaeology, Municipal, Geology, Water Resources, Soil Erosion, Land suitability analysis, Change detection.

UNIT IV

Fundamentals of Remote Sensing - Concept of Remote Sensing, Principal of Remote Sensing, Components of Remote Sensing, Seven Elements in Remote Sensing, Characteristics of Electromagnetic Radiation.

UNIT V

Platforms Ground - Based Platforms, Aerial Platforms, Satellite Platforms, Types of Remote Sensing, Passive Remote Sensing, Active Remote Sensing, Thermal Infrared Remote Sensing, Elements of Visual Interpretation, Digital Image Processing, Remote Sensing in India.

Text Books:

1. Advanced Surveying, EARSON Education, Satheesh,G. Sathikumar,R. and Madhu,N.(2007). South Asia.

Reference Books:

1. Introduction to Remote Sensing, Campbell, J.B. (1986). The Guilford Press, London.
2. Remote Sensing and Geographic Information Systems, Horwood, E. (1992). The Guilford Press, London,

Programme :	**B.Tech.**	**Semester :**	**VI**
Name of the Course:	**Urban Infrastructure**	**Course Code:**	**SOE-B-CE-23-606(08)**
Credits :	**3**	**No of Hours :**	**3 Hrs/Week**
Max Marks :	**100**		

Course description:
This course is designed to provide a comprehensive understanding of physical and organizational structures needed for the operation of an urban area, as well as the services and facilities necessary for society and the economy to function. Also to orient students to the basic planning concept that governs the infrastructure need in urban area, new township and SEZ Development.

Course Outcomes:
At the end of this course, the student will be able to:

CO Number	Course Outcome
CO1	Students are expected to understand planning of urban infra structures.
CO2	Students are expected to understand concept o town planning and urban infrastructure
CO3	Students are expected to understand concept of SEZs.
CO4	Students are expected to understand services in Urban Infrastructure.

Syllabus
UNIT I:
Urban Infrastructure: Understanding of different types of urban infrastructures in planning, layout of service lines and interface.
Unit II:
Planning: Urban infrastructure in India; Planning for urban Infrastructure; scope of infrastructure services; Services provided in the city; Infrastructure Service planning.
Unit III
Urban Environment: Social infrastructure; disaster management; Land Pooling and Land banking.
Unit IV:
Township Principles and Town planning: Growth of towns, Stages in town development, current trends in township project, planning of township, requirement of new town, master plan, survey, neighborhood planning, public utility in services existing town.

Unit-V:
SEZ: About SEZ, Legislative policies, setting up of SEZs, Routine operation of SEZ, Tax incentives, Infrastructure requirements for SEZ.

Text Books:

1. Chaturvedi, T, (2007), Guide to special Economic Zones, Commercial Law Publisher
2. Gupta K (2008), Law and Procedure, Township, Atlantis Publisher
3. Osborn, F.J. Whittick A. (1969), The New town, The answer to megalopolis, Leonard Hill

Reference Books:

1. Indian Infrastructure report 2009, Land as a resource.
2. Municipal and Rural Sanitation / EHBEN, V M
3. Solid Liquid flow Slurry pipeline Transportation / WASPE, E J

Programme:	**B. Tech.**	**Semester :**	**VI**
Name of the Course:	**Town Planning**	**Course Code:**	**SOE-B-CE-23-604(9)**
Credits :	**3**	**No of Hours :**	**3 Hrs/week**
Max Marks:	**100**		

Course Description

This course gives Introduction to Goals and Objectives of planning; components of planning; benefits of planning, Levels of planning: Regional plan, Development Plan, Town Planning Scheme, Neighbourhood plan, Types of Development plans, Master Plan, City Development Plan, Structure Plan. Special townships, Land Acquisition Rehabilitation and Resettlement Act

Course Outcomes

The students should be able –

Course Outcomes:	Course Outcomes:
CO1	To develop a planning; components of planning; benefits of planning, Levels of planning: Regional plan, Development Plan, Town Planning Scheme, Neighborhood plan, Types of Development plans, Master Plan, City Development Plan, and Structure Plan. Special townships, Land Acquisition Rehabilitation and Resettlement Act.
CO2	To understand the basis of economical and safe Town planning.
CO3	To develop ability of choosing proper Development plans.
CO4	To make use of knowledge of analysis in structural planning and design of various components of buildings.

Syllabus:

UNIT- I

Architectural Elements - Principles and elements of Architectural Composition, Qualities of Architecture: user friendly, contextual, ecofriendly, utility of spaces, future growth etc. Role of "Urban Planner and Architect" in planning and designing in relation with spatial organization, utility, demand of the area and supply

UNIT II

Landscaping - importance, objectives, principles, elements, material (soft and hard), Urban renewal for quality of life and livability. Importance of sustainable architecture with case study

UNIT III

Goals and Objectives of planning - components of planning; benefits of planning, Levels of planning: Regional plan, Development Plan, Town Planning Scheme, Neighbourhood plan; Types of Development plans: Master Plan, City Development Plan, and Structure Plan

UNIT IV

Various types of civic surveys for DP - demographic, housing, land use, Water Supply & sanitation, etc., planning agencies for various levels of planning. Their organization

and purpose (CIDCO-MHADA-MIDC, MMRDA/ PMRDA etc). Traffic transportation systems: urban road, hierarchy, traffic management, Intelligent Transport Systems.

UNIT V

Legislative mechanism for preparation of DP - MRTP Act 1966, UDPFI guidelines (for land use, infrastructure etc),SEZ, CRZ, Smart City Guidelines, Special townships, Land Acquisition Rehabilitation and Resettlement Act 2013, Application of GIS, GPS, remote sensing in planning.

Text Books:

1. Town Planning By G K Hiraskar --Town Planning By S Rangwala
2. Building Drawing and Built Environment- 5 Th Edition – Shah , Kale , Patki --- Planning Legislation By Koperdekar And Diwan.
3. Text Book of Town Planning ,G. K. Bandopadhyaya.
4. Climate Responsive Architecture – Arvind Krishnan.
5. Introduction To Landscape Architecture By Michael Laurie

Reference Books:

1. MRTP Act 1966
2. Manual Of Tropical Housing And Building By Koenigsbeger
3. Sustainable Building Design Manual
4. UDPFI Guidelines
5. "The Urban Pattern: City planning and design" by Gallion and Eisner.
6. Design of cities by Edmond bacon
7. LARR Act 2013
8. MoUD By GoI
9. NRSA

Programme:	**B. Tech**	**Semester :**	**VI**
Name of the Course:	**Geotechnical Engineering Lab-II**	**Course Code:**	**SOE-B-CE-23-607**
Credits :	**1**	**No of Hours :**	**2 Hrs/week**
Max Marks:	**50**		

Course Description

Geotechnical laboratory is to determine engineering properties of soil which are required for suitable design of foundations for any structure. The engineering properties include consolidation, compressibility, shear strength and bearing capacity of soil. By evaluating the properties of soil in the laboratory, students will be able to relate the concepts studied in the relevant theory course. Also students can utilize the knowledge of both theory and practical in the field application to real problems. In this laboratory both laboratory and in-situ experiments can be conducted. This laboratory course will help the students to understand the theoretical concepts learned in the course Geotechnical Engineering.

Course Outcomes: Students will able to:

CO	Course Outcomes
CO1	Knowledge of site specific field investigations including collection of soil samples for testing and observation of soil behaviour & Properties of the soil.
CO2	Be able to identify and classify soil based on standard geotechnical engineering practice.
CO3	Be able to perform laboratory compaction and in-place density tests for fill quality Control.

List of Experiments:

1. **Direct Shear Test**
   (i) On dry cohesionless/cohesive soil specimens (remoulded/unremoulded).
   (ii) Under Unconsolidated Undrained (UU) and Consolidated Undrained (CU) conditions.
2. **Unconfined Compression Test :**Determination of Unconfined Compressive Strength (UCS) of cohesive soils (remoulded/unremoulded).
3. **Triaxial Compression Test**
   (i) Unconsolidated Undrained (UU)
   (ii) Consolidated Undrained (CU)
   (iii) Consolidated Drained (CD)
4. **Laboratory Vane Shear Test:**Determination of shear strength of cohesive soils (remoulded/unremoulded).

5. **Standard Penetration Test (SPT)**: Study and interpretation of SPT data for soil characterization.
6. **One-Dimensional Consolidation Test** : Determination of coefficient of consolidation using Oedometer test.
7. **Plate Load Test :** Determination of bearing capacity and settlement characteristics of soil.
8. **Field Identification Tests:** Visual and manual identification of soil properties.
9. **Soil Sampling Methods:** Study of undisturbed and disturbed soil sampling techniques.
10. **Swelling Pressure Test:**Determination of swelling pressure of expansive soil (remoulded/unremoulded specimens).
11. **Relative Density Test:**Determination of density index (relative density) of cohesionless soils.

Recommended Books:

12. Respective Bureau of Indian Standard/ International Standard Codes of Practices.
13. Bowles, J.E. (2012). Engineering Properties of Soil and their Measurement, 4th Edition, McGraw Hill (India) Publishers.
14. Mandal, J.N. and Divshikar, D.G. (1994). Soil Testing in Civil Engineering, Oxford & IBH Publishing Company Pvt. Ltd., New Delhi, India.
15. Sivakugan, N., Arulrajah, A. and Bo, M.W. (2011). Laboratory Testing of Soils, Rocks and Aggregates.

Programme :	**B.Tech.**	**Semester :**	**VI**
Name of the Course :	**Environmental Engineering Lab**	**Course Code:**	**SOE-B-CE-23-609**
Credits :	**1**	**No of Hours :**	**2 Hrs/Week**
Max Marks :	**50**		

Course description:

This course provides fundamental knowledge and practical exposure to water quality analysis, wastewater treatment, and air pollution assessment**.**

Course Outcomes:

At the end of this course, the student will be able to:

CO Number	Course Outcome
CO1	Determine key physicochemical properties **of water, such as** pH, turbidity, acidity, alkalinity, chloride content, hardness, and total solids**.**
CO2	Measure Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), and Coagulant Dose**,** which are crucial for wastewater treatment.
CO3	Evaluate air pollution levels in various environments
CO4	Evaluate noise pollution levels in various environments
CO5	Perform laboratory experiments using standard environmental testing methods**.**

Syllabus

List of Experiments

(At least ten experiments are to be performed by every student)

1. Determination of pH and Turbidity of water sample.
2. Determination of Acidity and Alkalinity of water sample.
3. Determination of Chloride Content of water sample
4. Determination of Hardness of water sample.
5. Determination of DO Content of water sample.

6. Determination of Optimum Coagulant dose of water sample.
7. Determination of Total Solids in water sample.
9. Determination of BOD of water sample
12. Determination of air quality of nearby area.
13. Determination of noise level of the selected area.
14. Field visit of water treatment plant of a nearby area.

Recommended Books:

1. Garg, S.K. 'Environmental Engineering', Vol. I, Khanna Publications, New Delhi.
2. "Environmental Engineering – Vol. 1 & 2" – Howard S. Peavy, Donald R. Rowe, George Tchobanoglous

O. P. JINDAL UNIVERSITY
O. P. Jindal Knowledge Park, Punjipathra, Raigarh-496109
Department of Civil Engineering

OP Jindal University

Raigarh-Chhattisgarh

Scheme and Syllabus

of

B. Tech.

Civil Engineering

Batch: 2022-26

Programme Outcome (PO)

1. **Engineering Knowledge and Problem Analysis**: Apply the knowledge of engineering domain with adequate amalgamation of science, mathematics, and management to Identify, formulate, and critically analyze complex civil engineering problems.
2. **Modern tools and techniques for investigating complex problems** – Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
3. **Design and development of innovative systems**: Ability to provide design solutions for civil engineering problems and ability to design the processes that meet the needs regarding day to day working of Civil Engineering industry.
4. **Communication and Teamwork -** Develop skills to communicate effectively to diverse platforms and contribute meaningfully to different capacities as a leader, team member or individual.
5. **Project management and finance**: Develop and apply knowledge of engineering, management, and finance principles to handle a project in a multidisciplinary environment.
6. **Life-long learning**: Acquire fundamental knowledge for lifelong learning to participate in the extensive context of socio-technological change in civil engineering as a self-directed member and a leader.
7. **Ethics and citizenship**: Apply ethical principles and commit to professional ethics, norms, and responsibilities of the engineering practice; and act with informed awareness to participate in civic life activities.
8. **Society, Sustainability and Environment**: Understand the impact of various solutions in the context of societal, economical, health, safety legal and environmental impact for sustainable development.

Programme Specific Outcome (PSO)

PSO_1: Design and develop infrastructural facility using concepts of Mathematics, Civil Engineering and other related disciplines to meet end users' objectives.

PSO_2: Test and analyze the quality of various civil engineering materials and to integrate the same to assure quality in construction.

PSO_3: Ensure the holistic growth through the awareness of effective communication, ethical responsibilities and physical/mental fitness.

PSO_4: Build a solid foundation in the domain of Civil Engineering for developing analytical, technical, professional & management skills

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Course Structure for B.Tech Civil Engineering
(Session 2022-26)

Credit Distribution

Semester	Credit
1st	24
2nd	22
3rd	25
4th	25
5th	24
6th	24
7th	21
8th	21
Total	186

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Department of Civil Engineering

Civil Engineering
L: Lecture, T: Tutorial, P: Practical, C: Credit

Scheme of Teaching and Examination
B. Tech (Civil Engineering)

Academic Semester III

S. No.	Subject Code	Board of Study	SUBJECT	Periods per week			Scheme of Examination and Marks				Credit L+(T+P)/2 (L+P+T)
				L	T	P	PRE**		ESE*	Total Marks	
							Mid Sem	TA			
1	SOE-B-CE301	CIVIL	Surveying-I	4	0	0	30	20	50	100	4
2	SOE-B-CE302	CIVIL	Strength of Materials	4	0	0	30	20	50	100	4
3	SOE-B-CE303	CIVIL	Introduction to Python	3	0	0	30	20	50	100	3
4	SOE-B-MA301	MATH	Engineering Mathematics-III	4	0	0	30	20	50	100	4
5	SOE-B-CE304	CIVIL	Fluid Mechanics	4	0	0	30	20	50	100	4
6	SOE-B-CE305	CIVIL	Disaster Management(Online)	1	0	0	15	10	25	50	1
7	SOE-B-CE306	CIVIL	Surveying Lab	0	0	2	0	30	20	50	1
8	SOE-B-CE307	CIVIL	Fluid Mechanics lab	0	0	2	0	30	20	50	1
9	SOE-B-CE308	CIVIL	Civil Engineering Drawing Lab (Autocad based)	0	0	2	0	30	20	50	1
10	SOE-B-CE309	CIVIL	***Certificate Coarse on (MOOCs/NPTEL)	2	0	0	0	0	50	50	2
			TOTAL	**22**	**0**	**6**	**165**	**200**	**385**	**750**	**25**

* End Semester Examination
** Progress Review Examination
***Certificate Coarse on MOOCs/NPTEL: Students required to enroll for the course (Minimum 8 weeks) approved by department of civil engineering and submit the certificate of completion. The students who failed to score the desired marks as per minimum passing criteria of MOOC shall be required to appear for end sem examination of the course conducted by OPJU. For backlog students in this course examination will be conducted by OPJU.

O. P. JINDAL UNIVERSITY

O. P. Jindal Knowledge Park, Punjipathra, Raigarh-496109

Department of Civil Engineering

L: Lecture, T: Tutorial, P: Practical, C: Credit

Scheme of Teaching and Examination
B.Tech (Civil Engineering)

Academic Semester IV

S. No.	Subject Code	Board of Study	SUBJECT	Periods per week			Scheme of Examination and Marks				Credit L+(T+P) /2
				L	T	P	PRE**		ESE *	Total Marks	(L+T+P)
							Mid Sem	TA			
1	SOE-B-CE401	CIVIL	Theory of Structures- I	4	0	0	30	20	50	100	4
2	SOE-B-CE402	CIVIL	Engineering Hydrology	4	0	0	30	20	50	100	4
3	SOE-B-CE403	CIVIL	Transportation Engineering-I	4	0	0	30	20	50	100	4
4	SOE-B-MA401	MATH	Numerical Methods and Computing	3	0	0	30	20	50	100	3
5	SOE-B-CE404	CIVIL	Surveying-II	4	0	0	30	20	50	100	4
6	SOE-B-CE405	CIVIL	Theory of Structures Lab (STAAD Pro based)	0	0	2	0	30	20	50	1
7	SOE-B-CE406	CIVIL	Material Testing Lab And Studio	0	0	2	0	30	20	50	1
8	SOE-B-CE407	CIVIL	Transportation Engineering Lab	0	0	2	0	30	20	50	1
9	SOE-B-CE408	HUMANITIES	Professional Development	2	0	0	0	30	20	50	2
10	SOE-B-CE409	CIVIL	***Certificate Coarse on MOOCs/NPTEL	1	0	0	15	10	25	50	1
			TOTAL	**22**	**0**	**6**	**150**	**220**	**380**	**750**	**25**

* End Semester Examination

** Progress Review Examination

***Certificate Coarse on MOOCs/NPTEL: Students required to enroll for the course (Minimum 4 weeks) approved by department of civil engineering and submit the certificate of completion. The students who failed to score the desired marks as per minimum passing criteria of MOOC shall be required to appear for end sem examination of the course conducted by OPJU. for backlog students in this course examination will be conducted by OPJU.

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SEMESTER V

S. No.	Subject Code	Board of Study	SUBJECT	Periods per week			Scheme of Examination and Marks				Credit L+(T+P)/2
				L	T	P	PRE**		ESE*	Total Marks	(L+P+T)
							Mid Sem	TA			
1	SOE-B-CE501	CIVIL	Theory of Structures –II	3	0	0	30	20	50	100	3
2	SOE-B-CE502	CIVIL	Structural Engineering Design-I	3	0	0	30	20	50	100	3
3	SOE-B-CE503	CIVIL	Geotechnical Engineering-I	3	0	0	30	20	50	100	3
4	SOE-B-CE504	CIVIL	Transportation Engineering-II	3	0	0	30	20	50	100	3
5	SOE-B-CE505	CIVIL	Concrete Technology	3	0	0	30	20	50	100	3
6	SOE-B-CE506	CIVIL	Concrete Technology Lab	0	0	4	0	30	20	50	2
7	SOE-B-CE507	CIVIL	Structural Engineering Design-I Lab	0	0	4	0	30	20	50	2
8	SOE-B-CE508	CIVIL	Geotechnical Engineering-I Lab	0	0	4	0	30	20	50	2
9	SOE-B-CE509	CIVIL	Seminar On Industrial Training	1	0	0	0	25	25	50	1
10	SOE-B-CE510	CIVIL	***Design Thinking (online)	2	0	0	15	15	20	50	2
TOTAL				**18**	**0**	**12**	**165**	**230**	**355**	**750**	**24**

* End Semester Examination

** Progress Review Examination

***Certificate Coarse on MOOCs/NPTEL: Students required to enroll for the course Design Thinking (Minimum 4 weeks) approved by department of civil engineering and submit the certificate of completion. The students who failed to score the desired marks as per minimum passing criteria of MOOC shall be required to appear for end sem examination of the course conducted by OPJU. For backlog students in this course examination will be conducted by OPJU.

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SEMESTER VI

S. No.	Subject Code	Board of Study	SUBJECT	Periods per week			Scheme of Examination and Marks				Credit L+(T+P)/2 (L+T+P)
				L	T	P	PRE**		ESE*	Total Marks	
							Mid Sem	TA			
1	SOE-B-CE601	CIVIL	Structural Engineering Design-II	3	0	0	30	20	50	100	3
2	SOE-B-CE602	CIVIL	Geotechnical Engineering-II	3	0	0	30	20	50	100	3
3	SOE-B-CE603	CIVIL	Environmental Engineering I	3	0	0	30	20	50	100	3
4	SOE-B-CE604	CIVIL	Construction Planning and Management	3	0	0	30	20	50	100	3
5	SOE-B-CE605(1-9)	CIVIL	Professional Elective -I (**CIE Annexure - I**)	3	0	0	30	20	50	100	3
6	SOE-B-CE606	CIVIL	Structural Engineering Design-II Lab	0	0	4	0	30	20	50	2
7	SOE-B-CE607	CIVIL	Geotechnical Engineering-II Lab	0	0	4	0	30	20	50	2
8	SOE-B-CE608	CIVIL	Environmental Engineering Lab	0	0	4	0	30	20	50	2
9	SOE-B-CE609	CIVIL	Professional Development	1	0	0	0	25	25	50	1
10	SOE-B-CE610	CIVIL	Microsoft Project (MS Project)	2	0	0	15	15	20	50	2
TOTAL				**18**	**0**	**12**	**165**	**230**	**355**	**750**	**24**

Professional Elective-I (CIE Annexure - I)

Sr. No	Courses	Name of the Courses
1	SOE-B-CE605(1)	Design of Bridge Structures
2	SOE-B-CE605(2)	Traffic Engineering
3	SOE-B-CE605(3)	Solid Waste Management
4	SOE-B-CE605(4)	Computer Methods in Structural Analysis
5	SOE-B-CE604(5)	Maintenance, Repair and Rehabilitation of Civil Engineering Structures (MRCS)
6	SOE-B-CE605(6)	Remote Sensing and GIS in Civil Engineering
7	SOE-B-CE605(7)	Urban Infrastructure
8	SOE-B-CE605(8)	Town Planning
9	SOE-B-CE605(9)	Systems Approach in Civil Engineering

* End Semester Examination

** Progress Review Examination

B. Tech in Civil Engineering (VII- Semester)

S. No.	Subject Code	Board of Study	SUBJECT	Periods per week			Scheme of Examination and Marks				Credit L+(T+P)/2
				L	T	P	PRE		ESE	Total Marks	
							Mid Sem	TA			
1	SOE-B-CE701	Civil	Pre-stressed Concrete Structures	3	0	0	30	20	50	100	3
2	SOE-B-CE702	Civil	Water Resources Engineering I	3	0	0	30	20	50	100	3
3	SOE-B-CE703	Civil	Software application for civil engineering	1	0	2	0	30	20	50	2
4	SOE-B-CE704	Civil	Research Internship /Industry Internship (12- 14 Weeks)	0	0	20	0	125	125	250	10
5	SOE-B-CE705	Civil	Professional Elective II	2	0	0	15	10	25	50	2
6	SOE-B-CE706	Civil	Noncredit mandatory course(MOOCS)	-	-	-	-	-	-	-	-
7	SOE-B-HUM701	HUM	Professional Development	0	0	2	0	15	10	25	1
			TOTAL	**9**	**0**	**24**	**75**	**220**	**280**	**575**	**21**

Professional Elective- II (Annexure-II)

S.N	Subject Code	Courses
1.	SOE-B-CE705 (1)	Air Pollution & Control
2.	SOE-B-CE705 (2)	Ecology and Sustainable Development
3.	SOE-B-CE705 (3)	Safety in Construction Industry

B. Tech in Civil Engineering (VIII- Semester)

S. No.	Subject Code	Board of Study	SUBJECT	Periods per week			Scheme of Examination and Marks				Credit L+(T+P)/2
				L	T	P	PRE		ESE	Total Marks	
							Mid Sem	TA			
1	SOE-B-CE801	Civil	Water Resources Engineering II	4	0	0	30	20	50	100	3
2	SOE-B-CE802	Civil	Professional Practice	4	0	0	30	20	50	100	4
3	SOE-B-CE803(1-7)	Civil	Professional Elective III (Annexure –III)	3	0	0	30	20	50	100	4
4	SOE-B-CE804	Civil	Major Project	0	0	20	0	150	100	250	10
			TOTAL	**11**	**0**	**20**	**90**	**210**	**250**	**550**	**21**

Professional Elective- III(Annexure-III)

S.N	Subject Code	Courses
1.	SOE-B-CE803 (1)	Design of Earthquake Resistant Buildings
2.	SOE-B-CE803 (2)	Transportation Planning and Management
3.	SOE-B-CE803 (3)	Quality Control and Assurance in Construction
4.	SOE-B-CE803 (4)	Modern Construction Materials & Methods
5.	SOE-B-CE803 (5)	Advanced Reinforced Concrete Design
6.	SOE-B-CE803 (6)	Industrial Waste Management
7.	SOE-B-CE803 (7)	Foundation Engineering

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DETAILED SYLLABUS

VII- Semester

B. Tech in Civil Engineering

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Program:	**B.Tech.**	**Semester :**	**VII**
Name of the Course :	**Water Resources Engineering I**	**Course Code:**	**SOE-B-CE702**
Credits :	**3**	**No of Hours :**	**3 Hours/week**
Max Marks :	**100**		

Course Description

This course provides an in-depth understanding of water resources engineering principles, including hydrology, hydraulics, irrigation, and water resource management. Students will learn about surface and groundwater hydrology, water distribution systems, and flood control measures, along with modern techniques in water resources planning and management.

Course Outcomes

At the end of this course, the student will be able to:

1. To understand basic concepts of irrigation & water requirement of crop
2. To understand the concept of design of canal
3. To learn about water logging
4. To understand the concept of river training
5. To understand concepts of reservoir planning.

Syllabus

- **Unit-1: Methods of Irrigation and Water Requirements of crops**

  Need for Irrigation ,Soil-Water-Crop relationship, Methods of Irrigation, Water Requirement of Crops: Introduction, Water requirement of crop, quantity of water for irrigation, consumptive use of water or evapo-transpiration, crop season and crops of India, crop period and base period, delta, duty of water, relationship between delta and base period , Factors affecting duty, Methods of improving duty, Intensity of Irrigation, Irrigation requirement of crop.

  Unit-2: Canal Irrigation

  Classification of canal, parts of canal irrigation system, canal alignment, lay-out of canal system, typical canal cross section, command areas, losses in irrigation systems, and water requirement of irrigation channels. Design of Stable Channels in Alluvium: Introduction, Kennedy's silt theory, Garret's diagram, Lacey's Theory, Lacey's regime equations, Lacey's shock theory, Design of channels by Kennedy's and Lacey's theories.

Unit-3: Water Logging and its Control

Causes and ill effects of water logging, prevention and control, reclamation of water logged and saline lands, surface drainage. Design of Lined Channels: Introduction, benefits of lining, types of lining, economics of lining, procedure and design of lined canal.

Unit-4: River behaviour, Control and Training

Objects, river characteristics, river patterns, classification of river training works, methods of River training embankments, bank protection, spur, cutoff, pitched island, river diversion, meandering causes and parameter.

Unit-5: Reservoir Planning

Introduction, Type of reservoirs, storage zones of a reservoir, mass curve and demand curve, determination of reservoir capacity, determination of reservoir capacity, environmental effects of reservoirs.

Text Books:

1. Garg, S.K., *Irrigation Engineering and Hydraulic Structures*, Khanna Publishers.
2. Subramanya, K., *Engineering Hydrology*, Tata McGraw-Hill.

Reference Books:

1. Raghunath, H.M., *Hydrology: Principles, Analysis, and Design*, New Age International.
2. Linsley, R.K., Kohler, M.A., & Paulhus, J.L.H., *Hydrology for Engineers*, McGraw-Hill.
3. Chadha, D.K., *Water Resources Engineering*, Standard Publishers.

Programme:	**B.Tech.**	**Semester:**	**VII**
Name of the Course:	**Software Applications in Civil Engineering**	**Course Code:**	**SOE-B-CE703**
Credits:	**2**	**No of Hours:**	**2 Hrs/week**
Max Marks:	**50**		

Course Description

This course provides hands-on experience with industry-relevant civil engineering software for structural analysis, BIM, numerical computing, project management, and GIS. Students will learn to apply digital tools for design, analysis, planning, and decision-making in civil engineering projects.

Course Outcomes:

Students will be able to

CO Number	Course Outcome
CO1	Analyze and design structures using ETABS and STAAD.Pro.
CO2	Develop 3D building models, detailing, and quantity estimation using Revit.
CO3	Solve civil engineering problems using MATLAB.
CO4	Plan and schedule projects using Primavera/MS Project.
CO5	Apply GIS for spatial analysis and infrastructure planning.

Syllabus:

Unit-I: Introduction to Civil Engineering Software: Overview of the role of software in civil engineering. Introduction to commonly used software for structural analysis, design, drafting, and project management. Importance of automation and digital tools in modern civil engineering practices.

Unit-II: Structural Analysis and Design using ETABS & STAAD.Pro: Fundamentals of structural modeling, load application, and analysis using ETABS and STAAD.Pro. Design of beams, columns, and slabs as per IS codes. Interpretation of results and report generation. Introduction to seismic and wind load analysis.

Unit-III: Building Information Modeling (BIM) using Revit: Introduction to BIM and its significance. 3D modeling of buildings using Revit. Structural detailing, reinforcement modeling, and quantity estimation. Coordination of different building components and clash detection.

UNIT- IV: Numerical Computing and Simulation using MATLAB

Introduction to MATLAB for civil engineering applications. Matrix operations, numerical methods, and simulation techniques. Structural and geotechnical problem-solving

using MATLAB scripts and toolboxes. Basics of computational fluid dynamics (CFD) for water resources engineering..

UNIT- V: Project Planning, Management, and GIS Applications

Application of Primavera/MS Project for scheduling and resource management. Basics of Geographic Information Systems (GIS) and its role in civil engineering. Introduction to QGIS/ArcGIS for spatial analysis, mapping, and infrastructure planning. Case studies on real-world applications..

Text Books:

- Krishnan, S. – Structural Analysis and Design Using ETABS and SAP2000 (CSI Publications, 2020).
- Chandrupatla, T. R. & Belegundu, A. D. – Introduction to Finite Elements in Engineering (Pearson, 2019).
- Eastman, C., Teicholz, P., Sacks, R., & Liston, K. – BIM Handbook: A Guide to Building Information Modeling (Wiley, 2018).

Reference Books:

- Hughes, H. & Hughes, D. – Building Information Modeling (BIM) with Autodesk Revit (Routledge, 2021).
- Kanti Mahato, J. – STAAD.Pro V8i for Structural Analysis and Design (BPB Publications, 2019).
- Chapra, S. C. & Canale, R. P. – Numerical Methods for Engineers (McGraw Hill, 2020).
- Kumar, S. – Geographic Information System (GIS) for Civil Engineering (New Age Publishers, 2019).
- Heldman, K. – Project Management JumpStart (Wiley, 2021) – for Primavera/MS Project.

Programme :	**B. Tech.**	**Semester :**	**VII**
Name of the Course :	**Air Pollution and Control**	**Course Code:**	**SOE-B-CE-705 (01)**
Credits :	**2**	**No of Hours :**	**2 Hrs/Week**
Max Marks :	**50**		

Course description:

This course designed to provide a comprehensive understanding of the causes and effects of air pollution, and the management measures and engineering technologies available for its control.

Course Outcomes:

At the end of this course, the student will be able to:

CO Number	Course Outcome
CO1	Identify various air pollutants and their sources.
CO2	Understand principles and techniques for air pollution control, including source control methods.
CO3	Understand the fundamentals of air quality modeling and its applications.
CO4	Analyze the effects of indoor pollutants on human health and indoor environments.
CO5	Understand Global Air Pollution Issues and Their Impacts

Syllabus:

UNIT I:

History of air pollution, Air pollution definition and types, Air pollutant, Ambient Air Pollution Monitoring, Stack Monitoring, Techniques & instrumentation, Experimental analysis, Gaseous & particulates, Standards & limits.

Unit-II:

Air pollution effects: On living and non-living beings, Principles of controls, Source control, Air pollution meterology.

Unit III

Air quality modelling, Fundamentals of air quality modelling, Deterministic approach, Gaussian Plume Dispersion Model, Deterministic models, Statistical models, Physical models, Limitation of models.

Unit-IV:

Indoor air pollution, Sources of indoor air pollution, Type and effect of indoor air pollution, Indoor air quality modelling. Types of modelling.

Unit-V:

Problems of air pollution, Global Warming, Greenhouse effect, Effects of Global Warming, Photochemical Smog, Effects on human health, Ozone Layer Depletion, Acid Rain.

Text Books:

1. Rao, M.N. and Rao, H. V. N., 1993. Air Pollution, Tata Mc-Graw Hill, New Delhi.
2. Murty, B. P., 2004. Environmental Meteorology, I.K. International Pvt. Ltd., New Delhi.
3. Nevers, N.D. 2000. Air Pollution Control Engineering, Second Edition, Pub., McGraw Hill, New York.
4. Cheremisinoff, N.P., 2002. Handbook of Air Pollution Prevention and Control, Pub., Butterworth-Heinemann, Elsevier Science, USA.

Reference Books:

1. C. D. Cooper and F.C. Alley, Air Pollution Control: A Design Approach, McGraw Hill
2. L. K. Wang, Air pollution control Engineering, Humana Press Inc., U.S.; 2Rev Ed edition, 2004

Program:	**B. Tech.**	**Semester :**	**VII**
Name of the Course :	**Ecology and Sustainable Development**	**Course Code:**	**SOE-B-CE705 (2)**
Credits :	**2**	**No of Hours :**	**2 Hours/week**
Max Marks :	**50**		

Course Description

This course provides an understanding of ecological principles and their applications in sustainable development. It covers topics such as ecosystems, biodiversity, environmental pollution, and sustainable resource management. The course emphasizes the role of civil engineering in promoting environmental sustainability through sustainable construction practices, green building techniques, and efficient resource utilization.

Course Outcomes

CO No.	Course Outcome
CO1	Understand the fundamental concepts of ecology and environmental sustainability.
CO2	Analyze the impact of civil engineering activities on the environment.
CO3	Apply ecological principles to sustainable resource management and pollution control.
CO4	Evaluate sustainable construction practices and green building techniques.
CO5	Develop strategies for sustainable development and environmental conservation.

Syllabus

UNIT I: Fundamentals of Ecology

- Definition and scope of ecology
- Components of the environment
- Structure and function of ecosystems
- Energy flow and nutrient cycles
- Biodiversity and its conservation

UNIT II: Environmental Pollution and Control

- Air, water, and soil pollution
- Sources, effects, and control measures of pollution
- Waste management strategies
- Environmental impact assessment (EIA)

UNIT III: Sustainable Development and Resource Management

- Principles of sustainable development
- Renewable and non-renewable resources
- Water conservation and rainwater harvesting
- Sustainable land-use planning
- Climate change and its implications

UNIT IV: Green Building and Sustainable Construction

- Concept of green buildings
- Sustainable construction materials
- Energy-efficient building design
- Waste reduction in construction
- Role of LEED and GRIHA rating systems

UNIT V: Policies and Case Studies in Sustainability

- Global and national policies on sustainability
- Role of civil engineers in sustainable development
- Case studies on successful sustainable development projects
- Future challenges and emerging trends in sustainability

Text Books:

1. Odum, E.P., *Fundamentals of Ecology*, Cengage Learning.
2. Rao, P.V., *Textbook of Environmental Engineering*, Prentice-Hall India.

Reference Books:

1. Sharma, P.D., *Ecology and Environment*, Rastogi Publications.
2. Rittmann, B.E., & McCarty, P.L., *Environmental Biotechnology: Principles and Applications*, McGraw-Hill.
3. Kibert, C.J., *Sustainable Construction: Green Building Design and Delivery*, Wiley.

Program:	**B.Tech.**	**Semester :**	**VII**
Name of the Course :	**Safety in Construction Industry**	**Course Code:**	**SOE-B-CE705 (3)**
Credits :	**2**	**No of Hours :**	**2 Hours/week**
Max Marks :	**50**		

Course Description

This course provides an in-depth understanding of safety principles and practices in the construction industry. It covers safety laws, hazard identification, risk assessment, accident prevention, and emergency response procedures. The course emphasizes the importance of safety management, compliance with regulations, and the application of best practices to minimize workplace hazards and ensure a safe working environment.

Course Outcomes

CO No.	Course Outcome
CO1	Understand fundamental safety principles and their importance in construction.
CO2	Identify potential hazards and apply risk assessment techniques.
CO3	Implement safety measures and accident prevention strategies.
CO4	Interpret construction safety laws and regulations.
CO5	Develop and apply emergency response and safety management plans.

Syllabus

UNIT I: Introduction to Construction Safety

- Importance of safety in construction
- Common hazards in construction sites
- Roles and responsibilities of stakeholders in safety management
- Safety culture and behavior-based safety

UNIT II: Safety Regulations and Standards

- Occupational Safety and Health Administration (OSHA) standards
- National Building Code (NBC) and safety guidelines
- Legal aspects and liabilities in construction safety
- International safety standards (ISO, OHSAS)

UNIT III: Hazard Identification and Risk Management

- Types of hazards: physical, chemical, biological, and ergonomic
- Risk assessment methodologies
- Personal Protective Equipment (PPE)
- Safety in handling equipment and materials

UNIT IV: Accident Prevention and Control Measures

- Causes and types of construction accidents
- Safety in excavation, scaffolding, and working at heights
- Fire prevention and control
- First aid and emergency response planning

UNIT V: Safety Management Systems and Best Practices

- Safety audits and inspections
- Safety training and awareness programs
- Safety documentation and reporting
- Case studies on construction safety failures and best practices

Text Books:

1. Reese, C.D., *Occupational Health and Safety Management: A Practical Approach*, CRC Press.
2. Hinze, J., *Construction Safety*, Prentice Hall.

Reference Books:

1. Goetsch, D.L., *Construction Safety and the OSHA Standards*, Pearson.
2. Hughes, P., & Ferrett, E., *Introduction to Health and Safety in Construction*, Routledge.
3. Stellman, J.M., *Encyclopaedia of Occupational Health and Safety*, ILO Publications.

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DETAILED SYLLABUS

VIII- Semester

B. Tech in Civil Engineering

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Program:	**B.Tech.**	**Semester :**	**VIII**
Name of the Course :	**Water Resources Engineering-II**	**Course Code:**	**SOE-B-CE801**
Credits :	**4**	**No of Hours :**	**4 Hours/week**
Max Marks :	**100**		

Course Description

This course provides an in-depth understanding of water resources engineering principles, including hydrology, hydraulics, irrigation, and water resource management. Students will learn about surface and groundwater hydrology, water distribution systems, and flood control measures, along with modern techniques in water resources planning and management.

Course Outcomes

At the end of this course, the student will be able to:

6. To understand about different types of dam and its design
7. To understand the concept of spillway
8. To learn about diversion headwork
9. To understand different types of regulation work
10. To understand concepts cross-drainage work

Syllabus

- **Unit-1: Unit-1: Dams**

Types of Dams, Suitability of a type of dam, Gravity dams – Forces acting on dams, failure of dams and criteria for structural stability, Overturning, Compression or crushing, tension, sliding, principal and shear stress, stability analysis, Elementary profile of a gravity dam, High and low gravity dams, Profile from practical considerations, Design considerations,

Unit-2: : Spillways and Energy Dissipaters

Introduction, essential requirements of a spillway, spillway capacity, components, Types of spillways Energy Dissipation below spillways, Types of Energy dissipater, Hydraulic jump as energy dissipater, Stilling basins, design of stilling basin, USBR stilling basins, standard basins

- **Unit-3: Diversion Headworks**
- Introduction, Types of diversion works, location and components, Weir and Barrage, Effect of construction of weir on the river regime, Causes of failures of Weirs on permeable foundations, their remedies, Bligh's creep theory .

Unit-4: Regulation Work

Introduction, Definition of falls, necessity and location of falls, Design and comparative study of the main types of falls.

Unit-5: Cross Drainage Works

Introduction, types, suitability, design of various types of C-D Works, Aqueduct, Syphon Aqueduct, Super Passage, Syphon, level crossing, inlets and outlets

Text Books:

3. Garg, S.K., *Irrigation Engineering and Hydraulic Structures*, Khanna Publishers.
4. Subramanya, K., *Engineering Hydrology*, Tata McGraw-Hill.

Reference Books:

4. Raghunath, H.M., *Hydrology: Principles, Analysis, and Design*, New Age International.
5. Linsley, R.K., Kohler, M.A., & Paulhus, J.L.H., *Hydrology for Engineers*, McGraw-Hill.
6. Chadha, D.K., *Water Resources Engineering*, Standard Publishers.

Program:	**B.Tech.**	**Semester :**	**VIII**
Name of the Course :	**Professional Practice**	**Course Code:**	**SOE-B-CE802**
Credits :	**4**	**No of Hours :**	**4 Hours/week**
Max Marks :	**100**		

Course Description

This course provides a comprehensive understanding of estimation, costing, and valuation in civil engineering projects. It covers methods of estimating quantities, cost analysis, rate analysis, and valuation of properties. Students will gain practical knowledge in preparing estimates, bill of quantities, and tendering procedures essential for effective project execution.

Course Outcomes

CO No.	Course Outcome
CO1	Understand the basic principles and techniques of estimating, costing, and valuation.
CO2	Prepare detailed and approximate estimates for various civil engineering works.
CO3	Perform rate analysis for different construction items and materials.
CO4	Apply tendering procedures and contract management principles.
CO5	Evaluate property valuation and depreciation for real estate and infrastructure projects.

Syllabus

UNIT I: Introduction to Estimation and Costing

- Importance and purpose of estimation and costing
- Types of estimates: Preliminary, detailed, and approximate estimates
- Methods of estimating: Centre line, long and short wall method
- Units of measurement and standard schedule of rates

UNIT II: Detailed Estimation and Bill of Quantities

- Preparation of detailed estimates for buildings, roads, and other structures
- Quantity surveying and bill of quantities (BOQ)
- Abstracting and billing procedures
- Cost estimation of materials, labour, and machinery

UNIT III: Rate Analysis and Specifications

- Purpose and importance of rate analysis
- Factors affecting rate analysis (labor, materials, overheads, etc.)
- Rate analysis for different items of work: Earthwork, concrete, brickwork, plastering, flooring, etc.
- Preparation of standard specifications for construction materials and works

UNIT IV: Tendering and Contract Management

- Types of contracts and their suitability
- Tendering process and preparation of tender documents
- Evaluation of tenders and selection of contractors
- Contract management, arbitration, and dispute resolution

UNIT V: Valuation and Depreciation

- Introduction to valuation and its importance
- Methods of property valuation: Rental method, land and building method, valuation based on market price
- Depreciation and its calculation methods
- Case studies on valuation of real estate properties

Text Books:

1. Dutta, B.N., *Estimating and Costing in Civil Engineering*, UBS Publishers.
2. Chakraborti, M., *Estimating, Costing, Specification and Valuation in Civil Engineering*, S. Chand & Company.

Reference Books:

1. Rangwala, S.C., *Estimating, Costing and Valuation*, Charotar Publishing House.
2. Kohli, D.D., & Kohli, R.C., *A Textbook of Estimating and Costing (Civil Engineering)*, S. Chand.
3. Birdie, G.S., *Textbook of Estimating and Costing*, Dhanpat Rai Publishing.

Programme:	**B.Tech.**	**Semester:**	**VIII**
Name of the Course:	**Design of Earthquake Resistant Building (PE-II)**	**Course Code:**	**SOE-B-CE803(1)**
Credits:	**3**	**No of Hours:**	**3Hrs/week**
Max Marks:	**100**		

Course Description:
This course gives Introduction to Earthquake basics and their effects on the nature and mainly to the building. Principally aimed to introduce the students about various methods of designing the earthquake resistant designs with the help of standard codes and the designs.

COURSE OUTCOMES:
Students will be able to**:**

CO Number	Course Outcome
CO1	The students will gain an experience in the implementation of Earthquake Engineering on engineering concepts which are applied in field Structural Engineering.
CO2	The students will get a diverse knowledge of earthquake engineering practices applied to real life problems
CO3	The students will learn to understand the theoretical and practical aspects of earthquake engineering along with the planning and design aspects.

Syllabus:

UNIT- I
Basics of Seismology: Earth and its interior, Plate Tectonics, Convection Currents, the Earth quake, Inter Plate Earthquake (Convergent Boundaries, Divergent Boundaries and Transform Boundaries), Intra Plate Earthquake (Faults and Types of Faults), Seismic Waves, Basic Terminology, Measuring UNIT-s and Instruments.

UNIT- II
Fundamentals of Earthquake Vibrations of Structures: Equation of Motion (By Newton's Law and by D'Alembert's Principle), Degrees of Freedom, Simplified Single Degree of Freedom, Mathematical Modelling. Building characteristics – Mode shape and fundamental period, building frequency and ground period, damping, ductility, seismic weight.

UNIT- III

Equation of Motion: Free Vibration for Damped and Un damped System (Single Degree of Freedom System), Equation of Motion for Forced Vibration for Damped and Un damped System (Single Degree of Freedom System), Definitions of basic problems in dynamics, static versus dynamic loads, different types of dynamic loads

UNIT- IV

Design forces: buildings Introduction; Equivalent static method; Mode superposition technique; Dynamic in elastic time history analysis; Advantages and disadvantages of these methods; Determination of lateral forces as per IS 1893(Part 1) – Equivalent static method, Model analysis using response spectrum.

UNIT- V

Earthquake Load Analysis on Structures: Introduction to methods of Earthquake Load Analysis (Linear Static, Linear Dynamic, Non-Linear Static, Non Linear Dynamic), Analysis of Structure by Linear Static Method (Seismic Coefficient Method).

Text Books:

1. Earthquake resistant design of structures, Agarwal P and Shrikhande M, (2006), Prentice-Hall of India
2. IS: 1893 (Part-I) 2002, Criteria for Earthquake Resistant Design General Provision to Building.
3. IITK-BMTPC, Earthquake Tips “Learning Earthquake Design and Construction” - Murthy C.V.R., Building Material and Technology Promotion Council.

Reference Books:

1. Dynamics of Structures, Chopra A. K., (2007), Pearson, New Delhi
2. Mechanical Vibration, Pearson, Rao S S, (1999), New Delhi
3. IS: 1893 (Part-I) (2002), Criteria for Earthquake Resistant Design General Provision to Building
4. Seismic design of reinforced concrete and masonry buildings, Paulay T, Priestley M.J.N., (1991), John Wiley & Sons.
5. Earthquake Resistance Design of Structures, Duggal S. K., (2010), Oxford University Press, New Delhi

IVProgramme :	**B.Tech.**	**Semester :**	**VIII**
Name of the Course :	**Modern Construction Materials and Methods**	**Course Code:**	**SOE-B-CE803 (04)**
Credits :	**3**	**No of Hours :**	**3 Hrs/Week**
Max Marks :	**100**		

Course description:

This course gives Introduction about various properties of modern construction materials and methods.

Course Outcomes:

At the end of this course, the student will be able to:

CO Number	Course Outcome
CO1	To know the importance and areas of application of modern construction materials and methods

Syllabus:

UNIT I

Concretes: High strength and High performance concrete-Fiber Reinforced concrete. Composites: Plastics-Reinforced polymers-FRP-Celular cores.

UNIT II

Other Materials: Water proofing compounds-Non -weathering Materials-Flooring and Facade Materials.

UNIT III

Smart and Intelligent Materials: Brief outline and uses.

UNIT IV

Sub-structure Construction Techniques Box jacking -Pipe Jacking-Under Water Construction of diaphragm walls and basement caisson-sinking cofferdam-cable anchoring and grouting-driving diaphragm walls, sheet piles-laying operations for built up offshore system-shoring for deep cutting-Large reservoir, well points Dewatering and stand by Plant equipment for underground open excavation

UNIT V

Super Structure Construction Vacuum Dewatering of concrete Flooring-Concrete Paving Technology-Techniques of construction for continuous concreting operation in Tall

buildings of various shapes and Varying Sections-Launching Techniques-Suspended from work-erection techniques of tall structures, Large span Structures-Launching techniques for heavy decks in situ prestressing in high rise structures.

Text Books:

1. Civil Engineering Materials (2nd Edition) – Shan Somayaji (Prentice Hall Inc., 2001)
2. Materials for Civil and Construction Engineers – Mamlouk, M.S. and Zaniewski, J.P. (Prentice Hall Inc., 1999)

Reference Books:

1. Materials for Civil and Highway Engineers (4th Edition) – Derucher, K.Korfiatis. G. and Ezeldin, S. (Prentice Hall Inc., 1999)
2. High Performance Concrete – Aitkens (McGraw Hill, 1999)

O. P. JINDAL UNIVERSITY

O. P. Jindal Knowledge Park, Punjipathra, Raigarh-496109

Department of Civil Engineering

Programme :	**B.Tech.**	**Semester :**	**VIII**
Name of the Course:	**Advance Reinforced Design**	**Course Code:**	**SOE-B-CE-23-803(05)**
Credits :	**3**	**No of Hours :**	**3 Hrs/Week**
Max Marks :	**100**		

Course Description

This course designed to provide a comprehensive understanding of advanced reinforced concrete structures and its design.

Course Outcomes:

Students will be able to

CO Number	Course Outcome
CO1	Understand Effective span, bending moments and shear forces of span and Design criteria.
CO2	Understand curved Beams, torsional moments, and its design.
CO3	Understand different types of water tanks and its design.
CO4	Understand Analysis of multi-storey frames and its design.
CO5	Design deep beams.

Syllabus:

UNIT I:

Introduction, Effective span, Span/depth ratio, Bending moments and shear forces, Design examples.

Unit-II:

Curved Beams: Analysis of bending and torsional moments in circular beams, Moment in semi-circular beams supported on three columns, Design example.

Unit III

Types of overhead water tanks, Intz type tank, Design example of intz type of water tank, Conical or funnel shaped tank. Design example of funnel shaped over head tank.

Unit-IV:

Analysis of multi-storey frames, Methods of substitute frames, design examples, bending moments in column, Analysis of multi-storey frames subjected to horizontal forces, Design examples.

Unit-V:

Deep Beams: General features, Parameters influence design, Flexural bending stress, Shear stress in deep beams, I.S. Code provisions, Design examples.

Text Books:

1. Raju, K.N., 2016. Advanced Reinforced Concrete Design.
2. Varghese, P.C., 2010, Advanced Reinforced Concrete Design.

Reference Books:

1. Dayaratnam, P. and Sarah, P. 2017. Design of Reinforced Concrete Structure

Programme :	**B. Tech.**	**Semester :**	**VIII**
Name of the Course :	**Industrial Waste management**	**Course Code:**	**SOE-B-CE-803(06)**
Credits :	**3**	**No of Hours :**	**3 Hrs/Week**
Max Marks :	**100**		

Course Description:

This course provides a comprehensive understanding of industrial waste management, focusing on the sources, classification, treatment, and disposal methods of industrial wastes. The course emphasizes pollution prevention, resource recovery, and sustainable management strategies. Topics include environmental regulations, industrial waste characterization, physical, chemical, and biological treatment technologies, hazardous waste management, and waste minimization techniques.

Course Outcomes:

At the end of this course, the student will be able to:

CO Number	Course Outcome
CO1	Identify various sources and types of industrial waste.
CO2	Understand waste characterization and regulatory aspects.
CO3	Learn different treatment and disposal techniques for industrial waste.
CO4	Study the role of recycling and resource recovery in waste management.
CO5	Analyze case studies and industrial best practices for waste minimization.

Course Outcomes:At the end of this course, the student will be able to:

CO NumberCourse

Syllabus:

UNIT I: INTRODUCTION TO INDUSTRIAL WASTE MANAGEMENT:

Definition of industrial waste, sources and classification, hazardous and non-hazardous wastes, characterization of industrial wastes, physical, chemical, and biological properties. Effects of

improper waste disposal on human health and the environment. Overview of industrial waste regulations and guidelines.

UNIT II: WASTE GENERATION AND CHARACTERIZATION

Types of industrial waste – liquid, solid, gaseous, hazardous and non-hazardous. Waste quantification methods. Industrial waste audit and monitoring. Standards for effluent discharge and air emissions. Case studies of industrial sectors generating significant waste.

UNIT III: INDUSTRIAL WASTE TREATMENT TECHNOLOGIES

Overview of treatment methods – physical (screening, sedimentation, filtration), chemical (neutralization, coagulation, precipitation), and biological (aerobic and anaerobic digestion, biofilters). Advanced treatment methods – membrane separation, adsorption, oxidation. Handling and disposal of sludge. Case studies on treatment technologies in industries.

UNIT IV: WASTE MINIMIZATION AND RESOURCE RECOVERY

Principles of waste minimization. Cleaner production and pollution prevention strategies. Resource recovery techniques – reuse, recycling, energy recovery. Industrial symbiosis and circular economy approach. Life cycle assessment (LCA) of industrial waste. Case studies on sustainable industrial waste management practices.

UNIT V: DISPOSAL AND MANAGEMENT OF HAZARDOUS WASTE

Hazardous waste classification, handling, and transportation. Landfill disposal: site selection, design considerations, and leachate management. Secure landfills and hazardous waste incineration. Bioremediation and phytoremediation techniques. Industrial waste management policies and status in India. Cost analysis of industrial waste management systems.

Text Books:

Rao, M.N. & Datta, A.K., Waste Disposal in Engineering Landfills, Narosa Publishing House.
Eckenfelder, W.W., Industrial Water Pollution Control, McGraw Hill.

References:

CPHEEO, Manual on Hazardous Waste Management, Government of India.

Tchobanoglous, G., & Kreith, F., Handbook of Solid Waste Management, McGraw Hill.

O. P. Jindal University

Raigarh-Chhattisgarh

Scheme and Syllabus

of

M.Tech

Structural Engineering

Session- 2025-27

Programme Outcomes for Engineering Post Graduate Programme

PO_1: Disciplinary knowledge: Accomplish vertical expertise in chosen discipline and enhance ability to function in multidisciplinary domains.

PO_2: Research aptitude: Ability and aptitude to exercise research intelligence in investigations/ innovations and to communicate the findings in a clear, concise manner.

PO_3: Project management: Develop and apply knowledge of engineering and management principles to manage a project in a multidisciplinary environment.

PO_4: Ethics: Gain knowledge of ethical principles and commit to professional ethics

PO_5: Self-directed lifelong learning: Ability to identify appropriate resources and learn independently for projects, research etc. using online resources.

Programme Specific Outcome (PSO) for Engineering Post Graduate Programme

PSO_1: Design and develop infrastructural facility using concepts of Mathematics, Civil Engineering and other related disciplines to meet end users' objectives.

PSO_2: Test and analyze the quality of various civil engineering materials and to integrate the same to assure quality in construction.

PSO_3: Ensure the holistic growth through the awareness of effective communication, ethical responsibilities and physical/mental fitness.

PSO_4: Build a solid foundation in the domain of Civil Engineering for developing analytical, technical, professional & management skills

As per NEP Policy, HEIs can offer 3 Designs of PG

Designs of Postgraduate Programme & Components

1. **For 2-year PG:** Students entering 2-year PG after a 3-year UG program can choose to do
   (i) Only coursework in the third and fourth semesters or
   (ii) Coursework in the third semester and research in the fourth semester or
   (iii) Only research in the third and fourth semesters.

2. **For 1-year PG:** Students entering 1-year PG after a 4-year UG program can choose to do
   (i) Only coursework or
   (ii) Research or
   (iii) Coursework and research.

3. **5-year Integrated Programme (UG+PG):** At the PG level, the curricular component of a 5-year integrated program will be similar to that of the 2-year PG mentioned above.

Credit Distribution

a) For 1-year PG

Choice	Curricular Components	PG Programme (one year) for 4-yr UG (Hons/Hons. with Research) Minimum Credits			
		Course Level	Coursework	Research Thesis/Project/Patent	Total Credits
1	Coursework + Research	500	20	20	40
2	Coursework	500	40	-	40
3	Research	-	-	40	40

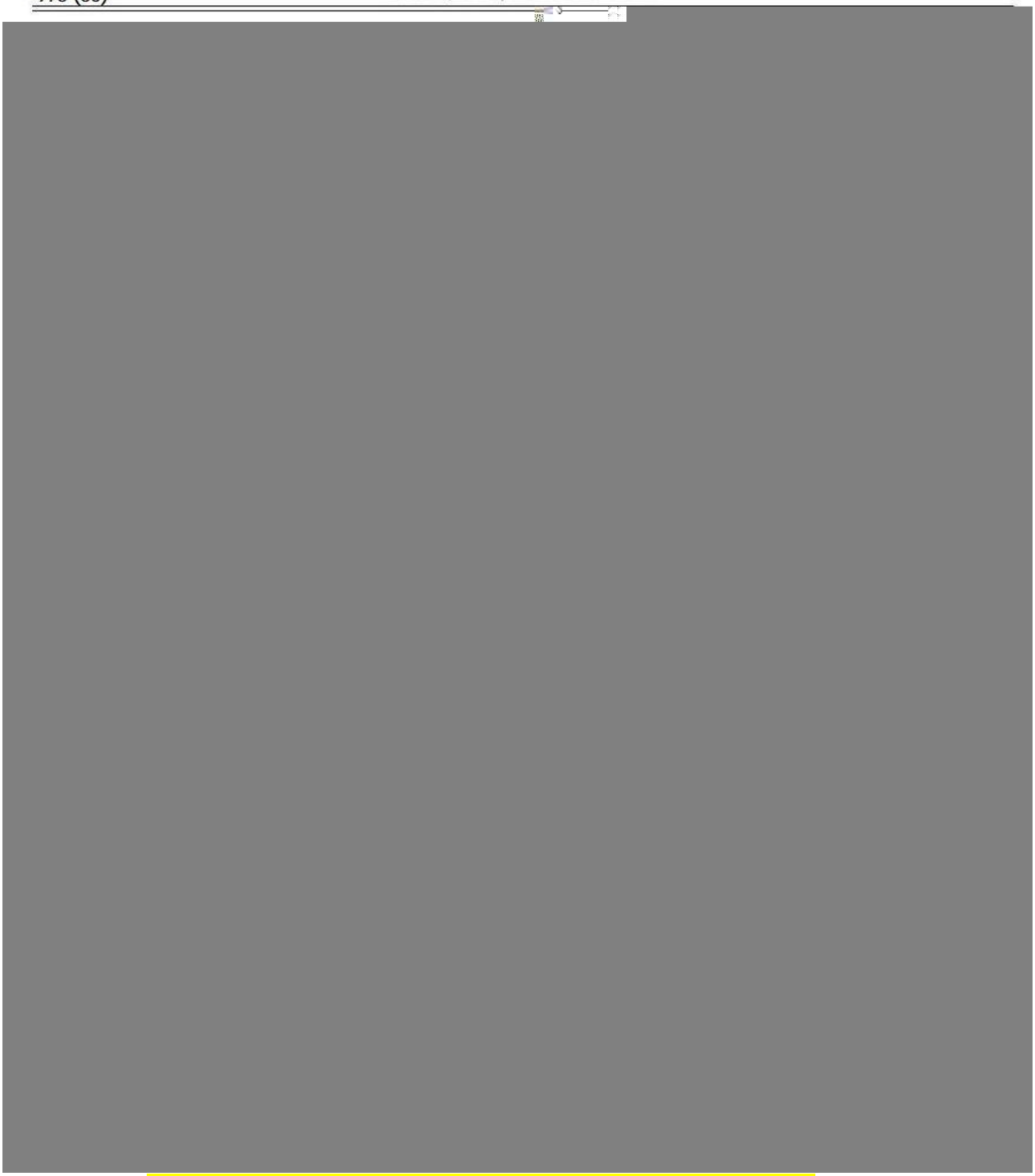
b) For 2-year PG

Choice	Curricular Components	Two-Year PG Programme (Generic and Professional) Minimum Credits			
		Course Level	Coursework	Research Thesis/Project/Patent	Total Credits
1_1st Y	PG Diploma	400	40	-	40
2_1st Y	1st Year (1st & 2nd Semester)	400 500	24 16	-	40
	Students who exit at the end of 1st year shall be awarded a **Postgraduate Diploma**				

1_2nd Y	2nd Year (3rd & 4th Semester)	Coursework + Research	500	20	20	40
2_2nd Y		Coursework	500	40	-	40
3_2nd Y		Research	-	-	40	40

All the above designs are for the PG courses such as M.A., M.Com., M.Sc.; etc. The entry criteria for M.Tech PG Course is given in Table 1 of OPJU Ordinance.

Table – 1
Qualification Type and Credit Requirements



Source: Approved NEP based ordinance no. 32_September 2024_OPJU

NEP Based Course Structure for M.Tech Structural Engineering (Civil Engineering) (Session 2025-27)

Semester	Core Courses	Professional Elective	Common Course	Industrial Training / Research Internship	Dissertation	Total Credits
I	16	3	1			20
II	13	3	4		3	20
Exit Point: For those who join 2-year PG programs, there shall only be one exit point. Students who exit at the end of 1st year shall be awarded a Postgraduate Diploma. The PG programs should include vocational courses relevant to the chosen discipline.						
III				8	12	20
IV					20	20
					Total	80
Students on exit shall be awarded a Master of Technology (in the Field of Study/ Discipline) after securing the requisite 80 credits on completion of Semester IV.						

M. Tech in (Structural Engineering)
Semester I

S. NO.	Subject Code	Subject	Periods per Week			Scheme of Examination Theory / Practical			Total Marks	Credit L+(T+P)/2
			L	T	P	MID	TA	ESE		
1	CE25-M-SE101	Theory of Plates and Shells	3	0	0	15	15	70	100	3
2	CE25-M-SE102	Advanced Solid Mechanics	3	0	0	15	15	70	100	3
3	CE25-M-SE103	Structural Dynamics	3	0	0	15	15	70	100	3
4	CE25-M-SE104	Matrix Methods in Structural Analysis	3	0	0	15	15	70	100	3
5	CE25-M-SE105 **(1-3)**	Program Elective **(Annexure -I)**	3	0	0	15	15	70	100	3
6	CE25-M-SE106	Structural Dynamics Lab	0	0	4	-	15	35	50	2
7	CE25-M-SE107	Matrix Method in Structural analysis Lab	0	0	4	-	15	35	50	2
8	FROM SOM	Introduction to Intellectual Property (Can run from MOOCs)	0	0	2	-	15	35	50	1
Total			**15**	**0**	**10**	**75**	**120**	**455**	**650**	**20**

Program Elective I (Annexure - I) (Can be done through MOOCs also)

S. No.	Subject Code	Name of the Courses
1	CE25-M-SE105(1)	Theory of Structural Stability
2	CE25-M-SE105(2)	Structural Optimization
3	CE25-M-SE105(3)	Structural Health Monitoring

M.Tech in (Structural Engineering)

Semester II

S. No.	Subject Code	Subject	Periods per Week			Scheme of Examination			Total Marks	Credit L+(T+P)/2
						Theory / Practical				
			L	T	P	MID	TA	ESE		
1	CE25-M-SE108	FEM in Structural Engineering	3	0	0	15	15	70	100	3
2	FROM SOS	Research Methodology	3	0	0	15	15	70	100	3
3	CE25-M-SE109	Design of Prestressed Concrete Structures	3	0	0	15	15	70	100	3
4	CE25-M-SE110	Advanced Steel Design	3	0	0	15	15	70	100	3
5	CE25-M-SE111 **(1-4)**	Program Elective – II (PE Annexure – II)	3	0	0	15	15	70	100	3
6	CE25-M-SE112	FEM Lab	0	0	4	-	15	35	50	2
7	CE25-M-SE113	Numerical Analysis of Steel Structure Lab	0	0	4	-	15	35	50	2
8	FROM SOS	Scientific Paper Writing	0	0	2	-	15	35	50	1
		Total	**15**	**0**	**10**	**75**	**120**	**455**	**650**	**20**

Program Elective -II (Annexure - II) (Can be done through MOOCs also)

S. N	Subject Code	Name of the Courses
1	CE25-M-SE111 (1)	Advanced Design of Foundation
2	CE25-M-SE111 (2)	Advanced Design of RCC Structure
3	CE25-M-SE111 (3)	Soil Structure Interaction
4	CE25-M-SE111 (4)	Design of Industrial Structure
5	CE25-M-SE111 (5)	Business Analytics
6	CE25-M-SE111 (6)	Analysis of Laminated Structrures

Semester III

S. N0.	Subject Code	Subject	Periods per Week			Scheme of Examination			Total Marks	Credit L+(T+P)/2
						Theory / Practical				
			L	T	P	MID	TA	ESE		
1	CE25-M-SE201	Industrial Training/ Research Internship	0	0	16	-	60	140	200	8
2	CE25-M-SE202	Dissertation I	0	0	24	-	90	210	300	12
Total			**0**	**0**	**40**	**0**	**150**	**350**	**500**	**20**

Semester IV

S. No.	Subject Code	Subject	Periods per Week			Scheme of Examination			Total Marks	Credit L+(T+P)/2
						Theory / Practical				
			L	T	P	MID	TA	ESE		
1	CE25-M-SE203	Dissertation II	0	0	40	-	150	350	500	20
Total			**0**	**0**	**40**	**-**	**150**	**350**	**500**	**20**

L- Lecture **ESE-** End Semester Exam **P-** Practical **T.A-** Teacher's Assessment

Letter Grades and Grade Points

Letter Grade	Grade Point
O (Outstanding)	10
A+ (Excellent)	9
A (Very Good)	8
B+ (Good)	7
B (Above Average)	6
C (Average)	5
P (Pass)	4
F (Fail)	0
Ab (Absent)	0

Example for Computation of SGPA

Semester	Course	Credit	Letter Grade	Grade point	(Credit x Grade)
1	Course 1	3	A	8	3 x 8 = 24
1	Course 1	4	B +	7	4 x 7 = 28
1	Course 1	3	B	6	3 x 6 = 18
1	Course 1	3	O	10	3 x 10 = 30
1	Course 1	3	C	5	3 x 5 = 15
1	Course 1	4	B	6	4 x 6 = 24
		20			139
SGPA					139/20=6.95

Example for Computation of CGPA

Semester 1	Semester 2	Semester 3	Semester 4
Credit 20 SGPA 6.9	Credit 20 SGPA 7.8	Credit 20 SGPA 5.6	Credit 20 SGPA 6.0
CGPA= (20 x 6.9 + 20 x 7.8 + 20 x 5.6 + 20 x 6.0)/80 = 6.6			

DETAILED SYLLABUS

Semester I

M. Tech in (Structural Engineering)

Programme:		**Semester :**	**I**
Name of the Course:	**Advanced Solid Mechanics**	**Course Code:**	**CE25-M-SE102**
Credits :	**03**	**No of Hours :**	**3 Hrs/week**
Max Marks:	**100**		

Course Description:

In this course 'Advanced Solid Mechanics' a general theory available to study the response of solids to applied forces will be developed and will be used to study simple boundary value problems. The aim of the course would be to inculcate in the reader some of the available tools to analyze a structure and to elucidate the simplifying assumptions made to make the structure analyzable.

Course Outcome:

Students will be able to:

Course Outcomes:	**Course Outcomes:**
CO1	Analyze 3D stress and strain states using tensor components, equilibrium equations, and Mohr's circle, and determine principal stresses and invariants.
CO2	Apply strain transformation and stress-strain relationships based on generalized Hooke's law and evaluate strain energy in structural problems.
CO3	Determine elastic constants and solve problems involving uniaxial stress, thermal stress, and mechanical properties of materials.
CO4	Solve plane stress and plane strain problems in Cartesian and polar coordinates using stress functions and address axisymmetric conditions.
CO5	Evaluate stress concentration, unsymmetrical bending, and torsion effects, and apply theories of failure and plasticity concepts to metals.

Syllabus

UNIT- I

Theory of 3D Stresses: Introduction to stress tensor components, Analysis of stress and strain, stress components on an arbitrary plane, Equilibrium equations, Stress transformation, Principal stresses, invariants, stress Boundary conditions. Mohr's circle for the three dimensional state of stress.

UNIT- II

Theory of 3D Strains: Introduction to strain tensor components, Strain transformation. Principal Strains, Compatibility. Stress-strain relationship, Generalized Hooke's law, Strain-energy, Illustrative problems.

UNIT- III

Elastic Constants (Relation b/w E, K and U), Uniaxial Tension Test Conditions affecting mechanical properties, Members subjected to Uniaxial stress, Thermal Stress, Illustrative problems.

UNIT- IV

St. Venant's principle, Plane stress and plane strain problems in Cartesian and polar coordinates, Stress functions, axisymmetric problems.

UNIT- V

Stress concentration, Unsymmetrical bending and Torsion. Theory of Failure. Significance of the theories of failure, mohr's theory of failure Introduction to plasticity for metals. Ideally plastic solids.

Text Books:

1. Advanced Mechanics of Solid, L.S. Srinath, 3rd ed., McGraw-Hill Education, 2009.
2. Theory of Elasticity, S.P. Timoshenko and J. N. Goodier, 3rd ed., McGraw-Hill Education, 2010.

Reference Books:

1. Theory of Elasticity, M. Filonenko-Borodich, University Press of the Pacific, 2003.
2. Advance Mechanics of Solid by R.C. Hibbeler Beer & Johnson Boresi, A.P., and Sidebottom 1947.

Course Outcomes:

Students will be able:

1. Solve the advanced practical problems related to the theory of elasticity, concepts of stress and strain, strain energy, and failure criteria.
2. Propose materials and structural elements to the analysis of complex structures.

Program:	**M.Tech.**	**Semester :**	**I**
Name of the Course :	**Matrix Methods in Structural Analysis**	**Course Code:**	**CE25-M-SE104**
Credits :	**3**	**No of Hours:**	**3 Hours/week**
Max Marks :	**100**		

Course Description:

This course introduces students to the matrix approach in structural analysis, emphasizing the stiffness and flexibility methods. The course covers fundamental concepts, derivation of element stiffness matrices, and their applications in analyzing structural systems such as beams, trusses, and frames. The use of computational techniques and software in structural analysis is also discussed.

Course Outcomes:

At the end of this course, the student will be able to:

CO Number	Course Outcome
CO 1	Understand the fundamental principles of the matrix approach in structural analysis.
CO 2	Formulate and apply the flexibility and stiffness matrices for different structural elements.
CO 3	Analyze beams, trusses, and frames using matrix methods.
CO 4	Implement direct stiffness methods in solving structural problems.
CO 5	Utilize computational techniques and software tools for structural analysis.

Syllabus

UNIT I

Introduction to Matrix Methods: Review of structural analysis concepts

Advantages of matrix methods over classical methods

Introduction to direct stiffness and flexibility methods

Formation of global stiffness and flexibility matrices.

UNIT II

Flexibility Method:

Concept and formulation of the flexibility method

Application to beams, trusses, and frames

Computation of element flexibility matrices

Solution of simple structural problems using the flexibility method

UNIT III

Stiffness Method:

Concept and derivation of the stiffness method

Assembly of global stiffness matrices

Application to trusses, beams, and frames, Transformation of coordinate systems

UNIT IV

Direct Stiffness Method and Computer Applications:

Element stiffness matrices for different structures

Assembly and solution of equilibrium equations

Use of numerical methods for solving large-scale structural problems

Introduction to software tools for matrix analysis

UNIT V

Special Topics and Advanced Applications:

Static condensation and sub structuring

Nonlinear structural analysis basics

Introduction to dynamic analysis using matrix methods

Case studies on real-world structural problems

Text Books:

1. Pandit, G.S., & Gupta, S.P., Structural Analysis - A Matrix Approach, Tata McGraw-Hill.
2. McGuire, W., Gallagher, R.H., & Ziemian, R.D., Matrix Structural Analysis, Wiley.

Reference Books:

1. Weaver, W., & Gere, J.M., Matrix Analysis of Framed Structures, Springer.

Program:	**M.Tech.**	**Semester :**	**I**
Name of the Course :	**Matrix Methods in Structural Analysis Laboratory**	**Course Code:**	**CE25-M-SE107**
Credits :	**2**	**No of Hours:**	**2 Hours/week**
Max Marks :	**50**		

2. Kanchi, M.B., Matrix Methods of Structural Analysis, Wiley Eastern.
3. Cook, R.D., Concepts and Applications of Finite Element Analysis, Wiley.

Course Description

This laboratory course complements the theoretical study of matrix methods in structural analysis by providing hands-on experience in implementing numerical techniques for analyzing structural systems. The experiments involve manual calculations, MATLAB/Python programming, and the use of structural analysis software to solve real-world engineering problems.

Course Outcomes

At the end of this course, the student will be able to:

CO No.	Course Outcome
CO1	Develop computational models for structural analysis using matrix methods.
CO2	Implement flexibility and stiffness methods in solving structural problems.
CO3	Analyze and interpret the results obtained from numerical and software-based approaches.
CO4	Use MATLAB/Python or other software tools for structural analysis.
CO5	Correlate theoretical results with experimental and software-based findings.

List of Experiments/Practicals

1. Introduction to matrix methods and software tools (MATLAB/Python/STAAD.Pro)
2. Calculation of stiffness and flexibility matrices for simple structural elements
3. Analysis of beams using the stiffness method
4. Analysis of trusses using the stiffness method
5. Analysis of frames using the stiffness method
6. Application of the flexibility method to structural elements
7. Transformation of stiffness matrices for inclined members
8. Static analysis of a 2D truss using direct stiffness method (manual and software)
9. Static analysis of a 2D frame using direct stiffness method (manual and software)

10. Analysis of a continuous beam using matrix methods
11. Comparative study of results from manual calculations and software-based solutions
12. Case study on real-world structural problems using software tools

Text Books:

1. Pandit, G.S., & Gupta, S.P., *Structural Analysis - A Matrix Approach*, Tata McGraw-Hill.
2. McGuire, W., Gallagher, R.H., & Ziemian, R.D., *Matrix Structural Analysis*, Wiley.

Reference Books:

1. Weaver, W., & Gere, J.M., *Matrix Analysis of Framed Structures*, Springer.
2. Kanchi, M.B., *Matrix Methods of Structural Analysis*, Wiley Eastern.
3. Cook, R.D., *Concepts and Applications of Finite Element Analysis*, Wiley.
4. Hibbeler, R.C., *Structural Analysis*, Pearson.

Programme:	**M.Tech.**	**Semester :**	**I**
Name of the Course:	**Structural Optimization**	**Course Code:**	**CE25-M-SE105(2)**
Credits :	**3**	**No of Hours :**	**3 Hrs/week**
Max Marks:	**100**		

Course Description:

Structural optimization is a discipline dealing with optimal design of load-carrying mechanical structures.

Course Outcomes:
Students will be able to:

Course Outcomes:	**Course Outcomes:**
CO1	Understand the concepts of Optimization problems in the Structural Engineering.
CO2	Know the different methods for the Optimization problems.
CO3	Understand the concepts of Linear and Non-Linear Programming techniques.
CO4	Understand the concepts of Stochastic Optimization Methods.
CO5	Understand the concepts of Genetic Algorithm based Optimization Methods.

Syllabus

UNIT- I
Optimal cross-section area profile for the stiffest bar under arbitrary loading. Including the governing equations in the weak form. Imposing upper and lower limits on the area of cross-section.

UNIT- II
Min-max type problems with stress constraints. Min-max type stress constraint. Deflection constraint at a point.

UNIT- III

Worst load determination, A case of a single scalar unknown along with an unknown function. Revisiting of the concepts with beam examples.

UNIT- IV

Design for deflection problem for a beam. Numerical implementation of structural optimization. Beam optimization problem using the optimality criteria method.

UNIT- V

Truss and frame optimization problem for the desired deflection and an inkling of topology optimization problem.

Text Books:

1. Calculus of Variations, Gelfand IM & Fomin S V, (2000), Dover publications.
2. Variational Methods in Optimization, Smith D R, (1998), Dover Publications.

Reference Books:

1) Elements of Structural Optimization (Vol 11), Haftka R T & Gurdal Z, (1991), Springer Science & Business Media.

Programme:	**M.Tech.**	**Semester :**	**I**
Name of the Course:	**Structural Health Monitoring**	**Course Code:**	**CE25-M-SE105(3)**
Credits :	**3**	**No of Hours :**	**3 Hrs/week**
Max Marks:	**100**		

Course Description:

Structural health monitoring (SHM) refers to the process of implementing damage detection and characterization strategy for engineering structures Here damage is defined as changes to the material and/or geometric properties of a structural system, including changes to the boundary conditions and system connectivity, which adversely affect the system's performance.

Course Outcomes:
Students will be able to:

Course Outcomes:	Course Outcomes:
CO1	To understand the structural health issue and identify.
CO2	To suggest techniques for health monitoring.
CO3	To perform health procedure and draw appropriate conclusion
CO4	To suggest optimized solution.

Syllabus

UNIT- I
Introduction: Definition, Principles, significance of SHM, potential applications in Civil, Naval, Aerospace & Manufacturing Engineering

UNIT - II
Operational Evaluation: Sensor technology, piezoelectric wafer active sensors, data acquisition and cleaning procedures, elastic waves in solid structures, guided waves

UNIT -III
Feature Extraction methods: Identifying damage sensitive properties, signal processing, Fourier and short term Fourier transform, wavelet analysis

UNIT- IV
Pattern Recognition: State-of-Art damage identification and pattern reorganization methods, neural networks, Feature extraction algorithms

UNIT -V
Case studies: SHM based flaw detection in mechanical structures- Integrity and damage recognition in plates and pipes, defect identification in weld joints, wear monitoring in cutting tools

Text Books:

1. Structural Health Monitoring, Balageas D, Fritzen C P & Güemes A. (Eds.), (2006), John Wiley & Sons.
2. Structural Health Monitoring with Piezoelectric wafer Active Sensors, Giurgiutiu V, (2008), Academic Press, 2nd Edition.

Reference Books:

1. Structural Health Monitoring: Current Status and Perspectives, Chang F K, (1998), CRC Press.

DETAILED SYLLABUS

Semester II

M. Tech in (Structural Engineering)

Programme:		**Semester :**	**II**
Name of the Course:	**FEM in Structural Engineering**	**Course Code:**	**CE25-M-SE108**
Credits :	**03**	**No of Hours :**	**3 Hrs/week**
Max Marks:	**100**		

Course Description:

This course covers the theoretical foundations and applications of the Finite Element Method (FEM) in engineering. It introduces discretization techniques, equilibrium equations, and variational methods such as Rayleigh-Ritz and Galerkin's method. Students will learn FEM formulation for structural problems, including one-dimensional (bars and beams) and multi-dimensional (plane stress, plane strain, and 3D) elements. The course explores isoparametric elements, numerical integration (Gauss quadrature), and plate bending analysis. It also includes MATLAB-based FEM programming and case studies using commercial software like ANSYS and ABAQUS. Emphasis is placed on error estimation, convergence criteria, and practical FEM applications in structural, thermal, and fluid problems, equipping students with essential skills for solving real-world engineering challenges.

Course Outcome:

Students will be able to:

Course Outcomes:	**Course Outcomes:**
CO1	Understand the fundamental concepts and mathematical principles of FEM, including discretization, element formulation, and variational methods.
CO2	Apply FEM to one-dimensional structural problems, such as bars and beams, by formulating and assembling stiffness matrices and solving numerical problems.

CO3	Model and analyze two- and three-dimensional structural problems, including plane stress, plane strain, and axisymmetric elements, using FEM techniques.
CO4	Utilize isoparametric elements and numerical integration methods for solving solid mechanics problems, including plate bending and multi-dimensional analysis.
CO5	Implement FEM programs and interpret results through MATLAB-based coding and commercial software (e.g., ANSYS, ABAQUS), while performing error estimation and convergence analysis.

Syllabus:

Unit I: Introduction to Finite Element Method

Importance and Applications of FEM in Engineering, Advantages and Limitations of FEM, Comparison of FEM with Classical Methods (Finite Difference Method, Variational Methods), Equations of equilibrium, Concept of Discretization: Elements and Nodes, Basic Steps in FEM Analysis, Variational Methods: Rayleigh-Ritz and Weighted Residual Methods, Galerkin's Method, Strong and Weak form.

Unit II: Formulation for Structural Problems: One Dimensional elements

Bar and Beam Elements, Element Stiffness Matrix Formulation: Derivation of Stiffness Matrix, Assembly of Global Stiffness Matrix, Application of Boundary Conditions. Mechanical and Thermal Stresses, Numerical Problems on bars and beam.

Unit III: Formulation for Structural Problems: Two and Three Dimensional elements

Coordinate systems, element properties, Convergence criteria, Plane stress and Plane strain problems, Different element types and their properties, Convergence criteria. Lagrangian and serendipity elements, Continuity of elements, Finite Element Formulation of Constant Strain Triangle (CST) element and its usage, Finite Element Formulation of Axisymmetric Element Concept of three Dimensional Elements. Numerical Problems on Plane trusses, space trusses and rigid frames.

Unit IV: Application to Solid Mechanics

Iso-parametric Elements: Natural coordinate system, Numerical integration: Gauss quadrature, Isoparametric, Superparametric and Subparametric Elements, shape function of four node, eight node and nine node iso-parametric elements, One Dimensional Two and Three Dimensional Numerical Integration, Analysis of plate bending problems by finite element through rectangular elements with different degrees of freedom.

Unit V: Computer Implementation of FEM and Error Analysis

Pre-Processing, Solution, Post-Processing, FEM Programming: Development of FEM Programs in MATLAB for Analysis of Bars, Beams, Trusses, and Frames. Practical FEM Applications: Case Studies in Structural, Thermal, and Fluid Problems, Introduction to Commercial FEM Software: ANSYS, ABAQUS etc. Error Estimation and Convergence: Sources of Errors in FEM: Modeling, Numerical, and Discretization Errors.

Text Books:

1. Concepts and Applications of Finite Element Analysis, Cook R. D., Wiley J., New York, 1995.
2. Finite Element Analysis, Seshu P., Prentice-Hall of India, 2005.
3. Finite Element Methods in Engineering, Belegundu A.D., Chandrupatla, T.R, Prentice Hall India, 1991.
4. Finite Element analysis: Theory and Programming, Krishnamoorthy, C. S., Tata McGraw Hill, 2017.
5. Finite Element Analysis, Bhavikatti, S. S. New Age International Publishers, 2015.

Reference Books:

1. The Finite Element Method: Its Basis and Fundamentals, Zienkiewicz, O. C., Taylor, R. L. and Zhu, J. Z., Seventh Edition, Butterworth-Heinemann Ltd.
2. The Finite Element Method for Solid and Structural Mechanics, Zienkiewicz, O. C., Taylor, R. L. and Fox, D. D., Seventh Edition, Butterworth-Heinemann Ltd., 2013
3. Fundamentals of Finite Element Analysis, Hutton David, McGraw Hill, 2004
4. Finite Element Analysis, Buchanan G.R., McGraw Hill Publications, New York, 1995.
5. The finite element method in engineering, Rao, S. S., Fifth Edition, Butterworth-Heinemann, 2010.
6. An introduction to Finite Element Method, Reddy, J. N., Third Edition, McGraw Hill Education, 2017.

Programme:	**M. Tech**	**Semester :**	**II**
Name of the Course:	**FEM Lab**	**Course Code:**	**CE25-M-SE112**
Credits :	**02**	**No of Hours :**	**2 Hrs/week**
Max Marks:	**50**		

Course Description:

This course aims to equip students with the skills to develop MATLAB code for finite element analysis (FEA) of structural systems. It covers spring, bar, truss, beam, and frame elements, along with 2D plane stress problems using CST, LST, rectangular, and isoparametric elements. Students will analyze structures under various boundary conditions and visualize displacement, stress, and strain results.

Course Outcome:

Students will be able to:

Course Outcomes:	**Course Outcomes:**
CO1	Develop and implement MATLAB code for finite element analysis (FEA) of structural systems, including spring, bar, truss, beam, and frame elements.
CO2	Perform structural analysis of beams and frames under various boundary conditions and loadings, and interpret the displacement, stress, and strain results.
CO3	Model and analyze 2D plane stress problems using CST, LST, rectangular, and isoparametric elements, applying appropriate meshing and visualization techniques.

List of Experiments:

Develop MATLAB code for finite element programming for the following structures and analyses:

1. Two-element spring system
2. Two-noded bar element
3. Three-noded bar element
4. Plane truss element
5. Beam element
6. Plane frame element
7. Analysis of beams with various boundary conditions and loadings
8. Analysis of frame structures
9. Plane stress element
10. Constant Strain Triangle (CST) element
11. Linear Strain Triangle (LST) element
12. Rectangular element
13. Isoparametric element

Recommended Books:

1. MATLAB Guide to Finite Elements: An Interactive Approach, Kattan, P. I., Second Edition, Springer, 2007.
2. Programming the Finite Element Method, Smith, I. M., Griffiths, D. V., and Margetts, L., Willey, 2014.

Programme:	**M. Tech.**	**Semester :**	**II**
Name of the Course:	**Advanced Steel Design**	**Course Code:**	**CE25-M-SE110**
Credits :	**3**	**No of Hours :**	**3 Hrs/week**
Max Marks:	**100**		

Course Description:
This course focuses on the advanced design and analysis of steel structures, incorporating modern design philosophies such as Plastic Design and Load and Resistance Factor Design (LRFD). Emphasis is placed on stability, strength, and serviceability considerations in steel structural components. The course covers design methodologies for beams, columns, plate girders, and industrial structures, along with the study of steel bridges and composite structures. Relevant Indian Standards (IS:800, IS:875, IS:1893, IRC, IRS) are explored for practical applications in real-world projects.

Course Outcomes:

Students will be able to

Course Outcomes:	**Course Outcomes:**
CO1	Apply ASD, Plastic Design, and LRFD principles in steel structure design.
CO2	Design beams, columns, and plate girders with stability and strength considerations.
CO3	Utilize IS, IRC, and IRS standards for steel structure design and load assessment.
CO4	Develop efficient design solutions for steel industrial buildings and bridges.
CO5	Design welded, bolted, and riveted connections, along with steel-concrete composite structures.

Syllabus
Unit-I: Advanced Design Philosophies:

Introduction to Allowable Stress Design (ASD), Plastic Design, and Load and Resistance Factor Design (LRFD). Concepts of ductility, residual stresses, and behavior of steel structures under different loading conditions.

Unit-II: Structural Loads and Codal Provisions
Detailed study of loading standards as per IS:800, IS:875 (Part 1–5), IS:1893, IRC, and IRS for various steel structures. Load combinations, stability requirements, and serviceability criteria for steel design.

Unit-III: Design of Structural Components
Advanced analysis and design of steel beams, beam-columns, plate girders, and open web structures. Structural stability and second-order effects. Design considerations for fatigue and buckling.

Unit-IV: Industrial Buildings and Bridges
Design of steel industrial buildings, including crane girders and multi-story structures. Introduction to bridge engineering, types of steel bridges, and their design considerations. Seismic and wind effects on steel bridges and industrial structures.

Unit-V: Connections and Composite Structures
Design of welded, bolted, and riveted connections. Behavior and design of composite structures, including steel-concrete composite beams, columns, and decks. Introduction to modern fabrication techniques and case studies on advanced steel design applications.

Text Books:
1. Design of Steel Structures, Arya A S & Ajmani J L, (2001), Nemchand and Bros, 5th Edition.
2. The Steel Skeleton: Volume 2, Plastic Behaviour and Design, Baker J S, Horne M R & Heyman J, (1956), Cambridge University Press.
3. Design of Steel Structures Limit State Method, Subramanian N, (2018), Oxford University Press.
4. Steel Structures: Design & Behavior, Johnson S, (2009), Pearson, 5th Edition.
5. Steel Structures: Controlling Behavior Through Design, Englekirk R E, (1994), John Wiley & Sons

Reference Books:
1. The Plastic Methods of Structural Analysis, Neal B G, (1977), Spon Press, 3rd Edition.
2. IS 800: 2007 – General Construction in Steel - Code of Practice, BIS, 2007.
3. SP – 6: Handbook of Structural Steel Detailing, BIS, 1964.

Programme:	**M.Tech.**	**Semester :**	**II**
Name of the Course:	**Numerical Analysis of Steel Structure Lab**	**Course Code:**	**CE25-M-SE113**
Credits :	**2**	**No of Hours :**	**2 Hrs/week**
Max Marks:	**50**		

Course Description: The Structural Analysis courses at PG level generally provide the fundamental concepts which are suitable for hand calculations.

Course Outcomes:

Students will be able to

CO Number	Course Outcome
CO1	At the completion of this course, the student shall acquire knowledge and ability to perform experiments and computer simulation of steel structures.

List of Experiments:

1. Analysis and Design of Bridge structure
   OR
2. Analysis and Design of Industrial Buildings including gantry girders.

Recommended Books:

1. Design of Steel Structures Volume II, Chandra R, (2016) Standard Book House.
2. Design of Steel Structures, Arya A S & Ajmani J L, (2001), Nemchand and Bros, 5th Edition.
3. The Steel Skeleton: Volume 2, Plastic Behaviour and Design, Baker J S, Horne M R & Heyman J, (1956), Cambridge University Press.

Program:	**M.Tech.**	**Semester :**	**II**
Name of the Course :	**Advance Design of Foundation**	**Course Code:**	**CE25-M-SE111 (1)**
Credits :	**3**	**No of Hours :**	**3 Hours/week**
Max Marks :	**100**		

Course Description:

This course covers advanced concepts in foundation engineering, including soil exploration, design of shallow and deep foundations, pile and well foundations, and tunneling. It emphasizes code-based design practices, load-settlement behavior, and soil-structure interaction relevant to complex geotechnical projects.

Course Outcomes:

At the end of this course, the student will be able to:

CO Number	Course Outcome
CO1	Plan and conduct soil exploration and interpret subsurface investigation data for foundation design.
CO2	Analyze and design shallow foundations considering bearing capacity and settlement criteria.
CO3	Design and evaluate pile foundations including load transfer, settlement, and load tests.
CO4	Understand design principles of well foundations and analyze tunneling effects and soil arching.
CO5	Design open cuts, coffer dams, and evaluate soil-structure interaction for foundation stability.

Syllabus:

UNIT I : Soil Exploration and Subsurface Investigation:

Objectives, importance, and factors affecting exploration programs,trial pits, geophysical methods (seismic, resistivity), and selection criteria.Boring Methods: Auger, wash, rotary, percussion boring, sample disturbance and selection.In-situ Tests: SPT, CPT, SCPT, vane shear test, pressure meter test, procedures and interpretation. Reporting: Bore logs, soil profiles, and geotechnical investigation reports. Planning of Soil Exploration for Different Projects, Methods of Subsurface Exploration, Methods of Borings along with various Penetration Tests.

UNIT II : Shallow Foundations and Bearing Capacity Analysis:

Introduction to Shallow Foundations:Types, functions, and requirements for satisfactory performance.Bearing Capacity Estimation Methods: Terzaghi's, Meyerhof's, and IS code methods, effect of water table, shape, and depth factors.Settlement of Footings and Rafts: Immediate and consolidation settlements,

empirical and analytical approaches. Proportioning of Foundations Using Field Test Data.Use of SPT, CPT, and plate load test results for design. Pressure-Settlement Characteristics from Constitutive Laws: Stress-strain behavior of soil, load-deformation response in design.

UNIT III : Pile Foundations

Introduction to Pile Foundations:Types, applications, and selection criteria, Load Transfer Mechanisms: Methods for estimating end-bearing and skin friction capacity,Settlement of Piles and Pile Groups, Elastic and consolidation settlements, group interaction effects,Pile Group Capacity and Proportioning: Block failure, efficiency, and layout optimization.Laterally Loaded Piles: Behavior under lateral loads, analysis methods, and deflection estimation,Pile Load Tests and Load-Settlement Analysis: Static and dynamic pile load tests, interpretation, analytical estimation of load-settlement response Lateral and uplift capacity analysis.

UNIT IV : Well Foundations and Tunneling

Well Foundations: Introduction and Design Concepts: Types, components, uses, sinking methods, advantages over pile foundations.Code Provisions: IS:3955 and IRC guidelines for design and construction. Design Methods:Elastic theory approach, ultimate resistance method for vertical and lateral loads.

Tunneling in Soils : Types of tunnels, methods of construction in soft soils and rock, tunnel stability. Soil Arching and Pressure Computation: Arching effects, pressure distribution around tunnels, and estimation using empirical and analytical methods.

UNIT V : Open Cuts, Coffer Dams, and Soil-Structure Interaction

Open Cuts and Support Systems: Design and construction of shallow and deep open cuts, sheeting and bracing systems in cohesive and cohesionless soils. Coffer Dams : Types (earth-filled, rock-fill, cellular, etc.), stability analysis, seepage control, and design considerations Foundations under Uplifting Loads: Design principles, anchoring systems, uplift resistance in various soil conditions.Soil-Structure Interaction: Concepts, effect on foundation behavior, and introduction to analytical and empirical approaches.

Text Books:

1. Das, B. M. (2021). Principles of Foundation Engineering (9th ed.). Cengage Learning.
2. Kurian, N. P. (2005). Design of Foundations: Concepts and Applications. Narosa Publishing House.
3. Ranjan, G., & Rao, A. S. R. (2000). Basic and Applied Soil Mechanics (2nd ed.). New Age International Publishers.
4. Bowles, J. E. (Year). Foundation Analysis and Design. New York: Tata McGraw-Hill..

Reference Books:

1 .Basu, D. N., & Salgado, R. (2021). Advanced Foundation Engineering. Cambridge

University Press.
2. Saran, S. Analysis and Design of Substructures. New Delhi: Oxford and IBH Publishing
Co. Pvt. Ltd.

Assessment:
Combination of class work, tutorials, assignments, quizzes, surprise test, online test, and exams.

Program:	**M.Tech.**	**Semester :**	**II**
Name of the Course :	**Soil Structure Interaction**	**Course Code:**	**CE25-M-SE111 (3)**
Credits :	**3**	**No of Hours :**	**3 Hours/week**
Max Marks :	**100**		

Course Description:
This course covers advanced concepts and analysis techniques for soil-structure interaction, focusing on realistic soil behavior, foundation systems, and computational modeling for effective design and evaluation.

Course Outcomes:
At the end of this course, the student will be able to:

CO Number	Course Outcome
CO1	Understand and apply advanced analytical methods to assess soil-structure interaction beyond conventional design.
CO2	Analyze the behavior of structures under various loading and subsoil conditions through SSI concepts.
CO3	Develop and apply computer-based models for analyzing foundation elements using subgrade reaction theory.
CO4	Evaluate the response of frame structures on stratified soils considering linear and nolinear soil behavior.
CO5	Assess pile capacity, group effects, and uplift resistance using realistic stress-strain characteristics of soils.

Syllabus:

UNIT I :Fundamentals of Soil-Structure Interaction and Advanced Analytical Techniques:

Overview of Conventional Foundation Design Methods: Assumptions, limitations, and need for considering interaction effects. Nature of Soil-Structure Interaction (SSI): Definition, influencing factors, types of interaction problems (e.g., shallow vs deep foundations, rigid vs flexible structures).Complexities in SSI Analysis: Nonlinearity, heterogeneity, and time-dependency of soil behavior. Introduction to Advanced Analysis Techniques: Basics of Finite Element Method (FEM) and Finite Difference Method (FDM); application in SSI problems.

UNIT II : Relaxation and Interaction Analysis for Soil-Structure Systems:

Concept of Relaxation and Redistribution in SSI: Load transfer mechanisms, stress redistribution between soil and structure. Effect of Structural Type on SSI: Comparison of interaction behavior for buildings, bridges, tanks, and retaining structures. Influence of Subsoil Characteristics: Role of stratification, stiffness, compressibility, and groundwater conditions on SSI behavior. Loading Conditions and Their Impact: Static, dynamic, seismic, and transient loading conditions; case-based evaluation of interaction responses.

UNIT III : Computational Modeling of Soil-Structure Interaction Using Subgrade Reaction Theory:

Theory of Sub-grade Reaction and Its Applications: Concept, assumptions, and limitations; relevance in SSI problems.Modeling of Beams, Footings, and Rafts on Elastic Foundations: Analysis using Winkler and Pasternak models; settlement and pressure distribution. Development of Design-Oriented Computer Programs: Algorithm development for SSI problems; applications in structural foundations.Case Studies and Sample SSI Simulations :Validation of program output with analytical or software-based results.

UNIT IV : Interaction Analysis of Framed Structures on Stratified Soil Deposits:

Types of Frame Structures and Foundation Systems : Overview of structural systems and their interaction with soil. Characteristics of Stratified Natural Soil Deposits: Variability in layers, stiffness contrast, and impact on foundation response. Linear and Non-Linear Stress-Strain Behavior of Soils: Comparison of elastic and elasto-plastic behavior in SSI analysis.Analysis of Frame-Soil Systems under Vertical and Lateral Loads: Application of numerical models for SSI in layered soils, influence of soil heterogeneity.

UNIT V : Pile-Soil Interaction and Pull-Out Resistance:

Estimation of Pile Capacities : Methods for evaluating ultimate and allowable capacities considering real soil behavior. Negative Skin Friction on Piles : Causes, effects, and design considerations in layered and compressible soils. Group Action of Piles : Stress-strain interaction in pile groups; load sharing and settlement behavior.Anchor Piles and Pull-Out Resistance : Function of anchor piles, analytical methods for determining uplift resistance.

Text Books:

1. Bowles, J. E. (1996). Foundation Analysis and Design (5th ed.). McGraw-Hill.
2. Selvadurai, A. P. S. (1979). Elastic Analysis of Soil-Foundation Interaction. Elsevier Scientific Publishing Company.
3. Desai, C. S., & Christian, J. T. (1977). Numerical Methods in Geotechnical Engineering. McGraw-Hill Book Co., New York.
4. Institution of Structural Engineers. (1996). Soil-Structure Interaction: The Real Behaviour of Structures. The Institution of Structural Engineers, London.

Reference Books:

1. Chaudhuri, D. (2008). Soil Structure Interaction. Oxford University Press.
2. Basu, D. N., & Salgado, R. (2021). Advanced Foundation Engineering. Cambridge University Press.

Assessment:

Combination of class work, tutorials, assignments, quizzes, surprise test, online test, and exams.

Programme:	**M. Tech.**	**Semester :**	**II**
Name of the Course:	**Design of Industrial Structure**	**Course Code:**	**CE25-M-SE111 (4)**
Credits :	**3**	**No of Hours :**	**4 Hrs/week**
Max Marks:	**100**		

Course Description:

This course is meant primarily for post-graduate students in Civil Engineering. Major topics covered are: gantry girder, permissible stress, types of gantry girders and crane rails, crane data, maximum moments and shears, construction detail,

design procedure, Design of square bunker – Jansen's and Airy's theories – IS Code provisions – Design of side plates – Stiffeners – Hooper – Longitudinal beams Design of cylindrical silo – Side plates – Ring girder – stiffeners, chimney, water tank.

Course Outcomes:
Students will be able to

Course Outcomes:	**Course Outcomes:**
CO1	Design Steel Gantry Girders.
CO2	Design Steel Portal, Gable Frames.
CO3	Design Steel Bunkers and Silos.
CO4	Design Chimneys and Water Tanks.

Syllabus

Unit I:
Steel Gantry Girders – Introduction, loads acting on gantry girder, permissible stress, types of gantry girders and crane rails, crane data, maximum moments and shears, construction detail, design procedure.

Unit II:
Portal Frames – Design of portal frame with hinge base, design of portal frame with fixed base -Gable Structures – Lightweight Structures.

Unit III:
Steel Bunkers and Silos – Design of square bunker – Jansen's andAiry's theories – IS Codeprovisions – Design of side plates – Stiffeners – Hooper – Longitudinal beams Design of cylindrical silo – Side plates – Ring girder – stiffeners.

Unit IV:

Chimneys – Introduction, dimensions of steel stacks, chimney lining, breech openings and access ladder, loading and load combinations, design considerations, stability consideration, design of base plate, design of foundation bolts, design of foundation.

Unit V:
Design of pressed steel water tank – Design of stays – Joints – Design of hemispherical bottom water tank – side plates – Bottom plates – joints – Ring girder –Design of staging and foundation. Design of Steel Bridges (Railway Bridges).

Program:	**M.Tech.**	**Semester :**	**II**
Name of the Course :	**Business Analytics**	**Course Code:**	CE25-M-SE111 (5)
Credits :	**3**	**No of Hours:**	**3 Hours/week**
Max Marks :	**100**		

Text Books:

1. Design of Steel Structure, Punmia B C, Jain A K & Jain A K, (1998), Lakshmi Publishers, 2nd Edition.
2. Design of Steel Structures, Chandra R, (2009), Standard Publishers, 12th Edition.
3. Design of Steel Structures Limit State Method, Subramanian N, (2018), Oxford University Press.
4. Design of Prestressed Concrete Structures, Lin T Y, (2010), Wiley India Pvt. Ltd., 3rd Edition.

Reference Books:

1. Advanced Reinforced Concrete Design, Raju N K, (2016), CBS Publishers & Distributors, 3rd Edition.
2. Reinforced Concrete Structure Structural Elements: Behavior Analysis and Design, Purushothaman P, (1984), McGraw Hill.
3. Design of Concrete Structures, Nilson A H, (2009), McGraw-Hill, 12th Revised Edition.

Course Description

This course introduces students to fundamental concepts and applications of business analytics. It covers data-driven decision-making, statistical and predictive modeling techniques, and

optimization methods. The course also explores the role of business intelligence tools and data visualization in analyzing business performance and supporting strategic decisions.

Course Outcomes

At the end of this course, the student will be able to:

CO No.	Course Outcome
CO1	Understand the key concepts and importance of business analytics in decision-making.
CO2	Apply statistical and predictive modeling techniques to analyze business data.
CO3	Utilize data visualization tools for effective business communication and insights.
CO4	Implement optimization and simulation methods for business problem-solving.
CO5	Develop data-driven strategies using business intelligence and machine learning tools.

Syllabus

UNIT I: Introduction to Business Analytics

- Definition and importance of business analytics
- Types of analytics: Descriptive, predictive, and prescriptive
- Business analytics applications in various industries
- Role of data in decision-making

UNIT II: Statistical Analysis for Business

- Basic statistical concepts: Measures of central tendency and dispersion
- Probability distributions and sampling techniques
- Hypothesis testing and confidence intervals
- Regression analysis and correlation

UNIT III: Data Visualization and Business Intelligence

- Importance of data visualization in analytics
- Tools for data visualization (Excel, Tableau, Power BI)
- Dashboard creation and reporting
- Business intelligence applications in organizations

UNIT IV: Predictive Analytics and Machine Learning

- Introduction to predictive modeling techniques
- Supervised and unsupervised learning methods
- Decision trees, random forests, and clustering techniques

Program:	**M.Tech.**	**Semester :**	**II**
Name of the Course :	**Analysis of Laminated Composite Plates**	**Course Code:**	**CE25-M-SE111 (6)**
Credits :	**3**	**No of Hours:**	**3 Hours/week**
Max Marks :	**100**		

- Practical applications in marketing, finance, and operations

UNIT V: Optimization and Simulation in Business Analytics

- Introduction to optimization techniques
- Linear programming and decision analysis
- Simulation models for risk assessment
- Case studies on real-world business applications

Text Books:

1. Evans, J.R., *Business Analytics: Methods, Models, and Decisions*, Pearson.
2. Sahil Raj, *Business Analytics*, Cengage Learning.

Reference Books:

1. Albright, S.C., & Winston, W.L., *Business Analytics: Data Analysis and Decision Making*, Cengage Learning.
2. Provost, F., & Fawcett, T., *Data Science for Business*, O'Reilly Media.
3. Anderson, D.R., Sweeney, D.J., & Williams, T.A., *An Introduction to Management Science: Quantitative Approaches to Decision Making*, Cengage Learning.

Course Description

This course provides a comprehensive understanding of the mechanics and analysis of laminated composite plates. The course covers classical and refined plate theories, stress-strain behavior, bending, buckling, and vibration analysis of composite plates. Analytical and numerical approaches for solving composite plate problems will be discussed, along with real-world engineering applications.

Course Outcomes

At the end of this course, the student will be able to:

CO No.	Course Outcome
CO1	Understand the fundamental concepts of laminated composite materials and their mechanical behavior.
CO2	Analyze stress-strain relations and failure criteria of laminated composites.
CO3	Apply classical and higher-order theories to analyze laminated composite plates.
CO4	Perform bending, buckling, and vibration analysis of composite plates.
CO5	Utilize analytical and numerical methods for the design and optimization of laminated composite structures.

Syllabus

UNIT I: Introduction to Laminated Composites

- Overview of composite materials and their applications
- Classification of composite materials
- Introduction to laminated composite plates
- Basic concepts of micromechanics and macromechanics

UNIT II: Stress-Strain Relations and Failure Criteria

- Stress-strain relations for anisotropic materials
- Classical lamination theory (CLT)
- Failure criteria: Tsai-Wu, Tsai-Hill, Hoffman, and maximum stress/strain theories
- Hygrothermal effects in laminated composites

UNIT III: Bending Analysis of Laminated Plates

- Kirchhoff-Love plate theory for laminated composites
- First-order shear deformation theory (FSDT)
- Higher-order shear deformation theories (HSDT)
- Analytical and numerical solutions for bending problems

UNIT IV: Buckling and Vibration Analysis

- Stability analysis of laminated composite plates
- Buckling of simply supported and clamped plates
- Free and forced vibration analysis of laminated plates
- Effect of boundary conditions and stacking sequence

UNIT V: Advanced Topics and Computational Methods

- Finite element modeling of laminated composite plates
- Dynamic response and impact analysis
- Smart composite materials and structures
- Case studies on aerospace and automotive applications

Text Books:

1. Reddy, J.N., *Mechanics of Laminated Composite Plates and Shells: Theory and Analysis*, CRC Press.
2. Jones, R.M., *Mechanics of Composite Materials*, Taylor & Francis.

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