COCHIN UNIVERSITY OF SCIENCE & TECHNOLOGY

SCHEME & SYLLABUS
(I – VIII Semesters)

B. TECH. PROGRAMME

in

CIVIL ENGINEERING

(2023 Admission onwards)

B.TECH. DEGREE PROGRAMME IN CIVIL ENGINEERING

Vision

To impart knowledge and excellence in Civil Engineering with a global perspective and to groom professionals with ethical values to meet the current and future challenges for nation building.

Mission

1. To promote quality education, research and consultancy for Industrial and societal needs.

2. To inculcate professionalism and moral values in budding Civil Engineers through sustainable engineering practices.

3. To inspire the new generation of Civil Engineers with innovative ideas and creativity for lifelong learning, to meet the current and future challenges of nation in a global perspective.

Programme Educational Objectives (PEOs)

PEO1	**PREPARATION**: To prepare students to excel in postgraduate programmes or to succeed in industry/technical profession through global rigorous education.
PEO2	**CORE COMPETENCE**: To provide students with a solid foundation in mathematical, scientific and engineering fundamentals required to solve engineering problems and also to pursue higher studies.
PEO3	**BREADTH**: To train students with good scientific and engineering concepts soas to comprehend, analyze, design and create novel products and innovative solutions for the real life problems.
PEO4	**PROFESSIONALISM**: To inculcate in students professional and ethical attitude, effective communication skills, team work skills, multidisciplinary approach and an ability to relate engineering issues to broader social context.
PEO5	**LEARNING ENVIRONMENT**: To provide student with an academic environment that values excellence, leadership, ethical codes and guidelines, and the life-long learning for a successful professional career.

Programme Articulation Matrix

PEO / Mission Statements	PEO1	PEO2	PEO3	PEO4	PEO5
To promote quality education, research and consultancy for industrial and societal needs.	3	3	2	2	3
To inculcate professionalism and moral values in budding Civil Engineers through sustainable engineering practices.	3	3	2	3	3
To inspire the new generation of Civil Engineers with innovative ideas and creativity for lifelong learning, to meet the current and future challenges of nation in a global perspective.	2	2	3	3	2

1-Slightly , 2- Moderately, 3-Substantially

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

1. **Engineering Knowledge**: Apply the knowledge of Mathematics, Science, Engineering Fundamentals and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research Literature, analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and Engineering sciences.
3. **Design/ Development of solutions**: Design solutions for complex Civil engineering problems and design processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct Investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select and apply appropriate techniques, resources, and **modern** engineering and IT tools including prediction and modeling to complex civil engineering activities with an understanding of the limitations.
6. **The Engineer and society**: Apply reasoning acquired by the contextual knowledge to address societal, health, safety, legal and cultural issues and to bear consequent responsibilities relevant to the professional engineering practice.
7. **Environmental sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Ability to express ideas clearly and to communicate verbally in writing and make presentations.
11. **Project management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply those to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-Long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

Civil Engineering graduates will be able to:

1. **Prepare** detailed project reports, working drawings and estimates of building, hydraulic structures, transportation systems, treatment plants and other infrastructure facilities based on societal needs.
2. **Design** various facilities needed for a sustainable development of the society and apply best management practices for its construction and maintenance.
3. **Create Awareness** on the impact of Civil engineering solutions in a societal context and to respond effectively to natural and man made hazards.

Categories of Courses with the Breakup of Credits

Sl.No	Category of Courses	Credit breakup for B.Tech Programme in Civil Engineering (2023 scheme)
1	Humanities and Social Sciences including Management Courses	10
2	Basic Science Courses	21
3	Engineering Science Courses including workshop, drawing, basics of electronics/electrical/mechanical/computer etc.	21
4	Professional Courses	78
5	Professional elective courses relevant to chosen specialization/discipline	18
6	Open subjects-Electives from other technical and /or emerging subjects	6
7	Project work, seminar and internship in industry or elsewhere	16
8	Mandatory courses	(non-credit)
	Total	170

Stream A – Civil, Mechanical, Safety Engineering

SEMESTER I [STREAM A]

Stream A: Civil Engineering, Mechanical Engineering and Safety and Fire Engineering

Code No.	Subject	L H/W	T H/W	P/D H/W	C	Marks		Total
						CA	SEE	
23-200-0101A	Calculus	3	1	0	3	50	50	100
23-200-0102A	Engineering Chemistry	3	0	1	3	50	50	100
23-200-0103A	Engineering Graphics	2	0	3	3	50	50	100
23-200-0104A	Basic Civil Engineering	3	1	0	4	50	50	100
23-200-0105A	Basic Mechanical Engineering	3	1	0	4	50	50	100
23-200-0106A	Environmental and Life Sciences	3	0	0	3	50	50	100
23-200-0107A	Civil Engineering Workshop	0	0	3	1	25	25	50
23-200-0108A	Mechanical Engineering Workshop	0	0	3	1	25	25	50
	TOTAL	17	3	10	**22**			

CA – Continuous Assessment, SEE – Semester End Examination

SEMESTER II [STREAM A]

Code No.	Subject	L H/W	T H/W	P/D H/ W	C	Marks		Total
						CA	SEE	
23-200-0201A	Computer Programming and Problem Solving	3	1	0	4	50	50	100
23-200-0202A	Engineering Physics	3	0	1	3	50	50	100
23-200-0203A	Engineering Mechanics	3	1	0	4	50	50	100
23-200-0204A	Basic Electrical Engineering	3	0	0	3	50	50	100
23-200-0205A	Basic Electronics Engineering	3	0	0	3	50	50	100
23-200-0206A	Soft Skills Development	2	0	0	2	50	-	50
23-200-0207A	Computer Programming Laboratory	0	0	3	1	25	25	50
23-200-0208A	Basic Electrical and Electronics Engineering Laboratory	0	0	3	1	25	25	50
23-200-0209A	Language Laboratory	0	0	2	1	25	25	50
23-200-0210A	NSS/Nature conservation Activities/Yoga	0	0	2	0	-	-	-
	TOTAL	17	2	11	**22**			

SEMESTER III

Code No.	Subject	L H/W	T H/W	P/D H/W	C	Marks		Total
						CA	SEE	
23-200-0301A*	Linear Algebra and Transform Techniques	3	1	0	3	50	50	100
23-201-0302	Surveying –I	3	1	0	3	50	50	100
23-201-0303	Strength of Materials	3	1	0	3	50	50	100
23-201-0304	Concrete Technology	3	1	0	3	50	50	100
23-201-0305	Fluid Mechanics –I	3	1	0	3	50	50	100
23-201-0306	Building Technology and Functional Planning	3	1	0	3	50	50	100
23-201-0307	Strength of Materials Testing Laboratory	0	0	3	1	25	25	50
23-201 -0308	Concrete Testing Laboratory	0	0	3	1	25	25	50
23-201-0309	Internship-1	0	0	0	1	50	-	50
	TOTAL	18	6	6	**21**			
Minor in Civil Engineering								
23-201-0310	Civil Infrastructure Engineering	3	0	0	3	50	50	100

*Common for CE, ME and SE B.Tech Programmes. CA – Continuous Assessment, SEE – Semester End Examination. Internship-I of a minimum duration of two weeks (10 working days) must be completed during the summer vacation after the II Semester, and evaluation will take place during the III Semester. For Lateral Entry students mini project carried out can be considered equivalent to Internship-I.

SEMESTER IV

Code No.	Subject	L H/W	T H/W	P/D H/W	C	Marks		Total
						C A	SEE	
23-200-0401A*	Complex Variables and Partial Differential Equations	3	1	0	3	50	50	100
23-201-0402	Surveying –II	3	1	0	3	50	50	100
23-201-0403	Analysis of Structures -I	3	1	0	3	50	50	100
23-201-0404	Transportation Engineering -I	3	1	0	3	50	50	100
23-201-0405	Fluid Mechanics II	3	1	0	3	50	50	100
23-201-0406	Geotechnical Engineering -I	3	0	0	3	50	50	100
23-201-0407**	Universal Human Values	2	1	0	3	25	25	50
23-201-0408	Survey Practices Laboratory	0	0	3	1	25	25	50
23-201-0409	Fluid Mechanics Laboratory	0	0	3	1	25	25	50
	TOTAL	21	6	6	**23**			
Minor in Civil Engineering								
23-201-0410	Concrete Technology-Theory and Practice	3	0	0	3	50	50	100
23-201-0411#	MOOC-I: Broad Area-Sustainable Construction Practices	0	0	0	3	0	0	100
Honours in Civil Engineering								
23-201-0412	Advanced Concrete Technology	3	0	0	3	50	50	100

*Common for CE, ME and SE B.Tech Programmes, ** Common for all branches

Students should take Massive Open Online Courses (MOOCs) approved by the concerned Division/Board of Studies (BoS). Evaluation Pattern for UHV will be same as laboratory course.

SEMESTER V

Code No.	Subject	L H/W	T H/W	P/D H/W	C	Marks		Total
						CA	SEE	
23-200-0501A*	Numerical and Statistical Methods	3	1	0	3	50	50	100
23-201-0502	Design of Concrete Structures-I	3	1	0	3	50	50	100
23-201-0503	Analysis of Structures -II	3	1	0	3	50	50	100
23-201-0504	Transportation Engineering –II	3	1	0	3	50	50	100
23-201-0505	Geotechnical Engineering -II	3	1	0	3	50	50	100
23-201-05**	Professional Elective –I (MOOC)	0	0	0	3	0	0	100
23-201-0510	Geotechnical Engineering Laboratory	0	0	3	1	25	25	50
23-201-0511	Transportation Engineering Laboratory	0	0	3	1	25	25	50
23-201-0512	Internship-II	0	0	0	1	50	-	50
	TOTAL	15	6	6	**21**			
Minor in Civil Engineering								
23-201-0513#	MOOC II: Broad Area- Disaster Management	0	0	0	3	0	0	100
Honours in Civil Engineering								
23-201-0514	Subsurface Investigations and Instrumentation	3	0	0	3	50	50	100
23-201-0515	Research Methodology & IPR	3	0	0	3	50	50	100

*Common for CE, ME and SE B.Tech Programmes

Students should take Massive Open Online Courses (MOOCs) approved by the concerned Division/Board of Studies (BoS).

Internship-II, which has a minimum duration of two weeks (10 working days), must be completed during the summer vacation after the IV Semester, and evaluation will take place during the V Semester.

23-201-0506 to 23-201-0509 Professional Elective – I (MOOC)	
Code No.	**Broad Area**
23-201-0506(IE)	Precast Construction
23-201-0507	Traffic Engineering
23-201-0508	Engineering Seismology
23-201-0509	Disaster Management

SEMESTER VI

Code No.	Subject	L H/W	T H/W	P/D H/W	C	Marks		Total
						CA	SEE	
23-201-0601	Environmental Engineering –I	3	1	0	3	50	50	100
23-201-0602	Design of Steel Structures	3	1	0	3	50	50	100
23-201-0603	Advanced Methods of Structural Analysis	3	1	0	3	50	50	100
23-201-0604	Water Resources and Irrigation Engineering	3	1	0	3	50	50	100
23-201-0605	Construction Management	3	1	0	3	50	50	100
23-201-06**	Professional Elective – II	3	1	0	3	50	50	100
23-201-0610	Environmental Engineering Laboratory	0	0	3	1	25	25	50
23-201-0611	Mini Project-Architecture Design Studio	0	0	3	1	25	25	50
	TOTAL	18	6	6	**20**			
Minor in Civil Engineering								
23-201-0612#	MOOC-III: Broad Area-Building Services Engineering and Planning	0	0	0	3	0	0	100
23-201-0613	Mini Project	0	0	3	3	100	-	100
Honours in Civil Engineering								
23-201-0614#	MOOC-I: Broad Area- Contracts and Legal Aspects in Construction	0	0	0	3	0	0	100
23-201-0615#	MOOC-II: Broad Area- Advanced Foundation Engineering	0	0	0	3	0	0	100

Students should take Massive Open Online Courses (MOOCs) approved by the concerned Division/Board of Studies (BoS)

23-201-0606 to 23-201-0609 Professional Elective – II	
Code No.	**Subject**
23-201-0606(IE)	Construction Engineering and Materials Management
23-201-0607	Pavement Analysis and Design
23-201-0608	Air Pollution Control and Management
23-201-0609	Machine Learning in Civil Engineering

SEMESTER VII

Code No.	Subject	L H/W	T H/W	P/D H/W	C	Marks		Total
						CE	SEE	
23-201-0701	Environmental Engineering – II	3	1	0	3	50	50	100
23-201-0702	Quantity Surveying and Valuation	3	1	0	3	50	50	100
23-201-0703	Design of Concrete Structures –II	3	1	0	3	50	50	100
23-201 -07**	Professional Elective – III	3	1	0	3	50	50	100
23-201 -07**	Open Elective –I	3	0	0	3	50	50	100
23-201 -0712	Structural Design Studio	0	0	3	1	25	25	50
23-201 -0713	Structural Engineering and Building Technology Laboratory	0	0	3	1	25	25	50
23-201 -0714	Entrepreneurship Development	0	0	2	1	50	-	50
23-201 -0715	Project –Phase I	0	0	3	2	50	-	50
23-201 -0716	Internship-III	0	0	0	1	50	-	50
	TOTAL	**15**	**4**	**11**	**21**			
Honours in Civil Engineering								
23-201-0717#	MOOC III – Broad Area: Finite Element Methods	0	0	0	3	0	0	100

**Electives - A student should opt for at least one open elective offered by a Division other than their branch of study in the 7th or 8th semester.

Internship-III, which has a minimum duration of two weeks (10 working days), must be completed during the summer vacation after the VI Semester, and evaluation will take place during the VII Semester

Students should take Massive Open Online Courses (MOOCs) approved by the concerned Division/Board of Studies (BoS)

23-201 -0704 to 23-201-0707 Professional Elective – III	
Code No.	Subject
23-201 -0704 (IE)	Ground Improvement Techniques
23-20 1-0705	Bridge Engineering
23-201 -0706	River Engineering
23-201 -0707	Architecture and Urban Planning

23-20 -0708 to 23-20 -0711 Open Elective – I	
Code No.	Subject
23-201-0708	Modern Construction Materials
23-201-0709	Housing Policy and Planning
23-201-0710	Industrial Waste Engineering and Management
23-201-0711	Non-destructive testing and Evaluation of Structures

SEMESTER VIII- Regular Track

Code No.	Subject	L H/W	T H/W	P/D H/W	C	Marks		Total
						CA	SEE	
23-201 -08**	Professional Elective IV	3	1	0	3	50	50	100
23-201 -08**	Professional Elective V	3	1	0	3	50	50	100
23-201 -08**	Professional Elective VI	3	1	0	3	50	50	100
23-201 -08**	Open Elective II	3	0	0	3	50	50	100
23-201 -0818	Seminar	0	0	3	1	50	-	50
23-201 -0819	Project Phase II	0	0	12	6	200	-	200
23-201 -0820	Comprehensive Viva Voce	-	-	0	1	-	50	50
	TOTAL	**12**	**3**	**15**	**20**			

SEMESTER VIII- Internship Track*

Code No.	Subject	L Hours/ Week	T Hours/ Week	P/D Hours/ Week	C	Marks		Total
						CA	SEE	
23-201 -08**	Professional Elective IV	3	1	0	3	50	50	100
23-201 -08**	Elective (Professional /Open)	3	1	0	3	50	50	100
23-201 -0818	Seminar			3	1	50	-	50
23-201 -0819	Project Phase – II			12	6	200	-	200
23-201 -0820	Comprehensive Viva Voce			0	1	-	50	50
23-201 -0821	Internship-IV				6	200		200
	TOTAL	**6**	**2**	**15**	**20**			

23-201 -0801 to 23-201-0804 Professional Elective – IV	
Code No.	Subject
23-201-0801	Design of special Structures
23-201-0802	Building Information Modelling
23-201-0803	Construction Safety and Fire Engineering
23-201-0804	Remote Sensing and GIS

23-201-0805 to 23-201-0808 Professional Elective – V	
Code No.	Subject
23-201-0805	Construction Economics and Finance
23-201-0806	Retrofitting and Rehabilitation of Structures
23-201-0807	Geo-environmental Engineering
23-201-0808	Design of Hydraulic Structures

23-201-0809 to 23-201-0812 Professional Elective – VI	
Code No.	Subject
23-201 -0809	Earthquake Engineering
23-201 -0810	Design of Masonry Structures
23-201 -0811	Watershed Management
23-201-0812	Solid Waste Management

23-201-0813 to 23-201-0817 Open Elective – II*	
Code No.	Subject
23-201-0813	Building Services Engineering
23-201-0814	Environmental Impact Assessment
23-201-0815	Sustainable Built Environment
23-201-0816	Experimental Stress Analysis
23-200-0817*	Constitutional Law

*Common to all programmes

List of Courses for Minor in Civil Engineering

Code No.	Subject	L H/W	T H/W	P/D H/W	C	Marks		Total Marks	Offering Semester	Mode of learning
						CA	SEE			
23-201-0310	Civil Infrastructure Engineering	3	0	0	3	50	50	100	III	Class room
23-201-0410	Concrete Technology-Theory and Practice	3	0	0	3	50	50	100	IV	Class room
23-201-0411	MOOC-I: Broad Area-Sustainable Construction Practices	0	0	0	3	0	0	100	IV	Class room/ On-line
23-201-0513	MOOC-II: Broad Area: Disaster Management	0	0	0	3	0	0	100	V	Class room/ On-line
23-201-0612	MOOC-III: Broad Area- Building Services Engineering and Planning	0	0	0	3	0	0	100	VI	Class room/ On-line
23-201-0613	Mini Project	0	0	3	3	100	0	100	VI	

*For MOOC-I, MOOC- II and MOOC- III, students can select Swayam/NPTEL courses, approved by the BoS in Civil Engineering.

List of Courses for Honours in Civil Engineering

Code No.	Subject	L H/W	T H/W	P/D H/W	C	Marks		Total Marks	Offering Semester	Mode of learning
						CA	SEE			
23-201-0412	Advanced Concrete Technology	3	0	0	3	50	50	100	IV	Class room
23-201-0514	Subsurface Investigations and Instrumentation	3	0	0	3	50	50	100	V	Class room
23-201-0515	Research Methodology	3	0	0	3	50	50	100	V	Class room
23-201-0614	MOOC-I: Broad Area- Contracts and Legal Aspects in Construction	0	0	0	3	0	0	100	VI	Class room/ On-line
23-201-0615	MOOC-II: Broad Area- Advanced Foundation Engineering	0	0	0	3	0	0	100	VI	Class room/ On-line
23-201-0717	MOOC -III: Broad Area- Finite Element Methods	0	0	0	3	0	0	100	VII	Class room/ On-line

*For MOOC –I, MOOC- II and MOOC III students can select Swayam/NPTEL courses, approved by the BoS in Civil Engineering.

Industry based Electives

Industry based Electives are offered in 5th, 6th and 7th Semesters and are listed among the Professional Electives with notation (IE) along with the subject code. A student should opt for at least one Industry based elective during the B.Tech. programme.

MOOC

Every student shall undergo at least one MOOC of a minimum 12 weeks duration during the programme (preferably before the final semester) as per the University Regulations for conducting online courses (MOOC)

Open Electives:

Open Electives are offered in 7th and 8th Semesters. A student should opt for at least one Open Elective offered by any Division other than their branch of study.

SEMESTER VIII Internship Track

Students who intend to go for internship track should inform the division head concerned before the commencement of 8th semester. The students will be given an option to change the track within 30 days from the commencement of 8th semester.

Students opting for Internship Track have to do Project-Phase – II and appear for the Comprehensive Viva-Voce.

The interns may opt for courses recommended by the division from the list of Swayam/NPTEL courses approved by BoS.

The students opting for divisional courses have to fulfill the requirements of continuous assessment and semester end examination.

One elective from Open Elective pool is mandatory if they have not completed one mandatory Open Elective in the seventh semester.

Project Phase II is the continuation of Project Phase I in the seventh semester or a separate one approved by the division

The Internship-IV, of a minimum six weeks duration, must be done in an Industry approved by either the Placement Cell or the respective Department based on a valid MOU or in any Government organization or any organization approved by the division.

The Internship-IV is equivalent to two 3-credit courses of total 200 marks

The progress of Internship-IV will be evaluated twice during the semester, along with the internal examinations and finally after the completion of the internship.

Evaluation Pattern for Theory and Practical courses

1. Theory courses

Type of Questions for Semester End Examination (SEE)

PART - A (5 x 2 = 10 marks)

Question No. I (a) to (e) –Five short answer questions of 2 marks each with at least one question from each of the four modules.

PART - B (4x10 = 40 marks)

Question nos. II and III (from Module I) of 10 marks each with option to answer either II or III. The question may have sub sections (a) and (b)

Question nos. IV and V (from Module II) of 10 marks each with option to answer either IV or V. The question may have sub sections (a) and (b).

Question nos. VI and VII (from Module III) of 10 marks each with option to answer either VI or VII. The question may have sub sections (a) and (b).

Question nos. VIII and IX of 10 marks each with option to answer either VIII or IX. The question may have sub sections (a) and (b)

The maximum marks that can be awarded for the Semester End Examination (SEE) will be only 50.

2. Practical courses

50% marks is earmarked for Continuous Evaluation, and 50% marks for Semester End Examination. The Semester End Examination to be conducted by a minimum of two examiners.

3. Pass Requirements

A candidate has to obtain a minimum of 50% marks for continuous assessment and semester end examination put together with a minimum of 40% marks in the semester end examination for a pass in theory and laboratory courses.

In the case of theory/laboratory/other courses having only continuous assessment, a candidate has to obtain a minimum of 50% marks in continuous assessment for a pass.

SEMESTER I
23-200-0101A CALCULUS

Course Outcomes

On completion of this course the student will be able to:

1. Solve ordinary differential equations and linear differential equations of higher orders with constant coefficient and apply them in engineering problems
2. Determine the maxima and minima of multi variable functions.
3. Convert line integrals into surface integrals and surface integrals into volume integrals
4. Illustrate the physical meaning and application of gradient, divergence and curl.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	2	2	2					
CO2	3	3	3	2	2	2	2					
CO3	3	3	3	2	2	2	2					
CO4	3	3	3	2	2	2	2					

1-Slightly; 2-Moderately; 3-Substantially

Module I

Ordinary differential equations:

First order differential equations - exact differential equations, Bernoulli's equations--Methods of solution and Simple applications.

Linear differential equations of higher orders with constant co-efficient-Methods of solution of these equations. Cauchy's linear differential equations. Simultaneous linear differential equations- Simple applications of linear differential equations in engineering problems –Electrical Circuits, Mechanical Systems.

Module II

Partial differentiation: Partial differentiation-Concept of partial derivative - Chain rule- Total derivative- Euler's theorem for homogeneous functions, Differentials and their applications in errors and approximations, Jacobians - Maxima minima of functions of two variables (Proof of the result not required)- Simple applications.

Co-ordinate systems: Rectangular co-ordinates-Polar co-ordinates-In plane and in Space-Cylindrical polar co-ordinates-Spherical polar co-ordinates.

Module III

Integral calculus:

Application of definite integrals: Area, Volume, Arc length, Surface area.

Multiple integral: Evaluation of double integrals-Change of order of integration. Evaluation of triple integrals-Change of Variables in integrals.

Applications of multiple integrals. Plane Area, Surface area &Volumes of solids

Module IV

Vector calculus: scalar and vector point functions, gradient and directional derivative of a scalr point function, divergence and curl of vector point functions, their physical meaning. Evaluation of line integral, surface integral, and volume integrals, Gauss's divergence theorem, Stoke's theorem (No proofs), conservative force fields, scalar potential.

References:

1. Sastry, S.S. Engineering Mathematics: Vol1. (Fourth edition). PHI Learning, New Delhi. (2008).
2. Erwin Kreyzig. Advanced Engineering Mathematics (Tenth edition). John Wiley& Sons, Hoboken, NJ. (2011)
3. Veerarajan, T. Engineering Mathematics. (Third edition). Tata McGraw Hill Publishers, New Delhi. (2011)
4. Grewal, B.S. Higher Engineering Mathematics. (Forty third Edition). Khanna Publishers, New Delhi. (2013).

23-200-0102A ENGINEERING CHEMISTRY

Course Outcomes:

On completion of this course the student will be able to:

1. Explain the basic concepts of chemical thermodynamics, and quantum chemistry.
2. Illustrate the spectroscopic methods in characterizing materials.
3. Develop electro chemical methods to protect different metals from corrosion.
4. Interpret the chemistry of a few important engineering materials and their industrial applications.
5. Understand the principle, concept, working and applications of relevant technologies andcomparison of results with theoretical calculations.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	2									
CO2	3	2	3									
CO3	1	1	1									
CO4	1	1	1									
CO5	2	2	3									

1-Slightly; 2-Moderately; 3-Substantially

Module I

Chemical Thermodynamics: Fundamentals. First law of thermodynamics, Molecular interpretation of internal energy, enthalpy and entropy. Heat of reaction. Kirchoff's equations. Dependence on pressure and temperature. Gibbs-Helmholtz equation. Free energy changes and equilibrium constant. Chemical potential and fugacity. Thermodynamics of biochemical reactions.

Phase Rule: Terms involved in phase rule and examples, Application of phase rule to one component water system, Application of phase rule to two-component systems. (Simple eutectic systems).

Module II

Quantum Chemistry: Schrodinger wave equation – significance of Ψ, well behaved functions, Postulatesof quantum mechanics, Application of quantum mechanics to simple systems - particle in 1 D box, normalization of wave function, Forms of hydrogen atom wave functions and the plots of these functions to explore their spatial variations, Quantum numbers.

Module III

Spectroscopy: Principles of spectroscopy and selection rules. Electronic spectroscopy. Vibrational and rotational spectroscopy of diatomic molecules. Applications. ^{1}H NMR spectroscopy – Principle - Relation between field strength and frequency - chemical shift - spin- spin splitting - coupling constant - applications of NMR- MRI.

Module IV

Electrochemistry: Cell EMF- its measurement and applications. Nernst Equation and application, relationof e.m.f. with thermodynamic functions (ΔH, ΔF and Δ S). Lead storage battery. Corrosion; causes, effectsand its prevention.
Polymers- Classifications- Thermoplastics and thermosetting plastics- A brief account of conducting polymers (polypyrrole and polythiophene) and their applications.
Lubricants- Introduction solid and liquid lubricants- Properties of lubricants-Viscosity index- flash and fire point- cloud and pour point- aniline value.
Refractories: Classifications – Properties of refractories.

Laboratory Experiments to be conducted in the virtual lab mode.

List of Experiments (Minimum six experiments shall be conducted)

1. Determination of the partition coefficient of a solute in two immiscible liquids.
2. Phase diagram of two component System (Naphthalene-dipenylamine)
3. Conductometric titration of **S**trong acids with Strong base.
4. Potentiometric titration: Fe^{2+} vs KMNO4
5. Heat of neutralization
6. Verification of Beer-Lamberts law
7. Determination of rate constant of a reaction.
8. Determination of total hardness of water by EDTA method.
9. Determination of COD of water sample.
10. Determination of alkalinity of water.
11. Determination of chloride content of water by Mohr's method.
12. Determination of dissolved oxygen in given water sample.
13. Determination of acidity of water sample.
14. Determination of adsorption of acetic acid by charcoal.
15. Determination of acidity of water sample

References:

1. B. H. Mahan and R. J. Meyers. University Chemistry, 4th Edition, Pearson publishers. (2009).
2. Peter W. Atkins, Julio de Paula, and James Keele. Physical Chemistry, 11th Edition, Oxford publishers. (2018).
3. M. J. Sienko and R. A. Plane. Chemistry: Principles and Applications, 3rd Edition, McGraw-Hill Publishers. (1980).
4. C. N. Banwell. Fundamentals of Molecular Spectroscopy, 5th Edition, McGraw-Hill Publishers. (2013).
5. B.L. Tembe, M.S. Krishnan and Kamaluddin. Engineering Chemistry (NPTEL Web Course).
6. Shashi Chawla. A Text book of Engineering Chemistry. Dhanpat Rai & Co, New Delhi.(2013).

Pattern of Continuous Assessment

Test – I for the theory portions: 15 marks
Test -II for the theory portions: 15 marks Assignment from the theory portions: 5 marks Laboratory record and Viva -voce: 10 marks (5 + 5) Attendance: 5 marks
The students are required to submit the laboratory record.

23-200-0103A ENGINEERING GRAPHICS

Course Outcomes:

On completion of this course, the student will be able to:

1. Visualize and draw orthographic projection of straight lines and planes and solids
2. Understand development of surface of different geometric shapes
3. Construct isometric scale, isometric projections and views.
4. Obtain multiview projections and solid models of objects using CAD tools

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2		1				1	2		
CO2	2	3	2		1				1	2		
CO3	2	2	2		1				1	2		
CO4	2	2	2		1				1	2		

1-Slightly; 2-Moderately; 3-Substantially

Module I

Introduction to engineering graphics. Drawing instruments and their use. Familiarisation with current Indian Standard Code of Practice for general engineering drawing, scales and geometric curves.

Introduction to orthographic projections- plane of projection- principles of first angle and third angle projections, projection of points in different quadrants.

Orthographic projection of straight lines parallel to one plane and inclined to the other plane- straight lines inclined to both the planes- true length and inclination of lines with reference planes- traces of lines. Projection of plane laminae of geometrical shapes in oblique positions.

Module II

Projection of polyhedra and solids of revolution- frustum, projection of solids with axis parallelto one plane and parallel or perpendicular to other plane- projection of solids with axis inclinedto both the planes- projection of solids on auxiliary planes.

Section of solids by planes inclined to horizontal or vertical planes- true shape of sections.

Module III

Development of surface of cubes, prisms, cylinders, pyramids and cones

Intersection of surfaces- methods of determining lines of intersection - intersection of prism in prism and cylinder in cylinder.

Module IV

Introduction to isometric projection- isometric scales, isometric views- isometric projections of prisms, pyramids, cylinders, cones and spheres.

Introduction to perspective projections: visual ray method and vanishing point method- perspective of circles- perspective views of prisms and pyramids.

Note: A minimum of two exercises from each module shall be done using suitable drafting software.

References:

1. Bhat, N.D. Engineering Drawing. 54th Edition, Charotar Publishing House, Anand. (2023)
2. John, K.C. Engineering Graphics. PHI Learning, New Delhi. (2013)

3. Anilkumar, K.N., Engineering Graphics, 10th Edition, Adhyuth Narayan Publishers. (2016).
4. Gill P.S. Geometric Drawing. B.D Kataria&Sons, Ludhiana. (2012)
5. Kulkarni, D.M., Rastogi, A.P. and Sarkar, A.K., Engineering Graphics with AutoCAD, PHI. (2009).

Pattern of Question Paper for the Semester End Examination

Two questions of 12.5 marks each from all the four modules. Answer one question from each module.(4 x 12.5 = 50 marks).

23-200-0104A BASIC CIVIL ENGINEERING

Course Outcomes

On completion of this course, the student will be able to:

1. Summarize the types, uses and properties of various building materials
2. Explain the different components of building and types of foundations
3. Recognize the fundamental aspects and services in the field of civil engineering
4. Discuss about the surveying techniques and to solve problems related with levelling
5. Prepare site plan based up on the Kerala Panchayath and Municipality Building Rules

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2					1		1				1
CO2	2					1		1				1
CO3	2					1		1				1
CO4	1					1		1				1
CO5	2					1		1				1

1-Slightly; 2-Moderately; 3-Substantially

Module I

Overview of Civil Engineering - Civil Engineering contributions to the welfare of Society – Specialized sub disciplines in Civil Engineering – Structural, Construction, Geotechnical, Environmental, Transportation and Water Resources Engineering.

Engineering Materials: Cement - varieties and grade of cement and their uses. Steel- types of steel for reinforcement bars, steel structural sections. Brick- varieties, tests on bricks. Aggregates, Concrete, watercement ratio, workability, batching, mixing, transportation, placing, compaction and curing of concrete.

Module II

Construction: Components of a building-Foundation- types of foundations- isolated footing, combined footing, raft, pile & well foundation.

Super structure: Brick masonry, English bond and Flemish bond, Stone masonry-Ashlar masonry-Rubblemasonry. Roofing- Steel trusses, roofing for industrial buildings.

Module III

Surveying: Basic Principles of surveying, instruments, methods, and measurements- linear measurements-field works, latest surveying techniques- drones and aerial surveying

Levelling: Levelling instruments, reduction of levels by height of collimation method. Introduction

to Total Station.

Module IV

Site planning as per Building Rules-Selection of site-Site plan preparation for buildings- general provisions regarding site and building requirements- set back, coverage and Floor Area Ratio as per KeralaPanchayath and Municipal Building Rules.

Basic concepts of Intelligent Buildings and Green Buildings, Roads- Classification of Rural and urban Roads, Sources of Water - Water Supply-Quality of Water-Rain water harvesting.

References:

1. Mamlouk, M. S., and Zaniewski, J. P., Materials for Civil and Construction Engineering, PearsonPublishers (2011)
2. Chudley, R., Construction Technology, Vol. I to IV, Longman Group, England (2011).
3. McKay, W. B. and McKay, J. K., Building Construction, Vol. 1 to 4, Pearson India EducationServices. (2013)
4. Rangwala, S.C and Dalal, K.B, Building Construction, Charotar Publishing House (2017).
5. Kerala Panchayath and Municipal Building Rules (Latest revision)

23-200-0105A BASIC MECHANICAL ENGINEERING

Course Outcomes:

On completion of this course, the student will be able to:

1. Summarise the role of mechanical engineering, different energy sources, and basic thermodynamiclaws
2. Illustrate the principles and types of power generating and power producing devices
3. Explain the working of power transmission systems, electric and hybrid vehicles and modern fuelinjection systems.
4. Demonstrate the types and classification of composite and smart materials and joining processes
5. Summarise the machine tools operations and advanced manufacturing systems
6. Explain the concepts of Mechatronics, Robotics, and Automation in IoT

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3					1	2			1		1
CO2	3					1	1			1		1
CO3	3					1	1			1		1
CO4	3					1	1			1		1
CO5	3					1	1			1		1
CO6	3					1	1			1		1

1-Slightly; 2-Moderately; 3-Substantially

Module I

Introduction: Role of Mechanical Engineering in Industries and Society- Emerging Trends and Technologies in different sectors such as Energy, Manufacturing, Automotive, Aerospace, and Marine sectors.

Introduction to thermodynamic laws, power generating devices: Boilers, Turbines (Steam & Gas),

IC engines: Components and Working Principles of two stroke petrol engine and 4-Strokes Petrol and DieselEngines, Application of IC Engines. (Elementary ideas only no numerical problems).
Introduction to power consuming devices: Refrigerator, types and properties of refrigerants, working ofdomestic refrigerators, Air-conditioning systems, Windows and Split systems (only elementary ideas, no numerical problems)

Module II

Introduction to power transmission systems: Belts, chain, and Gear drives, types and application, (numerical problems related to simple power calculations only).
Energy: Introduction and applications of Energy sources like Fossil fuels, nuclear fuels, Hydel, Solar, wind, and bio-fuels, Environmental issues like Global warming and Ozone depletion.
Modern fuel injection systems in CI and SI engines: CRDi, MPFI systems, cooling and lubricating systems in two stroke and four stroke engines. (Only elementary ideas with block diagrams).
Insight into Future Mobility: Electric and Hybrid Vehicles, Components of Electric and HybridVehicles. Advantages and disadvantages of EVs and Hybrid vehicles.

Module III

Introduction to engineering materials: composite and smart materials.
Joining Processes: Soldering, Brazing and Welding, Definitions, classification of welding process, Arc welding, Gas welding and types of flames.

Machine Tool Operations: Working Principle of lathe, Lathe operations: Turning, facing, knurling. Working principles of Drilling Machine, drilling operations: drilling, boring, reaming. Working of MillingMachine, Milling operations: plane milling and slot milling.
(No sketches of machine tools, sketches to be used only for explaining the operations).
Introduction to Advanced Manufacturing **Systems**: Introduction, components of CNC, advantages andapplications of CNC, 3D printing.

Module IV

Introduction to Mechatronics and Robotics: open-loop and closed-loop mechatronic systems. Classification based on robotics configuration: polar cylindrical, Cartesian coordinate and spherical. Application, Advantages and disadvantages.
Automation in industry: Definition, types – Fixed, programmable and flexible automation, basic elementswith block diagrams, advantages.
Introduction to IOT: Definition and Characteristics, Physical design, protocols, Logical design of IoT, Functional blocks, and communication models.

References:

1. Jonathan Wickert and Kemper Lewis. An Introduction to Mechanical Engineering, ThirdEdition, Cengage Learning (2012).
2. Hazra Choudhry and Nirzar Roy. Elements of Workshop Technology (Vol. 1 and 2), MediaPromoters and Publishers Pvt. Ltd. (2010).
3. V. Ganesan. Internal Combustion Engines, 4th edition, Tata McGraw Hill Education(2017).
4. Appu Kuttan K K. Robotics Volume 1, I K. International Publishing House Pvt Ltd (2013).
5. SRN Reddy, Rachit Thukral and Manasi Mishra. Introduction to Internet of Things: APractical Approach, ETI Labs (2021).

23-200-0106A ENVIRONMENTAL AND LIFE SCIENCES

Course Outcomes

On completion of this course the student will be able to:

1. Identify the global environmental issues
2. Examine the types of pollution in society along with their sources
3. Elucidate the basic biological concepts via relevant industrial applications and case studies.
4. Evaluate the principles of design and development, for exploring novel bioengineering projects.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2				3	3					
CO2	2	2				2	3					
CO3	2	2				2	2					
CO4	2	2				2	2					

1-Slightly; 2-Moderately; 3-Substantially

Module -I

Environment, Ecosystems and Biodiversity: Definition, scope and importance of environment — need for public awareness — concept of an ecosystem — structure and function of an ecosystem — producers, consumers and decomposers — energy flow in the ecosystem — ecological succession — food chains, foodwebs and ecological pyramids — Introduction, types, characteristic features, structure and function of the

(a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams,lakes, rivers, oceans, estuaries) — Introduction to biodiversity definition: genetic, species and ecosystem diversity — biogeographical classification of India — value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values — Biodiversity at global, national and local levels — Indiaas a mega-diversity nation — hot-spots of biodiversity — threats to biodiversity: habitat loss, poaching ofwildlife, man-wildlife conflicts — endangered and endemic species of India — conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Field study of common plants, insects, birds;Field study of simple ecosystems — pond, river, hill slopes, etc.

Module -II

Natural Resources: Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people — Water resources: Use and over- utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems

— Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies — Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies — Energy resources: Growing energy needs, renewable and non-renewable energy sources, use ofalternate energy sources. case studies — Land resources: Land as a resource, land degradation, man inducedlandslides, soil erosion and desertification — role of an individual in conservation of natural resources. Theconcept of sustainable development.

Environmental Pollution: Definition — causes, effects and control measures of: (a) Air pollution (b)

Waterpollution and (c) Soil pollution (d) Noise pollution. Management of e-waste.

Module – III

Biomolecules and their Applications (Qualitative): Carbohydrates (cellulose-based water filters, PHA and PLA as bioplastics), Nucleic acids (DNA Vaccine for Rabies and RNA vaccines for Covid19, Forensics
– DNA fingerprinting), Proteins (Proteins as food – whey protein and meat analogs, Plant based proteins),Lipids (biodiesel, cleaning agents/detergents), Enzymes (glucose-oxidase in biosensors, lignolytic enzymein bio-bleaching).

Nature-Bioinspired Materials and Mechanisms (Qualitative): Echolocation (ultrasonography, sonars), Photosynthesis (photovoltaic cells, bionic leaf). Bird flying (GPS and aircrafts), Lotus leaf effect (Super hydrophobic and self-cleaning surfaces), Plant burrs (Velcro), Shark skin (Friction reducing swim suits), Kingfisher beak (Bullet train). Human Blood substitutes - hemoglobin-based oxygen carriers (HBOCs) andperflourocarbons (PFCs).

Module -IV

Human Organ Systems and Bio Designs (Qualitative): Brain as a CPU system (architecture, CNS and Peripheral Nervous System, signal transmission, EEG, Robotic arms for prosthetics. Engineering solutionsfor Parkinson's disease). Eye as a Camera system (architecture of rod and cone cells, optical corrections, cataract, lens materials, bionic eye). Heart as a pump system (architecture, electrical signalling – ECG monitoring and heart related issues, reasons for blockages of blood vessels, design of stents, pace makers, defibrillators). Lungs as purification system (architecture, gas exchange mechanisms, spirometry, abnormal lung physiology - COPD, Ventilators, Heart-lung machine). Kidney as a filtration system (architecture, mechanism of filtration, CKD, dialysis systems). Muscular and Skeletal Systems as scaffolds (architecture,mechanisms, bioengineering solutions for muscular dystrophy and osteoporosis).
Bioprinting techniques and materials, 3D printing of ear, bone and skin. 3D printed foods.

References:

1. Rajagopalan, R. Environmental Studies: From Crisis to Cure. Oxford University Press, New Delhi,(2015).
2. Erach Bharucha. Textbook of Environmental Studies and Ethics. Universities Press (India),Hyderabad, (2013).
3. Thyagarajan S., Velmurugan N., Rajesh M.P., Nazeer R.A., Thilagaraj W., Barathi S., and Jaganthan M.K. Biology for Engineers, Tata McGraw-Hill, New Delhi, (2012).
4. Arthur T. Johnson. Biology for Engineers, CRC Press, Taylor and Francis, (2019).
5. Sohini Singh and Tanu Allen. Biology for Engineers, Vayu Education of India, New Delhi, (2020).
6. Ibrahim Ozbolat. 3D Bioprinting: Fundamentals, Principles and Applications, Academic Press,(2016).

23-200-0107A CIVIL ENGINEERING WORKSHOP

Course Outcomes:

On completion of this course the students will be able to:

1. Identify various building materials and simple plumbing and sanitary fittings
2. Construct brick walls using English Bond and Flemish Bond
3. Set out a building as per a given building plan using surveying instruments
4. Compute the various quantities of materials required for a building

Course Articulation Matrix

	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1					1	1	1	1		1
CO2	1						1	1	1			1
CO3	1						1	1	1	1		1
CO4	1	1					1	1	1	1		1

1-Slightly; 2-Moderately; 3-Substantially

List of Experiments

1. Building Materials:

Familiarization of building materials and their testing.

2. Plumbing:

Introduction to simple plumbing and sanitary fittings.

3. Masonry:

Construction of English bond and Flemish bond – wall junction – one brick – one and a halfbrick –and two brick thick

4. Surveying:

Surveying and levelling instruments

Setting out of building (single room only) as per the given building plan using surveyinginstruments

5. Demonstration of Total Station

Computation of area and/or volume of various features of a building/structure such as door andwindow size, number of bricks required to construct a wall of a building, diameter of bars usedin windows, RCC construction etc. (to create an awareness of measurements and units)

Assignment: *Students shall collect the list of various building materials used for the constructionof a building including their market rate.*

23-200-0108A MECHANICAL ENGINEERING WORKSHOP

Course Outcomes:

On completion of this course the student will be able to:

1. Identify and use tools, and make different types of joints used in carpentry, fitting, and sheetmetal shop.
2. Compare basic fabrication techniques of different types of welding.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						2			2			
CO2						2			2			

1-Slightly; 2-Moderately; 3-Substantially

Preliminary exercises for beginners in all the following shops. Specific models may be designed by theteachers.

1) Fitting Shop
2) Sheet Metal Shop
3) Foundry Shop
4) Welding Shop
5) Carpentry Shop
6) Familiarization of wheel replacement, automobile battery charging, identification of differentdashboard indications, IC engine parts, refrigerators, nut, bolts and its specifications.

SEMESTER II

23-200-0201A COMPUTER PROGRAMMING AND PROBLEM SOLVING

Course Outcomes:

On completion of this course the student will be able to:

1. Elucidate the basic architecture and functionalities of a computer and also recognize the hardware parts.
2. Apply programming constructs of C language to solve real-world problems
3. Explore user-defined data structures like arrays in implementing solutions to problems like searching and sorting
4. Explore user-defined data structures like structures, unions and pointers in implementing solutions
5. Design and Develop Solutions to problems using modular programming constructs using functions

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	3							
CO2	3	2	2	2	3							
CO3	2	2	2	2	3							
CO4	2	2	2	2	3							
CO5	2	2	2	2	3							

1-Slightly; 2-Moderately; 3-Substantially

Module I

Basics of Computer and Information Technology: Digital Computer System (CPU, Memory, I/O devices)- Working of a digital computer-Hardware and Software: Definition - Categories of Software, Application of Computers.

Problem Solving Methodology: Problem statement, Analysis, Design a solution, Implement/Coding the solution, Test the solution, Design tools (Algorithm, Flow-chart, Pseudo-code)- Develop algorithms for simple problems.

Programming Languages: Types of programming languages-Compiler–Interpreter-Linker–Loader–Execution of program.

Module II

Basics of C: Character set-Identifier- Keywords- Constants –Data Types- Variables and declaration – Operators and Expressions – Operator precedence and associativity – Expression Evaluation (Simple Examples) - Input and output functions – Simple computational problems involving the above constructs.

Control Statements: Selection, Conditional operator, Iteration (for, while, do-while), Branching (switch, break, continue, goto), Nesting of control statements- Problems using control statements.

Module III

Arrays and Strings: 1D and 2D arrays –Searching (Linear and Binary) - Sorting (Bubble, Selection) –

Matrix manipulation programs – Strings and basic operations on strings – Strings functions -Programs on string manipulation.
Functions: Definition – Calling – Declaration – Parameter Passing (by value and by reference) – Recursion –Programs based on functions.
User defined data types: Structure – Union - Enumerated data type - Programs involving structure and union.

Module IV

Pointers: Declaration, Initialization – Operations on pointers- Pointers and arrays – Pointers and Structures-Command line arguments-Dynamic memory allocation — Programs involving the above concepts.
Files: File concept – File pointer – File handling operations (open, close, read, write etc) on sequential and random-access files. Programs on file manipulations using fgetc(), fgets(),fseek().

References:

1. Pradip Dey and Manas Ghosh. Computer Fundamentals and Programming in C, Second Edition, Oxford University Press (2013).
2. Reema Thareja. Computer Fundamentals and Programming in C, Second Edition, Oxford University (2016).
3. Byron Gottfried. Programming with C, Second edition, Tata McGraw-Hill (2006).
4. Brian W. Kernighan and Dennis M. Ritchie. The C Programming Language, Second Edition, Pearson Education, (2001).
5. E. Balagurusamy. Programming in ANSI C, 8th Edition, Tata McGraw-Hill (2017).
6. Kanetkar Y. Let Us C: Authentic guide to C programming language, 19th Edition, BPB Publications (2022).

19-200-0202A ENGINEERING PHYSICS

Course Outcomes:

On completion of this course the student will be able to:

1. Interpret modern devices and technologies based on lasers and optical fibres.
2. Explain the basic principles of crystal physics
3. Summarise the characteristics and applications superconducting materials nanomaterials and smart materials
4. Illustrate the theory of semiconductors and magnetic materials
5. Understand the principle, concept, working and applications of relevant technologies and comparison of results with theoretical calculations.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2									
CO2	3	1	1									
CO3	3	2	1									
CO4	2	2	2									
CO5	3	2	2									

1-Slightly; 2-Moderately; 3-Substantially

Module I

Laser-properties-interaction of radiation with matter-absorption, spontaneous and stimulated emission-principle of laser--Einstein coefficients- population inversion- metastable state -Basic components of a laser- construction and working of Ruby laser and He-Ne laser -Applications.

Fibre optics - Basic structure - principle- step-index fibre and graded index fibre- single mode and multimode- Numerical aperture (no derivation) -acceptance angle and acceptance cone-propagation-Applications.

Module II

Crystallography – Space lattice- Basis- Unit cell-Bravais lattices- cubic lattices-sc, bcc, and fcc- Number of atoms per unit cell- Co-ordination number- Atomic radius-Packing factor- Relation between density and crystal lattice constants- Lattice planes and Miller indices-

X- rays- Production, Properties, characteristic and continuous X-rays, Moseley's law; Diffraction of X-rays-Bragg's law (derivation), Bragg's Spectrometer

Module III

Superconductor-transition temperature-Meissner effect-effect of current- isotope effect- Type 1 and type 2 superconductors –BCS theory (basic idea only)- Applications.

Nanomaterials- nanoparticle, nano ring, nano rod, nanoshells, fullerens- surface occupancy-quantum confinement effect- optical, electrical, magnetic and mechanical properties - Applications.

Smart materials-Liquid crystals, Metallic glasses, Shape memory alloys- optical, electrical magnetic and mechanical properties-applications.

Module IV

Magnetic Materials-Magnetic pole strength, magnetic moment, intensity of magnetization, magnetic field, magnetic induction, magnetic susceptibity, magnetic permeability, classification. Hard and soft-Paramagnetic materials-properties, Diamagnetic materials-properties, Ferromagnetic properties-Antiferromagnetic materials, Ferrimagnetic materials- Applications

Semiconductor-Properties-Energy band description-effect of temperature-intrinsic, extrinsic semiconductors-n-type and p-type semiconductors-Majority and minority carriers.

Laboratory Experiments to be conducted in the virtual lab mode

List of Experiments (Minimum six experiments shall be conducted)

1. Transmission grating: To find the wavelength of laser beam
2. Determination of NA of an optical fibre
3. Laser beam divergence and spot size
4. Determination of Grain size and lattice parameter using Bragg's X-ray spectrum
5. Lattice planes from X Y Z intercepts
6. LCR circuits to find the resonance frequency and quality factor.
7. Diode characteristics
8. Ohms law
9. LED circuits to find cutting voltage.
10. Determination of Energy band gap of a given semiconductor material
11. Magnetic field along the axis of a circular coil carrying current
12. Deflection Magnetometer

References:

1. S. Mani Naidu, A Text book of Engineering Physics, Pearson. (2010)

2. A.S. Vasudeva, Modern Engineering Physics, S. Chand & Co. (2013)
3. Prabir K. Vasu and Hrishikesh Dhasmana, Engineering Physics, Ane books Pvt. Ltd. (2010)
4. S.O. Pillai and Sivakami, Applied Physics, New Age International (P) Ltd., Second Edition.(2008)
5. G.S. Raghuvanshi, Engineering Physics, Prentice Hall of India. (2008)

Pattern of Continuous Assessment

Test – I for the theory portions: 15 marks
Test -II for the theory portions: 15 marks
Assignment from the theory portions: 5 marks
Laboratory record and Viva-voce: 10 marks (5 + 5)
Attendance: 5 marks
The students are required to submit the laboratory record.

23-200-0203A ENGINEERING MECHANICS

Course Outcomes:

On completion of this course, a student will be able to

1. Explain principles and theorems related to rigid body mechanics
2. Identify the components of a system of forces acting on the rigid body
3. Apply the conditions of equilibrium to various practical problems involving different force system.
4. Choose appropriate theorems, principles or formulae to solve problems of mechanics.
5. Solve problems involving rigid bodies, applying the properties of distributed areas and masses

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3										
CO2	2	3										
CO3	2	3										
CO4	2	3										
CO5	2	3										

1-Slightly; 2-Moderately; 3-Substantially

Module I

Introduction to Mechanics: Definition and classification of mechanics – rigid body (statics and dynamics) and deformable body mechanics.

Forces and Force systems: Force and its characteristics, Principles of statics – concept of resultant and equilibrant, Composition and resolution of forces, force systems.

Coplanar Concurrent force system: Equilibrium of two, three and more than three forces, Moment of a force, Varignon's theorem of moments, Equations of equilibrium, Friction and its effects on bodies,

Engineering applications.
Coplanar Parallel force System: Two parallel forces, General case of parallel forces in a plane, Centreof parallel forces, Centre of gravity, Centre of mass, Centroids of curves, areas and volumes – regular and composite, Pappus's theorems, Equilibrium of distributed forces in a plane, Applications of the concept of centroid in engineering practice.

Module II

Moment of Inertia: Concept of moment of inertia and second moment of area, Moment of inertia of regular and composite solids, Second moment of area of regular and irregular surfaces, Polar moment of inertia / second moment of area, Product of inertia, Principal moments of inertia and principal axes, Applications of the concepts in engineering practice.
Coplanar non-concurrent force system: Resultant of a general case of force system in a plane, Equilibrium equations, Applications in engineering practice.
Analysis of Plane trusses and frames: Concept of load carrying mechanism in trusses and frames – internal (axial) forces, two force and multi force members, Analysis of plane trusses by Method of joints and Method of sections, Analysis of Plane frames by Method of members, Applications of trusses and frames in structures.

Module III

Introduction to Dynamics: Definitions, Units, Divisions – Kinematics, Kinetics.
Rectilinear translation: Kinematics of rectilinear motion – displacement, velocity, acceleration, Kinetics – Differential equations of motion, D'Alembert's principle in rectilinear translation and its applications, Motion of a particle due to a constant force, Motion of a particle due to a force proportional to displacement – Simple harmonic motion, Momentum and impulse, Work and energy, Conservation of energy, Collision of two bodies – direct central impact.

Module IV

Curvilinear translation: Kinematics of curvilinear translation – components of displacement, velocityand acceleration, normal and tangential acceleration, Kinetics – Differential equations of motion, Motion of a projectile – projection on horizontal and inclined surfaces, D'Alembert's principle in curvilinear motion and its applications, Moment of momentum, Work and energy in curvilinear motion.Rotation of a rigid body: Kinematics of rotation – angular displacement, velocity and acceleration, RPM, Relations of kinematic parameters of linear and angular motions, Kinetics – Equation of motionof a rigid body rotating about a fixed axis, Rotation under the action of a constant moment, Rotation proportional to angular displacement.

References

1. Timoshenko and Young. Engineering mechanics. McGraw Hill Book Company, Singapore. (1956)
2. Beer, F. P. and Johnston, E. R. Mechanics for Engineers (Vol. 1: Statics and Vol.2: Dynamics). Tata McGraw Hill, New Delhi. (2004).
3. Merriam, H. L. and Kraige, L. G. (2003). Engineering Mechanics (Vol. 1: Statics and Vol.2: Dynamics*)*. John Wiley and Sons, Somerset, N.J. (2003)
4. Hibbeller, R.C. Engineering mechanics. Vol. 1: Statics, Vol. 2: Dynamics. (Twelfth edition). Pearson Education Asia Pvt. Ltd., New Delhi (2010).
5. Rajasekaran, S. and Sankarasubramanian, G. Fundamentals of Engineering Mechanics. (Third edition). Vikas Publishing House Pvt. Ltd., New Delhi. (2010)

23-200-0204A BASIC ELECTRICAL ENGINEERING

Course Outcomes:

On completion of this course the student will be able to:

1. Explain the concepts of various energy sources and electric circuits.
2. Apply the basic electrical laws to solve circuits.
3. Discuss the construction and operation of various electrical machines.
4. Identify suitable electrical machine for practical implementation

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	0	1	1	1					
CO2	3	3	2	1	1	1	0					
CO3	3	2	1	1	1	1	1					
CO4	3	2	2	1	0	1	1					

1-Slightly; 2-Moderately; 3-Substantially

Module I

Introduction: Conventional and non-conventional energy resources; General structure of electrical power systems using single line diagram approach.

Power Generation: Hydel, Nuclear, Solar & wind power generation (Block Diagram approach).

DC Circuits: Ohm's Law and its limitations. Kirchhoff's Current and Voltage Laws (KCL and KVL), series, parallel, series-parallel circuits. Faradays law, Lenz's law, Induced emf. Simple Numerical.

Module II

A.C. Fundamentals: Equation of AC Voltage and current, waveform, time period, frequency, amplitude, phase, phase difference, average value, RMS value, form factor, peak factor. (Only definitions)

Voltage and current relationship with phasor diagrams in R, L, and C circuits. Concept of Impedance. Analysis of R-L, R-C, R-L-C Series circuits. Concepts of active power, reactive power and apparent power. Concept of power factor. (Simple Numerical).

Three Phase Circuits: Generation of Three phase AC quantity, advantages and limitations; star and delta connection, relationship between line and phase quantities (excluding proof)

Module III

DC Machines:

DC Generator: Principle of operation, constructional details, induced emf expression, types of generators. Relation between induced emf and terminal voltage. Simple numerical.

DC Motor: Principle of operation, back emf and its significance. Torque equation, types of motors, characteristics and speed control (armature & field) of DC motors (series & shunt only). Applications of DC motors. Simple numerical.

Module IV

Transformers: Necessity of transformer, principle of operation, Types and construction of single- phase transformers, EMF equation, losses (physical concepts and applications), variation of losses withrespect

to load. Efficiency and simple numerical.
Three-phase induction Motors: Concept of rotating magnetic field, Principle of operation, constructional features of motor, types – squirrel cage and wound rotor. Slip and its significance. (Qualitative aspects only).
Equipment Safety measures: Working principle of Fuse and Miniature circuit breaker (MCB).

Personal safety measures: Electric Shock, Earthing and its types, Safety Precautions to avoid shock.

References:

1. Cotton, H. Electrical Technology. (Seventh edition). CBS Publishers and Distributors, New Delhi (2005).
2. D. P. Kothari and I. J. Nagrath. Basic Electrical Engineering, 4th edition, Tata McGraw Hill (2019).
3. Rajendra Prasad. Fundamentals of Electrical Engineering. Third edition. PHI Learning, NewDelhi (2014).
4. D C Kulshreshtha. Basic Electrical Engineering, First Edition, Tata McGraw Hill (2019).

23-200-0205A BASIC ELECTRONICS ENGINEERING

Course Outcomes:

On successful completion of this course the student will be able to:

1. Illustrate the concept of diode in rectifiers, filter circuits and wave shaping,
2. Interpret the functioning of oscillators and operational amplifiers.
3. Explain the principle of embedded systems and sensors
4. Summarise the functioning of a communication system and different modulation technologies.

Course Articulation Matrix:

	PO1	PO2		PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2					2							
CO2	2					2							
CO3	2					2							
CO4	2					2							

1-Slightly; 2-Moderately; 3-Substantially

Module I:

Semi-conductor devices and applications: p-n junction diode - Characteristics and Parameters Half-wave rectifier, Full-wave rectifiers and filters, Voltage regulators, Output resistance and voltage regulation, Voltage multipliers. (Only concepts and working and principle. No mathematical derivations).
Amplifiers – Types of amplifiers, Gain, Input and output resistance, Frequency response, Bandwidth, Phase shift, Negative feedback, multi-stage amplifiers. (Only elementary ideas. Mathematical treatment is not envisaged)

Module II:

Oscillators – Barkhausen criterion, sinusoidal and non-sinusoidal oscillators, Multivibrators, Crystal controlled oscillators (Only qualitative concepts, working principle, waveforms and applications).
Operational amplifiers -Operational amplifier parameters, Operational amplifier characteristics,

Operational amplifier configurations, Operational amplifier circuits (Only qualitative concepts, working principle and applications). Elementary concepts of logic gates.

Module III:

Introduction to Embedded Systems – Definition, Embedded systems vs general computing systems, Classification of Embedded Systems, Major application areas of Embedded Systems, Elements of an Embedded System, Core of the Embedded System, Microprocessor vs Microcontroller, RISC vs CISC (Elementary concepts only).

Sensors and Interfacing – Instrumentation and control systems (Elementary concepts only), Working principle and applications of Transducers, Sensors, Actuators, LED, and 7-Segment LED Display.

Module IV:

Communication Schemes – Modern communication system scheme, Information source,
And input transducer, Transmitter, Channel or Medium – Hardwired and Soft wired, Noise, Receiver, Multiplexing, Types of communication systems. Types of modulation (only concepts. No mathematical derivations) – AM, FM, Concept of Radio wave propagation (Space, sky)

Elementary concepts of satellite, mobile, and fibre optic communication.

References:

1. Mike Tooley. Electronic Circuits, Fundamentals & Applications,4thEdition, Elsevier (2015).
2. K V Shibu. Introduction to Embedded Systems, 2nd Edition, McGraw Hill Education (India) Private Limited (2016).
3. S L Kakani and Priyanka Punglia. Communication Systems, New Age International Publisher, (2017).

23-200-0206A SOFT SKILLS DEVELOPMENT

Course Outcomes:

On completion of this course the student will be able to:

1. Use English language at the formal and informal levels for daily conversation, presentation, group discussion and debate.
2. Demonstrate the ability to read, comprehend and answer questions based on literary, scientific and technological texts.
3. Develop self-motivation, raised aspiration, belief in one's own abilities and commitment to achieving one's goal.
4. Demonstrate emotional maturity and emotional health.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						1		2	2	3		
CO2						2		2	2	3		
CO3						1		2	2	2		
CO4						1		2	3	2		

1-Slightly; 2-Moderately; 3-Substantially

Module I

Role and importance of verbal communication, Everyday active vocabulary, Common words used in transitions, enhancing vocabulary, affixes and changes in pronunciation and grammatical functions, words often confused in pronunciation and usage. Passage comprehension- skimming, scanning techniques, note making, note taking and summarizing. Deciphering meaning from contexts. Two types of meaning- literal and contextual. Constructive criticism of speeches and explanations.

Module II

Fundamental grammar, Simple structures, passivizing the active sentences, reported speech, the judicious use of tenses and moods of verbs, forming questions and conversion from questions to statements and vice versa, forming open –ended and close- ended questions. Words and style used for formal and informal communication. Practice converting informal language to formal, the diction and the style of writing. Dealing with the nuances of ambiguous constructions in language. Learning authoritative writing skills, polite writing and good netiquette. Writing for internships and scholarships.

Module III

Kinesics, Proxemics, Haptics, and other areas of non-verbal communication, fighting communication barriers, positive grooming and activities on the same.

Different types of interviews, and presentation - oral, poster, ppt. Organizing ideas for group discussions, the difference between GD and debates.

Effective listening and seeking to understand others' perspectives. Non-violent negotiation and persuasion, communicating across age groups, cultures or identity groups.

Higher order thinking and evaluation, information-seeking, research, and independent learning, synthesis, creativity, problem analysis and problem solving. Decision making, Self-reflection and learning from experience.

Module IV

Developing positive self: Understanding oneself, A realistic awareness of oneself and one's abilities, strengths and potential, Self-esteem, Self-efficacy, steps for improvement.Intra-personal skills – Self-control, emotional regulation and self-discipline, conscientiousness, dutifulness, reliability, truthfulness, honesty and trustworthiness. Goal orientation and initiative. Time management – prioritising work.

Interpersonal skills – cross cultural competence and valuing diversity of perspectives, respecting and expressing concern for others. Empathy and ability to notice the effect of one's actions on others, tolerance for disagreement, conflict management and resolution.

Civic engagement and social responsibility – Global and local awareness (issues, challenges, priorities). Vision, ability to imagine something new or improved. Social responsibility and willingness to take constructive action.

References:

1. Duck, Steve and David T. Macmahan. Communication in Everyday Life. 3rd Ed. Sage, (2017).
2. Gamble, Kawl Teri and Michael W. Gamble. The Public Speaking Playbook. Sage, (2015).
3. Raman, Meenakshi and Sangeetha Sharma. Technical Communication: Principles and Practice, Oxford University Press, (2015).
4. Coleman, D. Emotional intelligence: Why it can matter more than IQ, Bantam Books, New York (2006).
5. Devadas Menon. Stop sleep walking through life, Yogi Impressions Books Pvt. Ltd, Mumbai (2012).
6. Barun K Mitra. Personality Development and Softskills, Oxford University Press (2012).

ASSESSMENT

1. 'Soft Skills Development' is a practical and activity-oriented course which has continuous assessment for 50 marks based on class room interaction, activities, and assignments. The activities may include 'Just a Minute' (JAM) sessions, group discussion, role play, debate, and extempore speech. The weightages for the different components shall be as follows:

Class room interaction – 10 marks

Activities – 30 marks

Assignments (from Modules I and II) – 10 marks

2. Semester End Examination is not envisaged.

3. A student should secure a minimum of 50% marks in continuous assessment for a pass in the course.

23-200-0207A COMPUTER PROGRAMMING LABORATORY

Course Outcomes:

On completion of this course the student will be able to:

1. Solve problems efficiently by choosing loops and decision-making statements in C programming.
2. Demonstrate different operations on arrays.
3. Solve problems using functions and recursion.
4. Develop C programs using the concepts of structure, pointers and files.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3											
CO2	2											
CO3	3											
CO4	2											

1-Slightly; 2-Moderately; 3-Substantially

Cycle I

Application Packages:

Text Editor

1. To create a word document like an advertisement.

Spread Sheet

2. To create a spread sheet to analyse the marks of the students of a class and also to create appropriate charts.

Presentation Software

3. To create a presentation for the department using Power Point.

C Programming Basics:

4. To write a program to calculate and display areas of rectangle and triangle.
Decision Making:
5. To write a program for electricity bill preparation.
6. To write a program to find the roots of a quadratic equation.
7. To write a simple menu driven calculator program using switch statement.
8. To write a program to find the sum of digits of a given number.

Cycle II
Looping:
9. To write a program to print all the prime numbers of a given range.
10. To write a program to print the sine and cosine series.
11. To write a program to print Pascal's triangle.
Arrays:
12. To write a program to print the sum and average of elements in an array.
13. To write a program to sort the given numbers using bubble sort.
14. To write a program to perform Matrix addition and matrix multiplication.
String:
15. To write a program to perform string manipulation functions like string concatenations, comparison, find the length and string copy without using library functions.
16. To write a program to arrange names in alphabetical order.

Cycle III
Functions:
17. To write a C program to calculate the mean, variance and standard deviation using functions.
18. To write a C program to perform sequential and binary search using functions.
Recursion:
19. To write a program to print the Fibonacci series using recursive function.
20. To write a program to print the factorial of the given number using recursive function.
Structure:
21. To print the mark sheet of n students using structures.
Pointers:
22. To write a program using pointers to access the elements of an array and count the number of occurrences of the given number in the array.
Files:
23. To write a program to count the number of characters, lines in a file.

References:

1. Pradip Dey and Manas Ghosh, Computer Fundamentals and Programming in C, Second Edition, Oxford University Press, (2013).
2. Smarajit Ghosh, All of C, PHI Learning Pvt. Ltd, (2009).
3. Byron Gottfried, Programming with C, 2 nd edition, Tata McGraw-Hill, (2006).
4. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Second Edition, Pearson Education, (2001).
5. Sukhendu Dey, Debobrata Dutta, Complete Knowledge in C, Narosa Publishing House, New Delhi, (2009).

23-200-0208A BASIC ELECTRICAL AND ELECTRONICS ENGINEERINGLABORATORY

Course Outcomes:

1. Identify the tools used for electrical wiring, electrical accessories, wires, cables, batteries and standard symbols
2. Develop the connection diagram, identify the suitable accessories and materials necessary for wiring simple lighting circuits for domestic buildings
3. Identify and test various electronic components
4. Draw circuit schematics with EDA tools
5. Assemble and test electronic circuits on boards

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3											
CO2	2											
CO3	3											
CO4	2											
CO5	2											

1-Slightly; 2-Moderately; 3-Substantially

List of Exercises / Experiments
(Any 9 exercises to be carried out)

1. a) Demonstrate the precautionary steps adopted in case of Electrical shocks.

b) Identify different types of cables, wires, switches, fuses, fuse carriers, MCB, ELCB and MCCB with ratings.

2. Wiring of simple light circuit for controlling light/ fan point (PVC conduit wiring)

3. Wiring of light/fan circuit using Two-way switches. (Staircase wiring)

4. Wiring of Fluorescent lamps and light sockets (6A) with a power circuit for controlling power device. (16A socket)

5. Wiring of power distribution arrangement using single phase MCB distribution board with ELCB, main switch and Energy meter.

6. a) Identify different types of batteries with their specifications.

b) Demonstrate the Pipe and Plate Earthing Schemes using Charts/Site Visit.

7. Familiarization/Identification of electronic components with specification

(Functionality, type, size, colour coding, package, symbol, cost etc. [Active, Passive, Electrical, Electronic, Electro-mechanical, Wires, Cables, Connectors, Fuses, Switches, Relays, Crystals, Displays, Fasteners, Heat sink etc.)

8. Drawing of electronic circuit diagrams using BIS/IEEE symbols and introduction to EDA tools (such as Dia or X Circuit), Interpret data sheets of discrete components and IC's, Estimation and costing.

9. Familiarization/Application of testing instruments and commonly used tools. [Multimeter, Function

generator, Power supply, DSO etc.] [Soldering iron, Desoldering pump, Pliers, Cutters, Wire strippers, Screw drivers, Tweezers, Crimping tool, Hot air soldering and de- soldering station etc.]

10. Measurement of input and output parameters of a transistor in CE, CB and CC configuration.
11. Design of a centre tap full wave rectifier circuit.
12. Testing of electronic components [Resistor, Capacitor, Diode, Transistor and JFET using multimeter.]
13. Measurement of voltage and current in a series RLC circuit using multimeter
14. Realisation of basic gates.
15. Inhouse substation visit.

23-200-0209A LANGUAGE LABORATORY

Course Outcomes:

On completion of this course the student will be able to:

1. Test pronunciation skills through stress on word accent, intonation, and rhythm.
2. Use English language effectively for writing business letters, resume, minutes of meeting and reports.
3. Use English language effectively to face interviews, group discussions, and public speaking.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1									2	3		2
CO2									2	3		2
CO3									2	3		2

1-Slightly; 2-Moderately; 3-Substantially

The following exercises are prescribed for the Language Laboratory sessions:

1. Introduction to the Sounds of English- Vowels, Diphthongs & Consonants.
2. Introduction to Stress and Intonation.
3. Preparing business letters
4. Preparing a resume
5. Conducting a meeting and writing the minutes
6. Writing a report
7. Situational Dialogues / Role Play.
8. Oral Presentations- Prepared and Extempore.
9. ‘Just A Minute’ Sessions (JAM).
10. Describing Objects / Situations / People.
11. Debate
12. Group discussion

23-200-0210A NSS/NATURE CONSERVATION ACTIVITIES/YOGA

NATIONAL SERVICE SCHEME (NSS)

Course Outcomes:

On completion of this course the student will be able to:

1. Identify the community in which they work
2. Utilise their knowledge in finding practical solution to individual and community problems
   A student enrolling as member of NSS will have to complete 10 hours of training / social service.

NATURE CONSERVATION ACTIVITIES

Course Outcomes:

On completion of this course the student will be able to:

1. Demonstrate the message of sustainable life styles
2. Explain the importance of green plants in mitigating global environmental problems
3. Identify suitable waste management practices for the local community

A student enrolling as member of the Nature Conservation Club will have to complete 10 hours of campus cleaning and greening activities.

YOGA

Course Outcomes:

On completion of this course the student will be able to:

1. Demonstrate the use of yoga for stress management
2. Illustrate the different yogic postures for physical and mental wellbeing.
3. Identify suitable methods of strengthening physical, emotional, intellectual aspects of "self" based on the principles and practices of Yoga and positive psychology.

23-200-0301A LINEAR ALGEBRA AND TRANSFORM TECHNIQUES

(Common for CE, ME, SE)

Course Outcomes:

1. Classify vector spaces, subspaces, spanning sets, linear dependence/independence, basis, and dimension of vector spaces.
2. Apply concepts of linear algebra like rank, Eigen values, Eigen vectors, diagonalization of matrices, inner products, Gram-Schmidt process and linear transformations to solve problems.
3. Analyze a system of linear equations for existence, uniqueness and general form of solutions using rank, inverse and Cayley Hamilton theorem.
4. Evaluate and solve differential and integral equations using Fourier analysis, Fourier transforms and Laplace transforms.

Course Articulation Matrix:

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

1- Slightly; 2- Moderately ;3- Substantially

Module I

Linear Algebra 1: Rank of a Matrix, Solution of a Linear System of Equations, Existence, Uniqueness, General Form, Eigenvalues and Eigenvectors, Properties of Eigenvalues, Diagonalization of a Matrix, Cayley-Hamilton Theorem (without proof), Verification, Finding Inverse and Power of a Matrix Using It, Quadratic Form, Orthogonal Reduction of Quadratic Form to Canonical Form. Applications of Linear Algebra in Machine Learning and Data Science.

Module II

Linear Algebra 2: Vector Space, Subspace, Linear Dependence and Independence, Spanning of a Subspace, Basis and Dimension, Inner Product, Inner Product Spaces, Orthogonal and Orthonormal Basis, Gram- Schmidt Orthogonalization Process, Linear Transformation. Applications of Linear Algebra in Computer Graphics and Optimization.

Module III

Fourier Analysis: Periodic Function, Fourier Series, Functions of Arbitrary Period, Even and Odd Functions, Half-Range Expansion, Harmonic Analysis, Complex Fourier Series, Fourier Integrals, Fourier Cosine and Sine Transform, Fourier Transform. Applications of Fourier Analysis in Signal Processing and Image Reconstruction.

Module IV

Laplace Transforms: Gamma Functions and Beta Function, Definition and Properties, Laplace Transforms, Inverse Laplace Transform, Shifting Theorem, Transform of Derivative and Integrals, Solution of Differential Equation and Integral Equation Using Laplace Transform, Convolution, Unit Step Function, Second Shifting Theorem, Laplace Transform of Periodic Function, Applications of Laplace Transforms in Control Systems and Electronic Circuits.

The students should be introduced to Computer Algebra Systems (CAS) such as Matlab/Python (utilizing NumPy, SymPy, and SciPy) for both symbolic and numerical calculations. *Homework and assignments should be given with the integration of CAS.

References:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 11th Edition, John Wiley & Sons.
2. Grewal, B. S., Higher Engineering Mathematics, 45th Edition, Khanna Publishers.
3. Hoffman K. and Kunze, R., Linear Algebra, Second Edition, Pearson.
4. Venkataraman M. K., Linear Algebra, The National Publishing Co.

23-201-0302 SURVEYING –I

Course Outcomes:

On completion of this course the student will be able to:

1. Acquire knowledge on different angular surveying methods and traversing
2. Understand the principles of levelling, advanced levelling and contouring
3. Calculation of area and earthwork measurements and application of remote sensing
4. Acquire knowledge of EDM and total station survey

Course Articulation Matrix:

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

1- Slightly; 2- Moderately ;3- Substantially

Module 1

Introduction: Classification of surveys, primary division of Surveying

Surveying for angular measurements: Compass survey-True and magnetic bearing-Dip and Declination- Local attraction Theodolite Surveying- Study of Theodolite - Temporary and permanent adjustments- measurement of horizontal angle- method of repetition and reiteration- measurement of vertical angle Tacheometric Surveying - Instruments used-Stadia System-fixed and movable hair methods- Tacheometric constants- Anallatic lens-Tangential System

Traversing: Plotting a Traverse Survey - Adjustment of a closed Traverse (angular error, bearings and closing error) - Bowditch rule-Transit rule-Gale's traverse Table

Module II

Levelling: Definitions of Terms used in Leveling- levelling instruments-Temporary and permanent adjustments-principles of levelling-Simple levelling, Differential levelling-Reduction of levels- Classification of levelling-Profile levelling and cross sectioning -correction for curvature and refraction-Reciprocal levelling- Errors in levelling. Digital and Auto Level

Contour Survey: Definition-characteristics of Contour- uses of contours- Methods of contouring-Interpolation Contours-uses of Contour map

Module III

Area and volumes: Areas along Boundaries- Mid ordinate rule-Average ordinate rule-Trapezoidal rule-Simpson's rule- Area by Meridian distance method- Area by Double meridian method. Departure and total latitude method-Coordinate method- Computation of volume by Trapezoidal and Prismoidal formula - Mass diagram: Construction, Characteristics and Uses.

Remote sensing – Basics, platform and sensors, Energy sources and radiation principles – Energy interactions in the atmosphere, Energy interactions with earth surface features - Elements of image interpretation

Module IV

Electromagnetic distance measurement (EDM):Electromagnetic waves, types of waves, Principle of EDM, measurement of distance from transit time and from phase difference, methods of modulation, Types of EDM instruments, effect of atmospheric conditions, atmospheric calibration of instruments, slope and height correction.

Total Station: Total station, accessories, advantages and applications. Field procedure for total station survey, errors in total station survey.

References:

1. Homas. M. Lillesand, Ralph. W. Kiefer and Jonathan W. Chipman, Remote Sensing and Image Interpretation , John Wiley and Sons, Inc., 6th edition.
2. Surveying. Vol.I& II, Punmia, B.C, Ashok Kumar Jain &Arun Kumar Jain, Laxmi Publications.
3. Advanced Surveying - Total Station, GPS, GIS and Remote Sensing Second Edition, Satheesh Gopi, R. Sathikumar, N. Madhu, Pearson publications
4. Surveying and Levelling, N.N Basak, , MC Graw Hill Education
5. Surveying Theory and Practice, James M Anderson, Edward M Mikhail, ,MC Graw Hill Education
6. Elementary Surveying Ghilani, C. D, and Wolf, P. R. , Prentice Hall.
7. Surveying. Vol.I and II Arora, K.R. Standard Book House.
8. Surveying. Vol. I Duggal, S.K.,Tata McGraw Hill Publishing Co Ltd.
9. Satheesh Gopi, R.Sathikumar, N. Madhu, Advanced Surveying: Total Station, GPS, GIS & Remote Sensing, Pearson Education, 2nd edition.

23- 201- 0303 STRENGTH OF MATERIALS

Course Outcomes:

On completion of this course the student will be able to:

1. Assimilate the strength parameters of the materials and solve for principal stresses and strains.
2. Analyze simply supported and cantilever beams for shear force and bending moment for different types of loading and illustrate the variation of bending moment and shear stress distribution across beam section.
3. Apply differential equation of elastic curve for determination of deflection of a beam for various loading conditions.
4. Analyze short and slender columns with various support conditions and analyse beams/shafts subjected to torsion.

Course Articulation Matrix:

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

1-Slightly; 2- Moderately ;3- Substantially

Module I

Introduction: general concepts - elasticity, plasticity, ductility, brittleness, malleability, isotropy / anisotropy, linear / non-linear elasticity, Stress-strain curve of a mild steel bar in a tension test

The concept of Stress and Strain: Definition of stress; stress analysis of axially loaded members; shear stresses; direct shear problems; axial strains and deformations in bars; Hooke's Law; Poisson's ratio; thermal strain; elastic strain energy; statically indeterminate systems; Hooke's law for isotropic materials; relationships between elastic constants;
Axially loaded Members: Change in lengths of axially loaded members, Changes in lengths of non-uniform bars, statically indeterminate problems, Thermal effects, misfits and pre strains.

Module II

Shear force and bending moment diagrams: sign conventions, axial force, shear force and bending moments (staticallydeterminate beams)
Bending stresses in beams: elastic flexure formula, bending stresses,
Shear stresses in beams in beams, shear flow and shear stress formula;

Module III

Torsion: torsion of circular elastic bars, statically indeterminate problems, torsion of inelastic circular bars, torsion of thin-walled tubes. Close and open coiled helical spring
Theory of columns: Definition, Classification, Analysis of short and long columns, buckling theory- Rankine's and Euler's formula, effect of end conditions, eccentric loads and secant formula. Analysis of thin-walled pressure vessels.

Module IV

Principal stresses -Analysis for Principal stresses, Mohr's circle of stress - principal strains - strain rosette
Deflection of beams: Differential equation of elastic curve - slope and deflection of beams by successive integration - Macaulay's method - moment area method.

References:

1. Gere, J. M. , *Mechanics of Materials*. Brooks/Cole Thomson Learning.
2. Popov, E. P. , *Engineering Mechanics of Solids*. Prentice-Hall of India Limited, New Delhi, India.
3. Timoshenko, S. P. and Young, D. H., *Elements of strength of materials*. East-West Press Private Limited, New Delhi, India.
4. Case, J.,Chilver, L. and Ross, C. T. F. , *Strength of Materials and Structures*. Elsevier, New Delhi.
5. Nash. , *Strength of Materials.* Shaum's outline series, McGraw Hill publishers.
6. Subramanian, R. , *Strength of Materials*. Oxford University Press.
7. Vazirani, V. N. and Ratwani, N. M., *Strength of Materials*. Vol I. Khanna Publishers.

23-201-0304 CONCRETE TECHNOLOGY

Course Outcomes:
On completion of this course the student will be able to:

1. Explain the constituent materials of concrete, their properties and functions.
2. Identify properties of concrete and tests for determination of them.
3. Design concrete mixes of specified grades and demonstrate manufacturing process
4. Identify special forms of concrete and some non-destructive testing methods.

Course Articulation Matrix:

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

1-Slightly; 2- Moderately ;3- Substantially

Module I

Materials: Cement:– Ingredients, Chemical composition, basic properties of cement compounds, Hydration of cement- heat of hydration, physical properties of Portland cements, Indian standard tests and specification, various types and grades of cement, storage of cement

Aggregates:- Classification of aggregates. Characteristics of aggregates – Strength of aggregate, particle shape and texture, specific gravity, bulk density, porosity, water absorption and moisture content of aggregate, bulking of fine aggregate, deleterious substance in aggregate, soundness of aggregate , alkali- aggregate reaction , sieve analysis:- grading curves, fineness modulus, grading requirements, grading of fine and coarse aggregates, zoning, IS tests and specification for aggregates for concrete.

Water: - Quality of mixing water, effect of impurities in water on properties of concrete. permissible impurities as per I.S

Admixtures:- Functions and classification of admixtures, factors influencing the dosage of different admixtures- IS specification for admixtures for concrete. accelerators - retarders - plasticizers - water reducing agents - use of silica fumes.

Module II

Properties of concrete: Fresh concrete:-Water/ Cement ratio and its significance in fresh concrete workability- different methods for assessing workability according to IS Specification, factors affecting workability, requirements of workability for various work, segregation, bleeding, setting, hardening, strength development. Hardened concrete:- Strength of concrete- strength of concrete in compression, tension and flexure - stress- strain characteristics and elastic properties - shrinkage and creep.

Durability of concrete: permeability - chemical attack - sulphate attack - resistance to abrasion and cavitation - resistance to freezing and thawing - resistance to fire - marine atmosphere - quality control - frequency of sampling - test specimens - statistical analysis of test results - standard deviation - acceptance criteria.

Module III

Mix Design: Quality Control - Factors causing variations in the quality of concrete - mix design - nominal mixes - design mixes - factors influencing mix design - A.C.I method - I.S method - design for high strength mixes.

Process of manufacture of Concrete: Mix proportion and grade of concrete - Various types of batching, mixing, transporting, placing, compacting, curing and finishing of concrete (in detail). Joints in concreting – construction and expansion, under water concreting

Module IV

Special concrete: Lightweight concrete, High strength concrete, Polymer concrete, fiber reinforced concrete, Geopolymer concrete, Ferro-cement, Ready mixed concrete. vacuum concrete - shotcrete - steel fibre reinforced concrete- high performance concrete, reactive powder concrete, self-compacting concrete, sustainability of concrete. Non-destructive testing of concrete: Rebound hammer test, ultrasonic pulse velocity test, core cutter test.

References:

1. Neville, A. M. , Concrete Technology. Pearson Education.
2. Neville, A. M. , Properties of Concrete (4th edition). Pearson Education.
3. Orchard, D. F. , Concrete Technology. Vol. I & II.,
4. Shetty, M. S. , Concrete Technology. S I Chand & Company.
5. Gambhin, M.L. , Concrete Technology. Tata McGraw Hill.
6. IS 10262:2019 Concrete Mix Proportioning - Guide lines and other relevant IS codes
7. Pe Jahren, Tangbo Sui, Concrete and Sustainability, CRC Pess, Taylor & Francis.

23-201-0305 FLUID MECHANICS –I

Course Outcomes: On completion of the course, a student will be able to

1. Compute hydrostatic forces acting on submerged surfaces and also to apply conservation laws to solve steady state fluid flow problems.
2. Apply the basic laws of mechanics in the fields of hydrology, irrigation engineering and hydraulic structures and also to apply the principles of dimensional analysis for design of experiments
3. Design experimental procedure for physical model studies
4. Analyse the characteristics of flow through pipes and to design simple pipe systems

Course Articulation Matrix:

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

1-Slightly; 2- Moderately ;3- Substantially

Module I

Introduction: Fundamental difference between a solid and a fluid, constituent relationships for solids and fluids, conservation principles applied in fluid mechanics.

Properties of fluids, concept of continuum, viscosity, compressibility, ideal and real fluids, surface tension, capillarity. Stress at a point, pressure, Pascal's law, Variation of pressure with elevation in compressible and incompressible fluids, hydrostatic law, Pressure measurement, piezometers and manometers.

Module II

Hydrostatic forces exerted on submerged surfaces. Description of fluid flow: with reference to translation, rotation and deformation, concept of

continuum, control mass and control volume approach. Steady flow and uniform flow.

Velocity field, one and two-dimensional flow analysis, circulation and vorticity, stream function and velocity potential function, potential flow, standard flow patterns, combination of flow patterns, flownet.

Module III

Forces exerted in a fluid flow, derivation of Continuity equation and Euler's equation. Bernoulli's equation and its applications. Momentum equation and its applications.

Dimensional Analysis as a tool in design of experiments, identification of non-dimensional numbers and their significance, dimensional analysis methods. Hydraulic Similitude: Similarity laws, and Model studies. Measurement of flow in pipes and open channels.

Module IV

Head loss in flow through pipes, Darcy Weisbach equation, major and minor losses. Flow through pipes and pipe networks, equivalent pipe. Laminar flow and its characteristics, Reynolds experiment. Laminar flow between parallel plates. Laminar flow through pipes, Hagen-Poiseuille equation. Introduction to turbulent flow, Velocity distribution in turbulent flow. Introduction to boundary layer theory.

References:

1. White, F. M. .Fluid Mechanics. Tata McGraw Hill Publication.
2. Fox, R. W., Pritchard, P. J. and McDonald, A. T. .Introduction to Fluid Mechanics(7th Student edition). Wiley India Edition.
3. Shames .Mechanics of Fluids.McGraw Hill Book Co., New Delhi.
4. Streeter, V. L. and Wylie, B. .Fluid Mechanics. McGraw Hill Book Co., New Delhi.
5. Modi, P. N. and Seth, S. M. (200).Hydraulics and Fluid Mechanics (including hydraulic machines). Standard Book House, Delhi, India.
6. Ojha, C.S.P, Chandramouli, P.N and Berndtsson, R . Fluid Mechanics and Machinery. Oxford University Press.

23-201-0306 BUILDING TECHNOLOGY AND FUNCTIONAL PLANNING

Course Outcomes:

On completion of the course, a student will be able to:

1. Understand non-structural building materials and their uses in construction.

2. Understand components of building construction, like stairs, doors, windows, lintels, walls, etc. and their appropriate uses. Also acquaint with finishing works in building construction

3. Understand the principles of Planning and bylaws

4. Prepare working drawings including plan, elevation, section, site plan, location plan, etc. of various types of buildings from requirements using building code

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12	PSO 1	PS O2	PS O3
CO1	3	-	1	-	-	-	1	1	1	-	-	2	3	-	1
CO2	3	2	1	-	1	-	1	1	1	-	-	2	3	-	1
CO3	3	2	3	-	1	-	-	-	1	2	-	2	3	-	1
CO4	3	-	3	-	2	-	-	1	1	2	-	2	3	-	1

1. Slightly, 2- Moderately, 3- Substantially

Module I

Building Technology: Structural Systems
Masonry Structures: brick piers and footings-brick walls – cross walls. Footings-combined footings & rafts-pile foundation-well foundation-foundation for steel columns. Arches-Different types of arches .Doors, windows & ventilators: components, sizes and different types. Stairs: typical stair layouts- R C C stair. Roofs: Types of roofs Truss – King Post Truss- Queen Post Truss- Steel Truss Principles of planning -Dimensions of buildings -Building bye-laws-KMBR, Orientation of buildings -Lighting and Ventilation Occupancy classification of buildings.

Module II

Planning, designing from given requirements of areas & specifications and preparation of sketch design and working drawings for:
1. Single storeyed Residence Building
2, Two Storeyed Residential Building
3. Hospital Building
4. Commercial Building
5. A School Building
6. A factory Building

References:

1. National Building Code of India
2. Kerala Municipal Building Rules
3. Balagopal T.S. Prabhu Building Drawing and Detailing, Spades, Calicut.
4. Punmia, B. C. Building Construction, LaxmiPublications, New Delhi
5. Shah M.G. Kalec. M. & Patki SY Building Drawing, Tata Mcgraw Hill, New Delhi.

Note: The Semester End Examination is 4 hours

Pattern of Questions for Semester-End Examination

1. Two questions from first module with an option to answer one of the questions, each carrying 12.5 marks (sub-sections are allowed).
2. Two questions from first module with an option to answer one of the questions, each carrying 37.5 marks.

23-201-0307 STRENGTH OF MATERIALS TESTING LABORATORY

Course Outcomes:

On completion of the course, a student will be able to:

1. Conceive and reinforce the ideas of axial tension, compression, bending, torsion (circular bar), thoroughly through the respective experiments.
2. Understand the determination of certain material properties, like, hardness, toughness, Young's modulus, Rigidity modulus, ductility, flexural strength, etc.
3. Familiarize with testing equipment and machine in the laboratory.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2	2	1	-	-	-	-	-	-	-	-	-	-	2	-
CO3	2	2	1	-	-	-	-	-	-	-	-	-	-	-	-

1- Slightly; 2- Moderately ;3- Substantially

List of Experiments: (10 Experiments mandatory)

1. Tension test on Structural Materials: Mild Steel and Tor steel (HYSD bars) (Universal testing machine and suitable extensometer)
2. Shear test on mild steel rod (Compression Testing Machine and Shear Shackle)
3. Bending test on mild steel (I sections) (Universal Testing Machine
4. Torsion test on Mild steel circular bars (Torsion Testing Machine)
5. Torsion test on Steel/Copper/ Aluminum wires
6. Impact test
    a. Izod test (Impact Testing Machine)
    b. Charpy test (Impact Testing Machine)
7. Hardness test
    a. Brinell Hardness test (Brinnel Hardenss Testing Machine)
    b. Rockwell Hardness test (Rockwell Hardness Testing Machine)
    c. Vickers Hardness test (Vickers Hardness Testing Machine)
8. Test on Springs
    a. Open coil (Spring Testing Machine)
    b. Close coil (Spring Testing Machine)
9. Bending Test on Timber (Universal Testing Machine and dial Gauge)
10. Bend & Rebend test on M S Rods
11. Verification of Clerk Maxwells Theorem

12. Demonstration of Fatigue Test
13. Study/demonstration of Strain Gauges and load cells
14. Tear strength measurement of different types of material

- *Group Project based on the laboratory course*

23-201 -0308 CONCRETE TESTING LABORATORY

Course Outcomes: On completion of the course, a student will be able to:

1. Determine properties of constituent materials of concrete.
2. Demonstrate preparation of concrete.
3. Determine fresh and hardened properties of concrete
4. Analyse test result of concrete.

Course Articulation Matrix

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

1-Slightly; 2- Moderately ;3- Substantially

List of Experiments: (12 Experiments mandatory)

1. Determination of Standard consistency and Initial Setting time of Cement.
2. Determination of specific gravity and soundness of cement (Le Chatelier's apparatus).
3. Specific gravity of fine and coarse aggregates.
4. Particle size distribution of fine and coarse aggregate – sieve analysis.
5. Bulking of sand.
6. Fineness of cement
7. Determination of compressive strength of cement
8. Mix Design, Workability of concrete and Casting of cubes, cylinders and beams
9. Compression test on concrete cubes and split-tensile test on concrete cylinders.
10. Determination of Modulus of elasticity of concrete.
11. Flexure test on plain concrete beam.
12. Workability tests of SeIf Compacting Concrete.

- *Group Project based on the laboratory course*

23-201-0309 INTERNSHIP-1

Course Outcomes:

On completion of this course, the student will be able to:

1. Understand the real time technical/managerial skills required and relevant to the subject area of internship
2. Initiate a habit of proper daily diary writing with adequacy and quality of information recorded, drawing and sketches and data, thought process and the proper organisation of the information gained during the internship.
3. Conceive the pros and cons of working in a real time industrial/incubation/ innovation /entrepreneurship/lab environment and the wonderful results which could evolve through team-work.
4. Present and defend self-prepared and corrected internship report (with the help of internship guide) of a self-created work to a peer audience.

Course Articulation Matrix

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

1-Slightly, 2- Moderately, 3- Substantially

Internship Guidelines

During the summer vacations, after the 2nd Semester, students are required to be involved in Inter/ Intra Institutional Activities viz; Training with higher Institutions; Soft skill training organized by Training and Placement Cell of the University; contribution at incubation/ innovation /entrepreneurship cell of the University; participation in conferences/ workshops/ competitions etc.; Learning at Departmental Lab/ Tinkering Lab/ Institutional workshop; Working for consultancy/ research project within the institutes and Participation in all the activities of Institute's Innovation Council for eg: IPR workshop/Leadership Talks/ Idea/ Design/ Innovation/ Business Completion/ Technical Expos etc. Students shall visit at least one industry relevant to Civil Engineering and gain industrial training in relevant topics such as Brick masonry construction- RCC construction-shallow foundation- RCC Column- RCC Beam- RCC Slab- RMC Plant.

A committee consisting of the Internship Coordinator (nominated by the Head of the Department/Division), faculty mentor, and at least one senior faculty member at the level of Associate Professor or above will carry out the final review. Training Certificate from the Inter/ Intra Institutional Activities from the concerned department/lab as mentioned above for the prescribed period shall be submitted at the end of the internship which can be considered as evidence for the the Internship-1. A report of the same should be submitted and evaluation shall be conducted based on the report.

Guidelines for evaluation:

1.	Regularity and progress of work	10
2.	Work knowledge and Involvement	10
3.	Semester End presentation and oral examination	10
4.	Level of completion of the internship	10
5.	Internship Report – Presentation style and content	10
Total		**50** Marks

23-201-0310 CIVIL INFRASTRUCTURE ENGINEERING

(Minor Course)

Course Outcomes:

On completion of this course the student will be able to:

1. Appraise different fields of Civil Engineering and infrastructure planning, and explain the need of sustainable infrastructure construction.
2. Explain the infrastructures used in water resource and environmental engineering.
3. Summarise about the infrastructures used for foundation engineering and transportation engineering.
4. Apply knowledge on development of various infrastructures in the field of Civil Engineering.

Course Articulation Matrix

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

1–Slightly; 2–Moderately; 3-Substantially

Module I

Infrastructure: Introduction to Infrastructure and Career in Civil Engineering, History and Heritage, Sustainability, The Civil Engineering Professions, Professional Issues, The Future of Civil Engineering.

Infrastructure Planning: Need for Planning – Infrastructure Planning – Land Use Planning – Regional Planning – Emergency Planning – Population Projections, Planning stages, Stakeholders, New Construction Technologies, Project Scheduling.

Module II

Water Resource Infrastructure: Introduction - Hydrologic Cycle– Watersheds – Rivers – Canals – Aqueducts - Habitat – Wetland - Geologic Formations – Groundwater – Atmosphere - Climate Change.

Environmental Infrastructure**:** Prevention of environmental impact, Pollution, Water Source and Demand, Waste and Water Treatment, Storage, Conveyance, Solid Waste – Collection – Transfer – Recycling and Reuse – Composting – Landfills – Incinerators, Hazardous Waste.

Module III

Geotechnical Engineering: Foundation Engineering, Types of foundations - isolated footing, combined footing, raft, pile & well foundation.

Transportation Infrastructure: Roads – Mass Transit –Aviation – Waterways – Ports – Locks – Tunnels – Rail – Advanced infrastructures - Speed Rails, Signal Systems.

Module IV

Construction Materials and Methods: Introduction, Evolution of materials and methods with respect to masonry and concrete, Challenges.

Structures: Buildings – Skyscrapers – Bridges – Dams - Levees and Floodwalls - Retaining Walls.

References:

1. Penn, M. R., & Parker, P. J. (2012). Introduction to infrastructure: an introduction to civil and environmental engineering.
2. Mau, S.T., & Sami, M. (2014) Introduction to Civil Engineering: A Student's Guide to Academic and Professional Success.
3. Labi, S. (2014). Introduction to civil engineering systems: A systems perspective to the development of civil engineering facilities. John Wiley & Sons.

23-200-0401A: COMPLEX VARIABLES AND PARTIAL DIFFERENTIAL EQUATIONS

(Common to CE, ME, SE branches)

Course Outcomes:

On completion of this course, the student will be able to:

1. Apply complex analysis principles in engineering scenarios, understanding key concepts like analytic functions, Cauchy's theorem, and contour integration.
2. Employ linear algebra techniques, such as eigenvalues and linear transformations, to solve engineering problems and model real-world systems effectively.
3. Solve partial differential equations using various methods and apply the solutions to analyze phenomena in engineering, machine learning, and computational biology.
4. Utilize advanced differential equations, including wave and heat equations, Alembert's solution, and Fourier series, for modelling and analyzing complex engineering problems.

Course Articulation Matrix:

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

1–Slightly; 2–Moderately; 3-Substantially

Module I

Analytic Function: Analytic function, Cauchy-Riemann equation (Cartesian and polar), Harmonic function, Construction of analytic function given real or imaginary parts, Conformal mapping of standard elementary function and bilinear transformation. Applications of Analytic Functions in Signal Processing and Image Analysis.

Module II

Complex Analysis: Cauchy's integral theorem, Cauchy's integral formula and for derivatives, Taylor's and Laurent's expansion (without proof), Singularities, Residues, Cauchy's Residues theorem, Contour integration involving unit circle. Applications of Complex Analysis in Engineering.

Module III

Partial Differential Equations: Formation of partial differential equation eliminating arbitrary constants and function, Solution of the first-order equation, Four standard types, Lagrange's equation, Linear homogeneous partial differential equation with constant coefficient. Applications of Partial Differential Equations in Engineering and Machine Learning.

Module IV

Advanced Topics in Differential Equations: One-dimensional wave equation, Alembert's solution and one-dimensional heat flow equation, Solution by the method of separation of variables, Application of Fourier series solution, Solution of Laplace's equation over a rectangular region by the method of separation of variables. Applications of Wave and Heat Equations in Signal Processing and Materials Science.

The students should be introduced to Computer Algebra Systems (CAS) such as Matlab/Python (utilizing NumPy, SymPy, and SciPy) for both symbolic and numerical calculations. Homework and assignments should be given with the integration of CAS.

References:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 11th Edition, John Wiley & Sons.
2. Grewal, B. S., Higher Engineering Mathematics, 45th Edition, Khanna Publishers.
3. Churchill, R.V. and Brown, J.W., Complex Variables and Applications, 10th Edition, McGraw Hill.
4. Stroud, K.A. and Booth, D.J., Advanced Engineering Mathematics, 6th Edition, Palgrave Macmillan.

23-201-0402 SURVEYING –II

Course Outcomes:

On completion of the course, a student will be able to:

1. Acquire knowledge on different type of curves provided on highways and railways
2. Carry out a geodetic survey, taking accurate measurements using instruments and apply mathematical adjustment of errors involved in surveying measurements
3. Invoke advanced surveying techniques over conventional methods in the field of civil engineering
4. Acquire knowledge on GIS, Hydrographic and photogrammetric survey

Course Articulate Matrix

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

1–Slightly; 2–Moderately; 3-Substantially

Module 1

Curves: Types of curves - Basic definitions-Elements of a simple curve - Methods of setting out (Linear methods and Angular methods)-Compound Curves-Elements of a compound curve- Reverse Curve-Transition curves-advantages-super elevation- length of a transition curve - vertical curves-Types of vertical curves- length of the vertical curve.

Module II

Triangulation: Principles of Triangulation-classification triangulation-reconnaissance-Selection of Triangulation Stations-Intervisibility of Triangulation stations-Determination of elevations of stations (No obstruction due to intervening ground and obstruction due to intervening ground) - Signals-Elevated towers-selection of site for base line-Base line measurement-corrections-Satellite station.

"Adjustments of observations: Laws of weight-Corrections to vertical controlled measurements with a closing error-Theory of least squares-Normal equation method-Most probable values of directly observed quantities and indirectly observed quantities, Triangulation adjustments -Station adjustments for 3 different. Cases (when the horizon is closed with angles of equal weight - unequal weight-when several angles are measured at a station individually and also in combinations)- Figure adjustment of a plane triangle adjustment of two connected triangles.

Module III

Field Astronomy: Definitions - solution of astronomical triangle

Global Positioning Systems- Components and principles, Satellite ranging- calculating positions, Satellite signal structure, code phase and carrier phase measurements, GPS errors and biases, Application of GPS.

GPS Surveying methods: Static, Rapid static, Kinematic methods, Phases of GPS survey, Planning and preparation, Field operation, horizontal and vertical control

Module IV

Hydrographic Survey: Introduction - Methods of sounding - Method of locating soundings – plotting soundings-Three Point problem.

Photogrammetry: Principle of Terrestrial and Arial photogrammetry, Scale and distortion of the vertical photograph, flying height, Application of Air photograph.

Geographical Information System: GIS basics - Maps – scale - coordinate system – GIS definition – Components of GIS – Spatial, Non- spatial and metadata - Types of spatial data - Raster and vector data formats – GNSS (GPS, GLONASS) – SBAS (GAGAN)

References:

1. Burrugh P , Principles of Geographical Information Systems ,Oxford University Press
2. George Joseph , Fundamentals of Remote Sensing, University Press .
3. Duggal, S.K. Surveying. Vol. II. Tata McGraw Hill Publishing Co Ltd.
4. Punmia, B.C, Jain, A. K. andJain,A. K. Surveying. Vol.II. Laxmi Publications.
5. Arora, K.R.Surveying.Vol. II and III. Standard Book House.

23-201-0403 ANALYSIS OF STRUCTURES – I

Course Outcomes:

On completion of this course the student will be able to:

1. Analyze the behavior of structures under impact loading, fatigue, and stress concentration and apprise the behavior of beams to asymmetric loading and geometry and the concept of shear centre in thin-walled members.
2. Apply the concept of strain energy in determining deflections and slopes in structures motivated by the importance of serviceability part of analysis and design.
3. Analyse built up beams and composite beams and also evaluate combined stresses under axial load, bending and torsion.
4. Analyse plane stress and plane strain problem and apply theories of failure in practical scenarios.
5. Interpret the powerful concepts influence lines on the analysis of moving loads and their applications in determinate structures, specifically in the context of bridge girders.

Course Articulation Matrix:

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

1–Slightly; 2–Moderately; 3-Substantially

Module I

Behaviour of Structures to Impact and Stress concentration: Impact loading, Fatigue (progressive fracture), Stress concentration in axial loading, bending and torsion (elementary treatment only).

Asymmetry in Bending: Asymmetry in loading and geometry, Stresses in doubly symmetric beams with inclined loads.

Shear flow and Shear centre**:** The concept of shear centre introduced through singly symmetric and asymmetric cross-sections of beams.

Module II

Strain Energy: Definition of strain energy and complementary energy, strain energy due to axial load, bending moment, shear force and twisting moment.

Deflection and slope in Beams by Strain energy method: Castigliano's theorems, Unit load method – deflection and slope in determinate beams.

Deflection of Determinate Trusses: Deflection of joints of trusses through Castigliano's theorems, Unit load method, temperature effects.

Module III

Built-up and Composite Beams: Analysis of built-up and composite beams. Combined stresses in Beams: Beams subjected to axial load, bending and torsion.

Plane stress and Plane strain problems: Introduction to plane stress and plane strain problems, equations of equilibrium, compatibility and constitutive equations in two-dimensions, examples of plane stress and plane strain problems.

Theories of failure: Maximum principal stress theory, maximum principal strain theory, maximum shear stress theory, maximum strain energy theory, maximum distortion energy theory, applications of each theory.

Module IV

Moving Loads and Influence Lines: Moving loads in structures introduced through examples of bridge girders, Definition and purpose (in analysis) of influence line, influence lines for reaction, shear force and bending moment at a given cross-section in statically determinate beams, criteria for maximum reaction, shear and bending moment at a section and absolute maximum of the same in determinate beams, Muller-Breslau influence theorem for statically determinate beams, influence lines for statically determinate trusses, criteria for maximum bending moment at a panel point on the loaded chord, and unloaded chord of a truss, Muller Breslau influence theorem for statically determinate trusses.

References:

1. Timoshenko, S. P., & Young, D.H. (2004). Elements of strength of materials. East-West Press Private Limited New Delhi, India.
2. Gere, J. M. (2004). Mechanics of Materials. Brooks/Cole Thomson Learning.
3. Wang, C. K. (2010). Intermediate Structural Analysis. McGraw Hill International Edition.
4. Popov, E. P. (1999). Engineering Mechanics of Solids. Prentice-Hall of India Limited, New Delhi, India.
5. Srinath, L. S. (2010). Advanced Mechanics of Solids. Tata McGraw Hill Education Pvt Ltd, New Delhi.
6. Punmia B. C., Jain A. K. and Jain A. K. (2005). Strength of Materials and Theory of Structures: Vol. II., Laxmi Publications (P) Ltd, New Delhi.
7. Menon, D. (2010). Structural Analysis. Narosa publishers.

23-201-0404 TRANSPORTATION ENGINEERING – 1

Course Outcomes

On completion of the course, a student will be able to:

1. Apply survey techniques in the planning and alignment of highways, and execute geometric design for highway infrastructure

2. Execute traffic studies, apply traffic regulations and control measures, and design intersections

3. Analyze the properties of pavement materials.

4. Conduct surveys and employ geometric design principles for airports.

Course Articulation Matrix

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

1- Slightly, 2- Moderately, 3- Substantially

Module I

Classification, Alignment and surveys: Classification of highways typical cross section of roads in embankment and in cutting, definition of various cross sectional elements requirements and factors controlling alignment of roads, Engineering surveys.

Geometrical Design of Highways: Camber sight distances Stopping, passing and overtaking Sight distances, Overtaking zone requirements, worked out problems design of horizontal alignments, design speed horizontal curves Super elevation Super elevation design radius of horizontal Curve extra widening of pavement transition curves and methods of provision of super elevation and design of horizontal alignment design of vertical alignment gradient and grade Compensation Vertical curves summit curves length of summit curve - valley curves length of valley curve.

Module II

Traffic Engineering: Introduction - road user, vehicle and traffic characteristics - traffic engineering studies speed speed and delay - volume - origin and destination - parking and accident studies.

Road intersections- Design of intersections at grade and grade separated intersections.

Traffic operation-Traffic control devices- classifications and uses of traffic signs and markings

Module III

Highway Materials, Testing and Design: Road aggregates Desirable props & tests Bituminous materials Types of bituminous materials used in highway construction requirements desirable properties and tests. Bituminous mix design

Highway construction and Maintenance: Construction of bituminous concrete and cement concrete pavements. Joints in Concrete pavements types and causes of failures in flexible and rigid pavements, Pavement Design Basic difference between flexible and rigid pavements factors to be considered in Design of pavements.

Module IV

Airport planning and design - Introduction - Various bodies and their role in air transportation: ICAO, FAA, AAI. Aircraft characteristics and their influence on planning of airports classification of airports- airport obstructions and zoning - component parts of airports and site selection runway design - orientation - basic runway length - corrections to basic runway length - worked out problems- geometric design of runways; design of taxiways and aprons Controlling of air traffic-Operation of instrument landing system-terminal area planning concepts and its facilities - aircraft parking configurations.

References:

1. Khanna, S.K., Justo and Veeraraghavan. Highway Engineering. NemChand and Bros, Roorkee, India.
2. Khadiyali, L.R.TrafficEngineering and Transport Planning. Khanna Publishers.
3. Ministry of Road Transport and Highways Specifications for Road and Bridge Works. Fourth Edition. Indian Roads Congress, New Delhi, India.
4. Khanna, S. K., Arora, M. G., and Jain, S. S. Airport planning and Design, Sixth Edition.Nem Chand and Bros, Roorkee, India.
5. Rangwala, S.C.AirportEngineering.Charoter Publishing House.

6. Horonjeff, R., McKelvey, F. X., Sproule, W. J., and Young, S. B. Planning and Design of Airports. Fifth Edition. McGraw-Hill, New York.

23-201-0405 FLUID MECHANICS II

Course Outcomes:

On completion of the course, a student will be able to

1. Design channels and Compute the flow profiles in channel transitions
2. Compute the discharge of rivers and streams
3. Formulate and solve the problem of propagation of flood wave and surges in channels
4. Design the working proportions of hydraulic machines

Course Articulation Matrix

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

1-Slightly; 2- Moderately ;3- Substantially

Module I

Uniform Open Channel Flow: Free surface flows. Comparison with pipe flow. Types of channels Classification of flow in open channels. Velocity distribution in open channels. Uniform flow Equations for uniformflow Chezy‘s and Manning‘s equations. Most efficient channel sections of different geometry. Conveyance, Normal depth and Hydraulic exponent for uniform flow, Determination of normal depth and velocity. Energy concepts in free surface flows. Specific energy and Specific force diagrams, Application of specific energy principle - transitions in rectangular channel Critical flow. Hydraulic exponent for critical flow.

Module II

Nonuniform Open Channel Flow: Gradually Varied Flow - Occurrence and importance. Basic assumptions. Dynamic equation for gradually varied flow. Different forms of the dynamic equation. Classification of Channel Bottom Slopes. Surface profiles in prismatic channels-Classification of Surface Profiles- Characteristics of Surface Profiles. Integration of the Varied Flow Equation. Computation of the length of the backwater curve - Graphical Integration and Step Methods.

Module III

Rapidly varied flow: characteristics of the flow - hydraulic jump - Theory of hydraulic jump, initial and sequent depths, evaluation of jump elements in rectangular and non-rectangular channel, practical application of hydraulic jump - types of jump in horizontal floor – basic characteristics of the jump - energy loss - efficiency - height of jump - jump as energy dissipater – stilling basins - jump position - tail water conditions - jump types – stilling basins of generalized design. Rapidly varied unsteady flow –surges.

Module IV

Hydraulic Machinery: Impact of jets, Classification of hydraulic machines, one dimensional flowanalysis and velocity triangles, Design of Pelton turbine, Design of Francis turbine, Design of a Kaplan turbine, Centrifugal pump - minimum speed to start the pump – multistage Pumps –Positive displacement pumps – reciprocating pump - negative slip - flow separation conditions - air vessels.

References:

1. Chow, V.T. Open Channel Hydraulics. Blackburn Press.
2. White, F. M. . Fluid Mechanics. Tata McGraw Hill Publications.
3. Fox, R. W., Orutcgardm, O. H. and McDonald, A. T. Introduction to Fluid Mechanics (7th student edition). Wiley India.
4. Subramnaya, K.Flow in Open Channel. Tata McGraw Hill Publications, New Delhi.
5. Modi, P. N. and Seth, S. M. .Hydraulics and Fluid Mechanics (including hydraulic machines). Standard Book House, Delhi, India.
6. Rajesh Srivastava . Flow Through Open Channels. Oxford University Press.

23-201-0406 GEOTECHNICAL ENGINEERING –I

Course Outcomes: On completion of the course, a student will be able to:

1. Understand the properties of soils and to classify them through laboratory investigation.
2. Compute the effective stress in soils under variable conditions, and understand about stress distribution in soil.
3. To understand the principles of compaction and consolidation.
4. Apply the knowledge of shear strength parameters determined under different drainage conditions to the field problems including that of slope stability.

Course Articulation Matrix

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

1-Slightly; 2- Moderately; 3- Substantially

Module I

Nature of soil and functional relationships: Soil types – residual soil and transported soil. Three phase system – void ratio –specific gravity-– porosity-water content-dry, saturated and submerged unit weight-– degree of saturation – relative density -Relationship between Basic Soil properties.Concepts of single grained, honey combed and flocculent structure - Basic Structural units of clay minerals- common clay minerals.

Laboratory and field identification of soils: Determination of water content by oven drying – specific gravity using Pycnometer and specific gravity bottle – grain size analysis by sieve analysis, hydrometer analysis and pipette analysis – Atterberg limit and indices - Activity of clay field density by core cutter, sand replacement and wax coating methods.

Classification of Soils: Necessity – Principles of classification – I.S. classification

Module II

Soil water: Classification- effective stress - total stress - pore pressure - pressure diagrams for different conditions. Permeability: definition - Darcy's law - factors affecting permeability – laboratory determination permeability of stratified soils.

Seepage through soils: Uplift pressure-piping-seepage force and quick sand condition- flow nets Stress distribution: Boussinesque's and Westergaard's equations for vertical pressure due to point loads and uniformly distributed loads - assumptions and limitations - pressure bulb – Equivalent point load method - 2:1 approximate method - Newmarks` charts and their use

Module III

Compaction: definition and objectives of compaction - proctor test and modified proctor test - concept of OMC and maximum dry density - zero air voids line - factors influencing compaction - field compaction methods - Field compaction- Control and specifications - Proctor needle

Consolidation: definition - concepts of coefficient of compressibility - coefficient of volume change and compression index - e-log p curves - pre-consolidation pressure - determination of preconsolidation pressure - Terzaghi's theory of one dimensional consolidation - determination of coefficient of consolidation – consolidation settlement of NC clays.

Module IV

Shear Strength: definition - Mohr's strength and stress circles - Mohr's envelope-Mohr-Coulomb strength theory - Total and effective shear strength parameters

Measurement of shear strength- direct shear test- triaxial testing- UU,CU and CD test, UCC test - laboratory and field vane shear test- sensitivity and thixotropy - choice of test conditions for field problem

Stress strain behavior of clays and granular soils - Definition of stress path

Stability of slopes: Infinite and finite slopes-Translational and rotational failures- Slope failure, base failure and toe failure - Swedish circle method - friction circle method - Taylor's stability number - stability charts.

References

1. Ranjan, G. and Rao, A.S.R. Basic and Applied Soil Mechanics, New Age International Publishers.
2. Das, B.M. Principles of Geotechnical Engineering. Thomas Brooks Cole, Singapore.
3. Punmia, B.C. Soil Mechanics and Foundations. Laxmi Publications.
4. Terzaghi, K. and Peck, R.B. Soil Mechanics in Engineering Practice. John Wiley.
5. Venkataramaiah, C. Geotechnical Engineering. New Age International Publishers.
6. Arora, K.R. Soil Mechanics and Foundation Engineering. Standard Publishers and Distributors.

23-200-0407: UNIVERSAL HUMAN VALUES II

Pre requisite – UNIVERSAL HUMAN VALUES I (conducted during Student Induction Programme)

(Common to all the branches)

Course Outcomes:

At the completion of the course, the students are able to

1. Recognize needs, basic guidelines, content and process of value education, explore the meaning of happiness and prosperity.
2. Understand human being as the co-existence of two realities, self and body and harmony in the individual level.
3. Verify the possibility of ensuring within the naturally acceptable feelings and express those to the others with an expectation of mutual happiness and mutual prosperity.
4. Identify the harmony in society, nature and existence and ensuring them through the effort to fulfil the human goal.
5. Apply the understanding of ethical human conduct to formulate strategies for ethical life and profession.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			1			2	2	1	2	2	2	2
CO2			1			2	3	1	3	1	2	2
CO3			1			2	2	3	3	3	2	2
CO4			1			3	3	3	3	3	3	3
CO5			2			3	3	3	3	3	3	3

Module I

Course Introduction - Need, Basic Guidelines, Content and Process for Value Education.
Purpose and motivation for the course, recapitulation from Universal Human Values-I.
Self-Exploration–what is it? – Its content and process; 'Natural Acceptance' and experiential Validation- as the process for self-exploration.
Continuous Happiness and Prosperity – A look at basic Human Aspirations.
Right understanding, Relationship and Physical Facility – the basic requirements for the fulfilment of aspirations of every human being with their priority.
Understanding Happiness and Prosperity rightly- A critical appraisal of the current Scenario.
Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

Include practice sessions to discuss natural acceptance in human beings as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than arbitrariness in choice based on liking-disliking.

Module II

Understanding Harmony in the Human Being - Harmony in Myself.
Understanding human beings as a co-existence of the sentient 'I' and the material 'Body'.
Understanding the needs of Self ('I') and 'Body' - happiness and physical facility.
Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer).
Understanding the characteristics and activities of 'I' and harmony in 'I'.
Understanding the harmony of I with the Body: Self-regulation (*Sanyam)* and Health; correct appraisal of Physical needs, the meaning of Prosperity in detail.
Programs to ensure Self-regulation (*Sanyam)* and Health.
Include practice sessions to discuss the role others have played in making material goods available to one self, identifying from own life. Differentiate between prosperity and accumulation. Discuss a program for ensuring health vs dealing with a disease.

Module III

Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship.
Understanding values in a human-human relationship; the meaning of Justice (nine universal values in relationships) and the program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship.
Understanding the meaning of Trust; Difference between intention and competence.
Understanding the meaning of Respect, the difference between respect and differentiation; the other salient values in a relationship.
Understanding the harmony in the society (society being an extension of the family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals.
Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.
Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real-life examples,

teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives.

Module IV

Understanding Harmony in Nature and Existence – Whole existence as Coexistence.

Understanding the Harmony in Nature.

Interconnectedness and mutual fulfilment among the four orders of nature – recyclability and self-regulation in nature.

Understanding Existence as Co-existence of mutually interacting units in all-pervasive space.

Holistic perception of harmony at all levels of existence.

Include practice sessions to discuss human beings as the cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

Implications of the above Holistic Understanding of Harmony on Professional Ethics: Natural acceptance of human values, Definitiveness of Ethical Human Conduct.

Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order.

Competence in professional ethics: a. Ability to utilize professional competence for augmenting universal human order, b. Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for the above production systems.

Case studies of typical holistic technologies, management models and production systems.

Strategy for the transition from the present state to Universal Human Order: a. At the level of the individual: as socially and ecologically responsible engineers, technologists and managers, b. At the level of society: as mutually enriching institutions and organizations.

Sum up.

Include practice exercises and case studies to discuss the conduct as an engineer or scientist etc.

Reference

1. Human Values and Professional Ethics (3rd revised edition) by R. R. Gaur, R Asthana, G P Bageria, Excel Books, New Delhi.
2. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 3rd Edition.
3. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 5th Edition.

23-201-0408 SURVEY PRACTICES LABORATORY

Course Outcomes:

On completion of the course, a student will be able to

Conduct survey, prepare field notes from survey data, interpret survey data and compute areas and volumes.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	-	-	-	-	-	-	-	-	-	2	-	-

1-Slightly; 2- Moderately; 3- Substantially

List of Experiments:

Leveling

1. Differential leveling.
2. Longitudinal sectioning and Cross sectioning.
3. Contour surveying.

Theodolite

4. Determination of Horizontal Angle- Repetition method, Reiteration Method.

5. Determination of Vertical angle
6. Three Point Problem
7. Determination of Tacheometric Constants. .
8. Heights and distances - stadia tachometry, tangential tachometry.
9. Setting out simple curve-angular methods.

Total Station.

10. Heights and distance
11. Area computation
12. Downloading

Study of Instruments- Automatic level, Digital level, Electronic Theodolite and hand held GPS.

- *Group Project based on the laboratory course*

23-201-0409 FLUID MECHANICS LABORATORY

Course Outcomes:

Course Outcomes: On completion of the course, a student will be able to

1. Identify the behaviour of various fluid flows and use this information in practical applications.
2. Apply the knowledge of metacentric height, losses due to friction, purpose of notches, etc. for practical use.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	-	-	-	-	-	-	-	-	-	2	-	-
CO2	-	-	-	-	-	2	-	-	2	-	-	2	-	2	-

1-Slightly; 2- Moderately; 3- Substantially

List of Experiments:

1. Study of pipe fittings and plumbing tools
2. Experiment on notches
3. Pipe friction apparatus
4. Determination of minor losses
5. Metacentric height
6. Venturimeter and Orifice meter
7. Flow through orifice
8. Heleshaw experiment
9. Reynolds experiment
10. Free & forced vortex apparatus
11. Verification of Bernoulli's equation
12. Hydraulic turbines and pumps

- *Group Project based on the laboratory course*

▪ 23-201-0410 CONCRETE TECHNOLOGY THEORY AND PRACTICES
(Minor Course)

Course Outcomes

On completion of this course the student will be able to:

1. Interpret the constituent materials of concrete, their properties and functions in concrete.
2. Discuss properties of concrete in its fresh and hardened state and tests for determination of them.
3. Design concrete mixes of specified grades via IS methods and generate an awareness regarding manufacturing process of concrete.
4. Adapt special forms of concrete based on different applications.

Course Articulation Matrix

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

1-Slightly; 2-Moderately; 3-Substantially

Module I

Materials: Cement: hydration of cement- heat of hydration, physical properties of Portland cements, various types and grades of cement.

Aggregates: strength of aggregate, specific gravity, bulk density, water absorption and moisture content of aggregate, bulking of fine aggregate, sieve analysis.

Water: quality of mixing water.

Admixtures: functions and classification of admixtures, factors influencing the dosage of different admixtures- is specification for admixtures for concrete. accelerators - retarders - plasticizers - water reducing agents - use of silica fumes.

Module II

Properties of concrete: fresh concrete: water/ cement ratio and its significance in fresh concrete- workability- slump test, factors affecting workability, requirements of workability for various work, segregation, bleeding, setting, hardening, strength development. demonstration of test for setting time and slump test.

hardened concrete: strength of concrete- strength of concrete in compression and tension, modulus of elasticity and Poisson ratio.

Durability of concrete: permeability - chemical attack - sulphate attack

Module III

Mix Design: quality control - factors causing variations in the quality of concrete - mix design - nominal mixes - design mixes - factors influencing mix - demonstration of mix design of concrete by IS code method

Process of manufacture of Concrete: mix proportion and grade of concrete - various types of batching, mixing, transporting, placing, compacting, curing and finishing of concrete. joints in concreting – construction and expansion.

Module 1V

Special concrete: lightweight concrete, high strength concrete, fiber reinforced concrete, ferro-cement, ready mixed concrete - shotcrete - high performance concrete, self-compacting concrete, sustainability of concrete.

References :

1. Gambhin, M.L., Concrete Technology. Tata McGraw Hill.
2. IS 10262:2019 Concrete Mix Proportioning - Guide lines and other relevant IS codes
3. Neville, A. M., Concrete Technology. Pearson Education.
4. Neville, A. M., Properties of Concrete (4th edition). Pearson Education.
5. Orchard, D. F., Concrete Technology. Vol. I & II.
6. Shetty, M. S., Concrete Technology. S I Chand & Company.

23-201-0411# SUSTAINABLE CONSTRUCTION PRACTICES/ * MOOC-I

(Minor Course)

Students should take Massive Open Online Courses (MOOCs) approved by the concerned Division/Board of Studies (BoS)

• 23-201-0412 ADVANCED CONCRETE TECHNOLOGY

(Course for Honours)

Course Outcomes:

On completion of this course a student will be able to

1. Apply the knowledge for various complexities and significance of concrete
2. Apply characteristics of high-performance concrete for special applications
3. Design mixture proportions according to the requirement of the project
4. Suggest innovative techniques according to the modern trends in construction industry

Course Articulation Matrix:
1-Slightly; 2- Moderately ;3- Substantially

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

Module I

The Structure of Concrete- Significance and Complexities, Structure of aggregate phase, Structure of hydrated cement paste - Structure property relationships in hydrated cement paste-Strength, Dimensional stability and Durability.

Transition zone in concrete-Significance of transition zone, Strength of transition zone and Influence of transition zone on properties of concrete.

Module II

Fresh properties and rheology of concrete, Hardened properties of concrete- Review on strength characteristics of concrete - Modulus of Elasticity - Poisson's Ratio - Multiaxial Strength - Shear Strength -Bond Strength - Impact Strength - Fatigue Strength, Concrete -Composite material modelling.

Durability: Creep- Relaxation- Shrinkage and Swelling- Permeability- Chemical attack -Corrosion of Steel Rebars- Frost Action- Fire Damage- Design for Durability.

Module III

Concrete Mix design: Methods of Mix Proportioning- Factors Influencing Design of Concrete Mix- Mix design using IS:10262(2019)- ACI 211.1-91(2002)- British Mix Design Method (DOE Method)- Modification with Artificial Aggregates, supplementary cementitious Materials Design of high strength and high-performance concrete and Self compacting concrete,

Module IV

Modern trends in concrete: manufacture and placement techniques, Methods of transportation, Placing and curing-extreme whether concreting, Special concreting methods, Vacuum dewatering of concrete-Under water concreting. Characterization of concrete- Variability of concrete strength- Non-destructive testing and quality control, XRD Analysis, Scanning Electron Microscope (SEM) analysis, Thermo Gravimetric Analysis (TGA)

References

1. Kumar Mehta P and Paulo J. M. Monteiro, Concrete, Microstructure, Properties and Materials Indian Concrete Institute, Chennai,1997.

2. Neville A.M., Properties of Concrete, Addison Wesley Longman Limited, England,1995.

3. Neville A.M. and J.J. Brooks, Concrete Technology, Pearson Education, Asia,2008.

4. Bartos P.J.M., M. Sonebi and A.K. Tamimi, Workability and Rheology of Fresh Concrete: Compendium of Tests, RILEM Publications S.A.R.L,France,2002

5. Ramachandran V.S and James J., Handbook of Analytical Techniques in Concrete Science and Technology, Principles, Techniques and Applications. William Andrew Publishing, U.S.A,2002.

23-200-0501A: NUMERICAL AND STATISTICAL METHODS

(Common to CE, ME, SE branches)

Course Outcomes:

On completion of this course, the student will be able to:

1. Comprehend foundational concepts in numerical analysis, statistical methods, and machine learning, including understanding the importance of numerical methods and statistical techniques in problem-solving.

2. Apply various numerical methods and statistical tests to solve algebraic and transcendental equations, analyze data, and draw inferences about populations and samples.

3. Evaluate and compare the efficiency of numerical techniques in solving engineering problems, demonstrating analytical skills in differentiation, integration, and solving ordinary differential equations.

4. Apply advanced statistical and machine learning techniques using Pandas for data exploration and processing, showcasing proficiency in descriptive statistics, regression analysis, and the implementation of basic machine learning models.

Course Articulation Matrix:

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

1- Slightly, 2- Moderately, 3- Substantially

Module I

Fundamentals of Numerical Analysis: Understanding Numerical Methods, Importance in Problem Solving, Error Analysis and Approximations. Numerical solution of algebraic and transcendental equations: Bisection,Newton-Raphson, Secant and Successive Iteration Method. System of Equations: Gauss-Seidel Iteration (Convergence without proof). Interpolation and Approximation: Polynomial, Lagrange, Newton's Forward/Backward/Divided-Difference, and Least Squares.

Module II

Numerical Differentiation at Tabulated Points: Forward, Backward, Central Differences. Numerical Integration: Trapezoidal, Simpson's, Gaussian Quadrature. Ordinary Differential Equations (ODEs): Initial Value Problems-Euler's Method, Taylor Series Method, and Runge-Kutta (2nd & 4th Order). Boundary Value Problems-Finite Difference Method (First & Second Order BVPs).

Module III

Statistical Concepts and Tests: Random Variables, Expectation, Mean, Variance. ProbabilityDistributions: Binomial, Poisson, Normal. Statistical Inference: Population, Sample, Sampling Distributions(Mean & Variance). Hypothesis Testing: Level of Significance, Z-Test, Chi-Square Tests (Variance & Goodness of Fit), F-Test.

Module IV

Descriptive Statistics and Regression Analysis. Overview of Descriptive Statistics. Regression Analysis of Numerical Data. Regression Analysis of Categorical Data. Visualization of Data Trends. Basic Concepts of Machine Learning: Introduction to Supervised Learning, Overview of Classification and Regression, Introduction to Unsupervised Learning: Clustering. Utilize Pandas for data exploration and processing.

The students should be introduced to Computer Algebra Systems (CAS) such as Matlab/Python (utilizing NumPy, SymPy, and SciPy) for both symbolic and numerical calculations. Homework and assignments should be given with the integration of CAS.

References:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 11th Edition, John Wiley & Sons .
2. Grewal, B. S., Higher Engineering Mathematics, 45th Edition, Khanna Publishers.
3. R.K. Jain, S.R.K. Iyengar, R.K. Jain, Numerical Methods for Scientific and Engineering Computation, 7th Edition, New Age International Publishers.
4. Jay L. Devore, Probability and Statistics for Engineering and the Sciences, 10th Edition, Cengage Learning.
5. Wes McKinney, Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython, 3rd Edition, O'Reilly Media.

23-201-0502 DESIGN OF CONCRETE STRUCTURES-I

Course Outcomes:

On completion of this course the student will be able to:

1. Apply the basic principles of structural design using limit state method of design and design Reinforced Concrete beams and slabs
2. Identify different types of loads and load combinations acting on structures and check serviceability of structures based on code specifications.
3. Design Reinforced Concrete Columns and staircase adopting limit state method to design
4. Prepare structural drawings of beam, slabs, staircases and columns

Course Articulation Matrix:

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

1–Slightly; 2–Moderately; 3-Substantially

Module I

Introduction to different design philosophies, Principles of Working Stress and Limit State methods (Limit State method in detail), Analysis of singly and doubly reinforced beams of rectangular and flanged sections– Design of singly and doubly reinforced beams of rectangular and flanged sections- Design for shear

Module II

Design of slabs – design of one-way slabs – temperature and shrinkage reinforcement – behaviour of two way edge supported slab – analysis by coefficient method. continuous slab

Introduction to yield line theory for slab,

Analysis and design for torsion: Torsion in plain concrete members – torsion in reinforced concrete members – combined torsion and shear – Limit state design of beams – Code provision for torsion design

Module III

Bond, anchorage and development length: Fundamentals of flexural bond – ultimate bond strength and development length – Code provisions for development of tension reinforcement – anchorage of tension bars by hooks – anchorage requirements for web reinforcement – development of bars in compression – bundled bars – bar cutoff and bend points in beams. Serviceability: Cracking in flexural members – Code provisions for crack control – control of deflection – immediate deflection – deflection due to long term loads – Code provisions for control of deflection – deflection due to shrinkage and temperature changes

Module IV

Staircases- types of staircase-design of straight flight stair cases. Columns: Design of short columns – axial compression – lateral ties and spirals – compression plus bending in rectangular columns – strain compatibility analysis and interaction diagrams – balanced failure – distributed reinforcement –unsymmetrical reinforcement – circular columns –- Interaction diagram - Code provisions for design of short columns – biaxial bending – Design of slender columns – concentrically loaded columns – compression plus bending – Code provisions for design of slender columns

References:

1. Nilson, A.H., Darwin D., and Dolan C.W., *Design of Concrete Structures.* McGraw Hill Companies.
2. Pillai, S.U.and Menon, D. Reinforced Concrete Design. Tata McGraw Hill Publishing Company Limited, New Delhi, India.
3. Varghese, P.C. Limit State Design of Reinforced Concrete. Prentice Hall of India Pvt Ltd, New Delhi, India.
4. Syal and Goel. Reinforced concrete structures, S Chand.
5. Jain, A. K., Reinforced Concrete -Limit State Design, Nem Chand and Bros.
6. Mallick, S. K., and Gupta, A. K., Reinforced Concrete, Oxford and IBH.

Note: Use of IS. Codes: 456-2000, 875-1987 and Interaction charts for column design (SP: 16) are permitted in the Examination Hall

Type of Questions for Semester End Examination

Question nos. I and II [with sub sections (a), (b),] (12.5 marks each with option to answer either I or II) from Module I.

Question nos. III and IV [with sub sections (a), (b),] (12.5 marks each with option to answer either III or IV) from Module II.

Question nos. V and VI [with sub sections (a), (b),] (12.5 marks each with option to answer either V or VI) from Module III.

Question nos. VII and VIII [with sub sections (a), (b),] (12.5 marks each with option to answer either VII or VIII) from Module IV.

The maximum marks that can be awarded for the Semester End Examination (SEE) will be only 50

23-201-0503 ANALYSIS OF STRUCTURES – II

Course Outcomes:

On completion of this course the student will be able to:

1. Distinguish clearly static and kinematic indeterminacy of structures and force and displacement methods of analysis of indeterminate structures.
2. Analyse pin-jointed and rigid-jointed indeterminate plane structures using force method of analysis.
3. Analyse rigid-jointed structures by the well-known displacement-based method, the slope-deflection technique motivated by matrix formulation of equilibrium equations of the method and its computer implementation.
4. Apply the iterative procedure of analysis of rigid-jointed structures illustrated via the moment distribution method and approximate method of analysis.
5. Identify the advantage of certain geometrical features in structures and supports through the analysis of arches and cable stayed suspension bridges.

Course Articulation Matrix:

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

1–Slightly; 2–Moderately; 3-Substantially

Module I

Indeterminacy of structures: Degree of static and kinematic indeterminacy of pin-jointed and rigid-jointed structures, redundant and degree of freedom, introduction to force and displacement methods based on the degree of static and kinematic indeterminacy.

Force method of Analysis of indeterminate beams and frames: Strain energy method (Castigliano's theorems), unit load method, induced reactions due to yielding of supports.
Force method of Analysis of indeterminate trusses: Force method in which reactions as redundant, axial forces in members as redundant, both reactions and axial forces as redundant, reactions due to yielding of support, pre-strains
Three moment equation method – Application of three moment equation to continuous beams, analysis of continuous beams subjected to uneven support settlement.

Module II
Displacement Method of Analysis – The Slope Deflection method: Derivation of the slope deflection equation for a one-span beam, analysis of continuous beams, beams subjected to uneven support settlement, analysis of rigid jointed frames with and without unknown joint translation, rigid frames subjected to support settlement, analysis of gable frames.

Module III
Displacement Method of Analysis – The Moment Distribution method:
Stiffness and carry over factors, distribution factors, analysis of continuous beams, check on moment distribution, modified stiffness factors at the near end when far end is hinged, beams subjected to uneven support settlement, analysis of rigid jointed frames with and without joint translation, rigid frames subjected to support settlement.
Approximate method of Analysis- Substitute frame method, Portal method, cantilever method.

Module IV
Arches and frames: Theory of arches, Eddy's theorem, three hinged arches, two hinged arches, fixed arches, Influence lines for bending moment, shear force and axial thrust.
Cable Suspension bridges: Equilibrium of un-stiffened cable, tension in the cable, length of the cable, anchor cable, roller support, saddle support, effect on cable length due to change in temperature. Shear force, bending moment and influence diagrams for two and three hinged stiffening girders.

References:

1. Wang, C.K.,Intermediate Structural Analysis. McGraw Hill International Edition.
2. Menon, D., Structural Analysis. Narosa publishers.
3. Pandit, G. S. and Gupta, S. P. Theory of structures, Vol.1 and 2, Tata McGraw Hill.
4. Roy and Chakrabarty., Fundamentals of Structural Analysis. S Chand.
5. Norris, C. H. and Wilbur J. B., Elementary Structural Analysis. McGraw Hill, New York.
6. Punmia, B.C. and Jain, A. K., Theory of Structures, Laxmi Publications (P) Ltd.

23-201-0504 TRANSPORTATION ENGINEERING – II

Course Outcomes
On completion of the course, a student will be able to:

1. Demonstrate comprehension of the fundamentals and design principles pertaining to diverse components of railway tracks.
2. Analyze railway operation control, and exhibit proficiency in tunnel driving procedures, encompassing lighting, ventilation, and drainage.
3. Outline the types of harbour and construction of break waters.
4. Elaborate on the varieties of docks and dredgers.

Course Articulation Matrix

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

1-Slightly, 2- Moderately, 3- Substantially

Module 1

Railway Engineering: Permanent way main requirements Component parts. Rails functions of rails requirements of a good rail, weight and length., defects in rails, rail joint and other fastenings, check and guard rails, coning of wheels, creep of rail. Sleeper- its functions and requirements, sleeper density, Ballast- functions and requirements, different types used. **Geometric Design**: Design of horizontal curves-Super elevation, negative super elevation in branches, length of transition curves grade compensation on curves, widening of gauge on curves.

High speed rail systems -operational principles, safety considerations, and track infrastructure, new concepts in railways.

Module 2

Railway Operation control: Points and Crossings-Design features of a turn out-Types of railway track points Details of station yards and Marshalling yards-Signaling and interlocking

Principles of track circuiting- Control of train movement by absolute block system-automatic block system-Centralized traffic control systems.

Tunnel Engineering: Tunnel sections-types size and shapes-tunnel surveying-Alignment, transferring center grade in to tunnel-tunnel driving procedure-tunneling through hard and soft soils(Only Shield method of tunneling and Compressed air method) Tunnel lining ventilation lighting and drainage of tunnels.

Module 3

Harbor Engineering: Classification of harbors Breakwaters-necessity and functions-different types-forces acting on breakwater-design principles-construction of breakwaters-general study of pier heads, quays, landing stages-wharves, jetties, transit sheds and warehouses-channel demarcation-signal characteristics Beacons, buoys, channel- lighting, light houses).

Module 4

Dock Engineering: Function and types of docks, dry docks, floating docks slipways, dock gates and caissons-s Dredging-Mechanical and hydraulic dredgers-general study of bucket ladder-Dredger, grab dredger and dipper dredgers.

Impacts of dredging operations on shore and ecology

References:

1. Chandra, S. and Agarwal, M.M. Railway Engineering. Oxford University Press, New Delhi, India.
2. Saxena, S.C, and Arora S. P. Railway Engineering. Dhanpat Rai and Sons, New Delhi, India.
3. Agarwal, M.M. Indian Railway Track. Prabha and Co., New Delhi, India.
4. Rangwala, S.C. Principles of Railway Engineering. Charotar Publishing House, Anand, India.
5. Bindra, S.P.A Course in Docks and Harbour Engineering. Dhanpat Rai and Sons, New Delhi, India.
6. Seetharaman, S. Dock and Harbour Engineering.Umesh Publications, New Delhi, India.
7. Srinivasan, R. Harbour, Dock and Tunnel Engineering.Charotar Publishing House, Anand, India.

23-201-0505 GEOTECHNICAL ENGINEERING –II

Course Outcomes:

On completion of the course, a student will be able to:

1. Determine the earth pressure on retaining structures and apply the knowledge on the design of sheet pile walls
2. Apply the knowledge on soil exploration methods to carry out soil investigation for civil engineering projects
3. Estimate the bearing capacity of soils and the probable settlement of foundations
4. Determine pile and pile group capacity for any type of soil and construction of well foundations

Course Articulation Matrix

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

1-Slightly; 2- Moderately; 3- Substantially

Module I

Earth Pressure-General and local states of plastic equilibrium – Rankines and coulomb's theories for active and passive conditions- influence of surcharge- Earth pressure due to layered backfill– Rebhann's and Culmann's graphical methods for active earth pressure

Sheet pile walls: Types and uses of sheet piles – Design of cantilever and anchored sheet pile walls (Free earth support only).

Module II

Site investigation and soil exploration: objectives - planning - reconnaissance - methods of subsurface exploration - test pits - Auger borings - rotary drilling - IS code specification regarding depth and spacing of exploration - bore log - soil profile- Field tests - S.P.T, Cone Penetration Tests, Plate load test, field vane shear test, field CBR test, geophysical methods (in brief) – sampling - Utility of samples - disturbed and undisturbed samples - soil investigation report.

Module III

Foundation -Functions of foundations - requisites of satisfactory foundations - definition of shallow and deep foundation - different types of foundations -selection of type of foundation.

Bearing capacity: ultimate bearing capacity and allowable soil pressure - Terzaghi's equation for bearing capacity for continuous , circular and square footings - bearing capacity factors and charts - Skempton's formulae - effect of water table on bearing capacity – IS recommendation. Settlement analysis: distribution of contact pressure – estimation of immediate and consolidation settlement – effects, causes and remedial measures of total and differential settlement – permissible total and differential settlements as per IS recommendation -

Design considerations –Proportioning of shallow foundations.

Raft foundations: governing criteria for allowable bearing pressure - floating foundations.

Module IV

Pile foundations: Classification of piles based on material, shape, mode of load transfer, method and effect of installation –selection of type of piles - determination of capacity of axially loaded single vertical pile (static and dynamic formulae) - determination of capacity from penetration test results - pile load tests (IS methods) - negative skin friction - pile spacing and group capacity – settlement of pile groups.

Caissons and cofferdams: different types – different shapes of Well foundations- component parts–forces acting on Well foundations- design considerations of well foundations - sinking of wells and remedial measures for tilts and shifts – types and uses of cofferdams.

References

1. Ranjan, G. and Rao, A.S.R. Basic and Applied Soil Mechanics, New Age International Publishers.
2. Bowles, J. E. Foundation Analysis and Design. McGraw Hill.
3. Tomlinson, M.J., Pile Design and Construction Practice, Point Publications, London.
4. Kurian, N. P.Design of foundation system.Narosa Publication.
5. Das, B.M.Principles of Foundation Engineering. Thomson Learning.
6. Varghese, P. C.Foundation Engineering. Prentice Hall of India.

PROFESSIONAL ELECTIVE-I

23-201-0506(IE) PRECAST CONSTRUCTION

Course Outcomes:
On completion of this course the student will be able to:

1. Identify the suitability and advantage of precast construction for various structures and components.
2. Explain the general principles in precast construction for structural integrity and stability and apply design principles for modular coordination and connections of pre- fabricated components.
3. Recommend precast constructions for floor slabs, beams, columns, walls and other components of the structures.
4. Apply precast construction techniques for architectural facades, cladding, panels and other such elements.

Course Articulation Matrix:

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

1–Slightly; 2–Moderately; 3-Substantially

Module I
Suitability of precast construction: When to use precast concrete – advantages and limitations: speed of construction, optimum use of materials, appearance and finishes, tolerance, transport and site erection, building services, quality assurance and product certification, and testing, codal provisions.
Production: Choice of production setup, manufacturing methods, stationary and mobile production, planning of production setup, storage of precast elements. Precast structures with prestressed concrete.
Preliminary design considerations: Approaches to design, Frame and skeletal system, bearing walls, facades, cell system, mixed construction.

Module II
General design principles: Overall stability, structural integrity, basic force transfer mechanism, types of connections, modular coordination and standardization, transportation and erection planning.
Frame and skeleton structures: Components of skeletal frame, Layout and modulation, Frame action: cantilever action of column, braced skeletal structures, comparison of system, floors and balconies.
Typical connections: Column to foundation connections, column to column connections, beam to column connection, beam to beam connection, beam to column to floor connection.

Module III
Precast floors: Totally precast floors, partially precast floors, stairs, modulation, design considerations: diaphragm action, transverse load distribution of concentrated loads, composite floor structures, ribbed soffit units, floor plates, beam-block floor, opening and cutouts.
Bearing walls: Load bearing cross walls, spine wall system, mixed system, elevator and stair well shaft, special arrangement at ground level, modulation, elements of load bearing walls: interior walls, cavity walls, interior walls, retaining walls, wall to wall connection, wall to floor connections.

Module IV
Architectural concrete facades: Capabilities, structural system: load bearing façade elements, non- load bearing façade elements, split structure façade, fibre reinforced cladding, guidelines to select a structural system.
Shape of façade units and dimensions**:** shape in relation to the moulds, preferred dimension, modulation and flexibility, joints in the exterior façade, Superficial appearance: Texture, colour, faced panels, Panel fixing: type of connections and applications, durability, fire protection. Case Study/Mini Project and Field visits to precast construction projects.

References:

1. De La Precontrainte, F. I.FIP-planning and design handbook on precast building structures. SETO.
2. Anderson, M. M. S., & Anderson, P. P. C. Prefab prototypes: Site-specific design for offsite construction.
3. Cobbers, A., Jahn, O. Prefab Houses. Germany: Taschen.
4. Costa Duran, S. New Prefab Architecture. Germany: Loft.
5. Handbook on Precast Concrete for Buildings. India: Indian Concrete Institute.
6. Elliot, K. S , Precast Concrete Structures. Second Edition, CRC Press, Taylor & Francis Group.

23-201-0507 TRAFFIC ENGINEERING

Course Outcomes:

On completion of the course, a student will be able to:

1. Attain comprehensive knowledge of traffic surveys.
2. Achieve knowledge on design of road intersections and signals and outline various traffic control and traffic management measures.
3. To design of an appropriate traffic flow theory for traffic characteristics and to decide the capacity of highways.
4. Encapsulate methods of economic evaluation.

Course Articulation Matrix

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

1-Slightly; 2- Moderately; 3- Substantially

Module I

Traffic Engineering: Definition, Functions.

Road User and the Vehicle: Human factors governing road user behavior - Vehicular characteristics.

Traffic Surveys: Speed, Journey time and delay study – Methods-Moving observer method, Presentation of data-grouping of speed data, cumulative frequency curve, problems. Vehicle volume counts and classifications - methods Parking surveys. Uses of photographic techniques in traffic survey.

Origin- Destination Surveys: methods, zoning and presentation of results.

Module II

Traffic Controls: Different types of traffic signs and markings. Traffic signals - design, coordinated signals-time-distance diagram -area traffic control-Other traffic control aids and street furniture.

Intersections And Interchanges –Types-Planning and layout

Parking: Parking problems – desirable parking space standards for different land use -common methods of on-street parking, off-street parking facilities, parking surveys

Traffic Management: Travel demand management, scope of traffic management measures- restrictions on turning movements and one-way streets.

Module III

Highway Capacity And Level Of Service: Definitions - PCU-LOS concept, Factors affecting capacity and LOS. Capacity of highways, urban streets, rotary, weaving sections and signalized intersections.

Theory Of Traffic Flow: Fundamental diagram of traffic flow-Relationship between speed and concentration.

Module IV

Transportation Economics: Cost and benefits of transport project, basic principles and methods of economic evaluation, rate of return method s and discounting cash flow methods– worked out problems. Road user cost-Motor Vehicle operation cost.

Traffic Safety: Accidents-causes and prevention.

Highway Lighting: Importance of highway lighting, design factors, spacing between lighting units.

References

1. Khadiyali, L.R. Traffic Engineering and Transport Planning. Khanna Publishers.
2. Roess, R. P., Prassas, E. S. and McShane, W. R. Traffic Engineering. 4th edition. Pearson.
3. May, A.D. Traffic Flow Fundamentals. First edition. Pearson.
4. Mannering,F. L., Washburn, S. S. and Walter P. K. Principles Of Highway Engineering And Traffic Analysis. 5th edition. Wiley India Pvt Ltd.
5. Slinn, M., Matthews, P. and Guest, P. Traffic Engineering Design: Principles and Practice. Butterworth-Heinemann.
6. Chakroborty, P. and Das, A. Principles of Transportation Engineering. Prentice Hall India Learning Private Limited.
7. Recommended Practice for Traffic Rotaries - IRC 65
8. Guidelines for capacity of roads in rural areas -IRC 64
9. Guidelines for design and installation of Road Traffic Signals -IRC 93

23-201-0508 ENGINEERING SEISMOLOGY

Course Outcomes

On completion of this course the student will be able to:

1. Rule on various physical and hydrogeological processes.
2. Interpret the choice of geomaterials through the mineralogical and petrological study.
3. Apply principles of engineering geology for subsurface explorations and the site selection of Civil Engineering projects.
4. Assess various geo-hazards and its mitigation techniques.

Course Articulation Matrix

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

1-Slightly; 2-Moderately; 3-Substantially

Module I

Introduction: Definition - branches of geology -scope of geology – geology in civil engineering – geological maps.

Physical Geology: Rock weathering and soils - physical weathering - chemical weathering – tests to assess weathering of rock – engineering significance of weathering - soil formation – geological classification of soil - soil erosion and its control.

Coastal processes – coastal protection.
Hydrogeology: Occurrence of ground water – Occurrence of ground water – types of aquifers – geological controls on ground water movements.

Module II

Mineralogy: Physical properties of important soil and rock forming minerals, Basics of SEM and XRD analysis.
Petrology: Classification, texture and structures of Igneous, Sedimentary and Metamorphic rocks – Engineering properties of rocks as construction material - Description, engineering properties and uses of the following rocks – Granite, Gabbro, Basalt, Limestone, Shale, Laterite, Quartzite and Marble – Rock types of Kerala.

Module III

Geological Investigation: Objectives – Methods of investigation – Surface investigation – Sub - surface explorations – Geophysical explorations of Engineering site.
Engineering Geology: Geological conditions necessary for design and construction of dam, reservoirs, tunnels, buildings and road cuttings in detail.
Structural Geology: Attitude of beds, study of structures –folds, faults, fractures and joints – classification, recognition in the field, relevance to civil engineering.

Module IV

Geological Hazards: Landslides – definition, classification, causes and mitigation methods.
Seismology: Internal structures of the earth – M-discontinuity – sources of seismic activity - Continental Drift - Plate tectonics –fault movement – Reservoir associated earthquakes – Elastic Rebound Theory - Seismic waves – Terminology – Intensity and Magnitude of Earthquake – Energy Released during earthquake – Locating Epicentre and Focus – Recording of an earthquake – Seismograph – working Principle and Sensitivity of a Seismographs – classification of earth quakes - cause of origin –effects of earthquakes – Primary effects – Secondary effects - Distribution of earth quakes –Seismic History of India Seismic Zones of India – Earthquake resistant construction.
Tsunami: Introduction – Tsunami velocity – Velocity in deep ocean –Velocity in shallow water - wavelength of tsunami wave – Drawdown and Run up of a tsunami – inundates of Tsunami waves.

References:

1. Blyth, F. G. H. and de Frieitis, M. H. *Geology for Engineering*
2. Duggal, S, K., Rawal, N and Pandey, H, K *Engineering Geology*, McGraw Hill Education, New Delhi
3. Frost, J. *An Introduction to Seismology*, Larsen and Keller Education.
4. Garg, SK , *Introduction to Physical and Engineering Geology*, Khanna Publishers, New Delhi
5. Gokhale, KVGK (2010) *Principles of Engineering Geology*, BS Pubications, Hyderabad
6. Judo, W. R. *Principles of Engineering Geology and Geotechnics*. McGraw Hill.
7. Kanithi V , *Engineering Geology*, Universities Press (India) Ltd., Hyderabad
8. Mukerjee, P. K. *A text book of geology*. World Press Ltd., Calcutta.
9. Singh, P. *A text book of Engineering and General Geology*. Katson Publishers, Ludhiana.
10. Waltham, T. *Foundations of Engineering Geology*. Spon Press, London.

23-201-0509 DISASTER MANAGEMENT

Course Objectives: To impart the concepts of different types of natural and industrial disasters and develop skills in various stages of disaster preparedness, mitigation and management as well as the methodologies for disaster risk assessment.

Course Outcomes: On completion of the course, a student will be able to:

1. Understand different types of disasters and their associated damages caused to environment and structures.
2. Able to analyze hydrological disaster and develop models for geological disaster.
3. Learn about the engineering and non-engineering controls of mitigating various natural disasters incorporating latest tools.
4. Prepare vulnerability mapping, and risk assessment and developing Emergency management System.

Course Articulation Matrix

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

1- Slightly, 2- Moderately, 3- Substantially

Module I

Disaster, Hazard, Vulnerability, Resilience. Types of hazards- Natural disasters - hydro-meteorological disasters such as flood, drought, cyclone etc.; geological disasters- earthquake, tsunami, landslides, volcanic eruption. Man made disasters - chemical industrial hazards, major power break downs, traffic accidents, fire hazards, biological hazards, nuclear accidents. Environmental hazards - forest hazards (deforestation, degradation and forest fire), land and soil degradation, desertification and pollution (water, air and soil). Global trends in disasters

Module II

Hydrological Hazards: Flooding – classification, causes and impacts - PMP – PMF – Inundation mapping -flood prone area analysis and management. - Drought- types of drought - Factors influencing drought - delimiting drought prone areas - drought index, SPI and Palmer. Geological Hazards: Earthquakes; location, faults, causes, types, associated hazards and impacts, Richter scale and Modified Mercalli scale. Mass movements: Definition of landslide - types – causes - slope stability analysis. Coastal Hazards – storm surge - Tsunami and floods – cyclone – coastal vulnerability – shore line erosion – shore defense structures.

Module III

Natural disasters- hazards in arid and semi-arid areas - nature of the hazard – hazard management activities – disaster mitigation – natural hazard prediction – emergency preparedness – community based DRR- disaster, rescue and relief – post disaster rehabilitation and reconstruction. Roles and responsibilities of the community, Panchayati Raj institutions/ Urban Local Bodies, States, Centre, and other stakeholders including NGOs. Education and training activities – vulnerable elements to be considered in the development planning for natural hazard management.

Module IV

Components of disaster relief - water, food, sanitation, shelter, health, waste management, Institutional arrangements for mitigation, response and preparedness, Legislation in India on Disaster Management. National disaster management policy. Existing organizational structure for managing disasters in India. Applications of remote sensing and GIS in disaster management. Prediction and early warning systems Case studies.

References:

1. S. R. Sharma, Disaster Management, A P H Publishers.
2. Sreeja. S. Nair, Training Manual on Geoinformatics Applications in Disaster Management, NIDM.
3. Harsh. K. Gupta, Disaster Management, Universities Press.
4. J. P. Singhal, Disaster Management, Laxmi Publications.
5. K. Venugopala Rao, Geoinformatics for Disaster Management, Manglam Publishers and
6. Distributors.
7. Matthews, J.A., Natural Hazards and Environmental Change, Bill McGuire, Ian Mason.
8. Sulphey, M. M.,Disaster Management, PHI Learning, 2016.
9. Damon P. Coppola, Introduction to International Disaster Management, Butterworth-Heinemann.
10. Parag Diwan,A Manual on Disaster Management, Pentagon Press, 2010, 10. Websites – National Disaster Management Authority, National Institute for Disaster Management, and State Disaster Management Authorities
11. ILO, Geneva. *Major Hazard Control – a Practical Manual.*

23-201-0510 GEOTECHNICAL ENGINEERING LABORATORY

Course Outcomes:
On completion of the course, a student will be able to:
1. Determine the index properties of soils.
2. Classify soils as per Indian Standards
3. Determine the engineering properties of soils.

Course Articulation Matrix

	PO1	PO2	PO2	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	-	-	-	-	2	-	-	1	-	1	1
CO2	3	3	3	3	-	-	-	-	2	-	-	1	-	1	1
CO3	3	2	3	2	-	-	-	-	2	-	-	1	-	1	1

1-Slightly, 2- Moderately, 3- Substantially

LIST OF EXPERIMENTS

1. Determination of Specific gravity, water content and particle size distribution by hydrometer method.
2. Determination of field density by core cutter and sand replacement method.
3. Determination of Atterberg Limits.
4. Compaction tests – I.S. light and heavy compaction.
5. Permeability tests – constant head and variable head methods.
6. Consolidation test.
7. Shear strength tests – Direct shear, Triaxial, UCC & Vane Shear Test

- *Group Project based on the laboratory course*

23-201-0511 TRANSPORTATION ENGINEERING LABORATORY

Course Outcomes

On completion of the course, a student will be able to:

1. Characterize the aggregates and bitumen used for road construction.
2. Design a bituminous mixture.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2	PSO3
CO1	2	-	-	2	-	-	-	-	2	-	-	2	1	-	-
CO2	2	-	-	2	-	-	-	-	2	-	-	2	-	2	-

1-Slightly, 2- Moderately, 3- Substantially

List of Experiments

Tests on Aggregates

1. Crushing Value
2. Los-Angeles Abrasion Value
3. Impact Value
4. Specific Gravity
5. Water Absorption
6. Shape Test Flakiness Index, Elongation Index & Angularity Number

Tests on Bitumen

7. Viscosity Test
8. Ductility Test
9. Softening Point Test
10. Specific Gravity
11. Penetration Test
12. Flash and Fire Point Test

Tests on Soil

13. CBR Test

Test on Bituminous mixes

14. Marshall Test
15. Bitumen extraction test

- *Group Project based on the laboratory course*

23-200-0512: INTERNSHIP-II

Course Outcomes:

On completion of this course the student will be able to:

1. Understand the real time technical/managerial skills required and relevant to the subject area of internship
2. Initiate a habit of proper daily diary writing with adequacy and quality of information recorded, drawing and sketches and data, thought process and the proper organisation of the information gained during the internship.
3. Conceive the pros and cons of working in a real time industrial environment and the wonderful results which could evolve through team-work.
4. Present and defend self-prepared and corrected internship report (with the help of internship guide/industry mentors) of a self-created work to a peer audience.

Course Articulation Matrix

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

1- Slightly, 2- Moderately, 3- Substantially

Topics for Internship: construction of special structures - tunnels-prestressed bridges, precast construction etc Students have to visit at least one industry relevant to Civil Engineering as part of industrial training and spend a minimum duration of 2 weeks after the completion of 5^{th} semester and before the commencement of 6th semester. A report of the same should be submitted at the beginning of the 4th semester and evaluation shall be conducted based on the report, presentation and viva

Internship Guidelines

- An internship plan has to be prepared by the interns incorporating the job description/internship duties, name of the project, if any and internship schedule and expected learning outcomes in consultation with industry supervisor/mentor and institute faculty.
- A detailed training report in the prescribed format shall be submitted at the end of the internship.

- Training Certificate from the industry for the prescribed period shall be submitted at the end of the internship.
- The work shall be reviewed and evaluated periodically.
- Orientation of interns, resourse requirement of interns, monitoring of interns progress on a daily basis shall be carried out by the industry offering internship in addition to ensuring safety and welfare of the interns.

A committee consisting of the Internship Coordinator (nominated by the Head of the Department/Division), faculty mentor, and at least one senior faculty member at the level of Associate Professor or above will carry out the final review.

Guidelines for evaluation:

1.	Regularity and progress of work	10
2.	Work knowledge and Involvement	10
3.	Semester End presentation and oral examination	10
4.	Level of completion of internship	10
5.	Internship Report – Presentation style and content	10
Total		**50** Marks

▪ 23-201-0513# DISASTER MANAGEMENT/*MOOC-II
(Minor Course)

Students should take Massive Open Online Courses (MOOCs) approved by the concerned Division/Board of Studies (BoS)

• 23-201-0514 SUBSURFACE INVESTIGATIONS AND INSTRUMENTATION
(Course for Honours)

Course Outcomes:
On completion of the course, a student will be able to:
1. Appreciate various exploration methods in soils and rock.
2. Apprehend the different field tests used as part of the soil exploration.
3. Analyse field and laboratory data for preparation of bore logs to form part of the soil investigation report.
4. Implement appropriate Geotechnical instrumentation required for any project.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2	PSO3
CO1	3	-	-	2	-	-	-	-	-	-	-	-	-	-	1
CO2	3	2	-	-	-	-	-	-	-	-	-	-	-	2	-
CO3	-	3	-	-	-	-	-	-	-	-	-	-	-	3	-
CO4	1	-	-	2	3	-	-	-	-	-	-	-	1	-	1

1-Slightly; 2- Moderately; 3- Substantially

Module I
Scope and objectives of exploration - planning an exploration program

Methods of exploration- open pits - methods of boring- stabilization of boreholes - spacing and depth of exploration –IS Code recommendations
Soil Sampling- disturbed and undisturbed soil samples- representative and non representative samples – methods to minimize sample disturbance – importance of inside clearance, outside clearance, area ratio, inside wall friction, non return valve etc.
Types of samplers–thin walled sampler, split spoon sampler, piston sampler, rotary sampler etc.
Challenges of site investigation in marine environment – under water/ offshore sampling - preservation and handling of samples.

Module II
Various types of field tests: Standard Penetration Test- precautions – corrections to the observed N values – correlations of N value with consistency / relative density of soils
Dynamic Cone Penetration Test – correlations with N value, Static Cone Penetration Test, Field CBR test

Module III
Other field tests: Pressure meter test- correlation of results with that of other field tests.
Field vane shear test, bore hole shear test and Insitu shear test.
Methods for measurement of field permeability.
Geophysical exploration and interpretation - Electrical resistivity method – resistivity mapping and resistivity sounding - Seismic refraction method.
Presentation of soil exploration data – Bore log and soil profile.

Module IV
Instrumentation in Geotechnical Engineering – purpose of instrumentation – objectives
Strain gauges – principle – electrical resistance, mechanical, vibrating wire type, pneumatic, optical, mercury-in-rubber type, and capacitive strain gauges.
Piezometers – primary requirements-open stand pipe type, pneumatic, hydraulic, strain gauge type and vibrating type piezometers – methods of installation.
Earth pressure cells – pneumatic, hydraulic strain gauge types and vibrating wire type earth pressure cells.
Slope Indicators/inclinometers – various types – applications.
Settlement and heave gauges – various types.

References

1. Hunt, R.E.,Geotechnical Engineering Investigation Manual, McGraw Hill.
2. Winterkorn,H.F.and Fang,H.Y,Foundation Engineering Hand Book,Nostrand Reinhold.
3. Alam Singh and Chowdhary, G.R.,Soil Engineering in Theory and Practice Volume-2, Geotechnical testing and instrumentation, CBS Publishers..
4. Nair, R.J. and Wood, P.M. Pressuremeter Testing Methods and Interpretation, Butter-worths.
5. Dunnicliff, J., and Green, G.E.,Geotechnical Instrumentation for Monitoring Field Performance, John Wiley.
6. Hanna, T.H. ,Field Instrumentation in Geotechnical Engineering, Trans Tech.

• 23-201-0515 RESEARCH METHODOLOGY AND IPR
(Course for Honours)

Course Outcomes:
On completion of this course the student will be able to:
1. Explain the research processes and investigate for solutions of a research problem
2. Carry out literature review and prepare a research proposal
3. Prepare a scientific article within a limited topic but with a quality such that the article could be accepted for presentation in a reputed conference or workshop
4. Apply the various research methods followed in engineering research for formulation and design of own research problems and to utilize them in their research project.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		2	2	2	1	1		1	1			1			
CO2		2		2				1		2		1			
CO3		2		2				1		2		1			
CO4		2		2	1	1		1				1			1

2- Slightly, 2- Moderately, 3- Substantially

Module I

Definition and objective of research, types of research, steps in research process, research Design, concept and types of research design, defining and formulating the research problems, importance of literature review- primary and secondary sources, reviews, monographs, patent, research database, web sources, identifying gap areas from the literature and research data base, surveying synthesis, Interpretation.

Module II

Research and Integrity, Scientific mis conduct: Falsification, Fabrication and Plagiarism (FFP), Conflict of research, Predatory publishers and Journals, Open access publication, citation and acknowledgement, reproducibility and accountability, software tools for similarity check. Introduction and significance of intellectual property rights, Patents and its basics, Case studies.

Module III

Research reports, proposals, publications, and IPR: Structure and components of research report, types of report, layout of research report, Research proposals - development and evaluation –research paper writing – layout of a research paper - journals in engineering – considerations in publishing –concept of impact factor.

Module IV

Research Methods – Measurement, sampling and Data acquisition: Measurement design – errors -validity and reliability in measurement - scaling and scale construction - sample design - sample size determination - sampling errors -data collection procedures - sources of data – data collection methods – data preparation and data analysis

References

1. Stuart Melville and Wayne Goddard, Research Methodology: An introduction for Science & Engineering students, Juta & Co Ltd.
2. Ranjit Kumar, Research Methodology: A Step by Step Guide for beginners, 2nd Edition, Pearson.
3. Markel, Mike, Technical Communication. 11th Edition, Mac Millan.
4. C. R. Kothari, Research Methodology, New Age International.
5. Panneerselvam, Research Methodology, Prentice Hall of India, New Delhi.

23-201-0601 ENVIRONMENTAL ENGINEERING –I

Course Outcomes:

1. Recognize the important professional and ethical responsibilities as an environmental engineer so as to estimate or analyse the quantity and quality of water required for a community water supply scheme

2. Apply perfect knowledge on water supply sources for the design of collection, transport, transmission systems

3. Demonstrate knowledge on sanitary plumbing systems, design of sewerage systems and distribution systems in water supply engineering

4. Recognize various natural methods of wastewater disposal and self- purification of streams

5. Demonstrate an ability to provide engineering solutions for the environmental problems related with air pollution, solid wastes disposal and noise pollution

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12	PSO1	PSO2	PS03
CO1	3	3	3	-	-	2	1	2	-	-	3	2	2	-	2
CO2	3	2	3	2	1	3	2	1	2	-	3	1	3	2	-
CO3	3	2	3	2	-	3	2	2	2	-	3	2	3	-	-
CO4	3	-	-	2	-	6	2	2	2	-	2	2	-	-	2
CO5	3	2	3	3	3	3	3	3	3	-	2	2	3	-	3

1- Slightly, 2- Moderately, 3- Substantially

Module I

Scope of Environmental Engineering. Global environmental problems. Water supply Engineering: Rural and Urban water supply systems - Water demand – percapita demand, factors affecting per capita demand, variations in the rate of consumption, fire demand, design period, forecasting population. Quality of water – impurities in water and their importance - analysis of water - physical, chemical and bacteriological tests. WHO and Indian standards for drinking water.

Module II

Sources of water: Surface water sources-groundwater sources. Collection of water: intakes - location, types, pipe materials- design of gravity and pumping main. Pumps: classification - selection of pumps - location of pumping stations. Distribution systems-different layout of pipe networks - appurtenances in the distribution system - meters, valves, fire hydrants etc. Pipe laying & testing- detection and prevention of leaks in distribution system- maintenance of distribution system.

Module III

Sanitary plumbing: Sanitary Fixtures-Systems of piping-House drainage-Connection of house drains and street sewers. Systems of sewerage-Quantity of storm sewage-Quantity of sanitary sewage-Sewers, types, materials, shape, construction, appurtenances, hydraulic design of sewers, sewer junctions-maintenance, inspection and ventilation of sewers.

Module IV

Natural methods of wastewater disposal: land disposal-Sewage farming-disposal by dilution-self-purification of streams-oxygen sag curve-dilution into sea. Air pollution: type of pollutants, standards, sources, health effects, meteorological aspects, , monitoring and air pollution control. Solid waste management: type, sources, characteristics, collection, vehicles for transportation and processing – Disposal: composting, sanitary land fill, incineration. Noise pollution: Sources, effects & control methods, noise standards.

References:

1. Garg S.K, Environmental & Engineering, Vol I & II, Khanna publications, New Delhi.
2. Birdic G.S &Birdic J.S, Water supply and Sanitary Engineering, DhanputRai& Sons,1998 , New Delhi
3. Peavy Rowe, Tchobanoglous, Environmental Engineering,McGraw Hill International Editions.
4. Veslind, Morgan & Heine - Introduction to Environmental Engineering, Cengage Learning .
5. M.N.Rao & H.V.N.Rao, Air Pollution, Tata McGraw Hill Pvt.Ltd, New Delhi.
6. Mark.J.Hammer& Mark. J .Hammer Jr, Water and Wastewater Technology, Prentice Hall of India,Pvt Ltd, New Delhi.4
7. CPHEEO, Manual on Water Supply and Treatment- Third edition,Ministry of Urban Development, Gov. of India .

23-201-0602 DESIGN OF STEEL STRUCTURES

Course Outcomes:

On completion of this course the student will be able to:

1. Apply the provisions in Indian standard codes of practice for the design of various steel structures
2. Design connections, tension and compression members.
3. Design beams and plate girders.
4. Design light gauge steel structures.
5. Design of continuous beams and simple frames using the concept of plastic design

Course Articulation Matrix:

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

1–Slightly; 2–Moderately; 3-Substantially

Module I

Materials and specifications: rolled steel sections- types of structural steels – specifications-Limit state and working stress design concepts, Types of connections – Bolted joints-Types of bolted joints-load transfer mechanism-failure of bolted joints-efficiency of the joint-welded joints advantages and disadvantages of welded joints – types of welds and their symbols -Design of welded and bolted connections

Module II

Tension member: Net sectional area – permissible stresses – design of axially loaded tension member. Compression member: strength of an axially loaded compression member – effective length – maximum slenderness ratio – compression member with two rolled sections back to back – design of compression members – lacing and battening for built-up compression member – column base – slab base – gussetted base

Module III

Design of beams- laterally restrained and unrestrained – simple and compound beams- plate girders subjected to uniformly distributed loads – bearing and intermediate stiffeners

Module IV

Light gauge steel structures – Types of sections, Flat width ratio, buckling of thin elements, Effective design width, Form factor, Design of tension, compression members and beams.

Plastic design- basic assumptions - shape factor, load factor- Redistribution of moments - upper bound lower bound and uniqueness theorems- analysis of simple and continuous beams, two span continuous beams and simple frames by plastic theory - static and kinematic methods, Plastic design- Design of section for Continuous beams and simple frames.

References:

1. Subramanian, N. *Design of steel structures*. Oxford University Press.
2. Duggal, S.K. Limit State Design Of Steel Structures.,McGraw Hill.

3. Arya, A.S. and Ajmani, J. L. Design of Steel Structures.Nemchand& Bros.
4. Dayaratnam, P. Design of Steel Structures. Wheeler.
5. Chandak N.R., Design of Steel Structures., S.K Kataria & Sons.
6. Sairam, K.S., Design of steel structures, Pearson.

Type of Questions for Semester End Examination

Question nos. I and II [with sub sections (a), (b),] (12.5 marks each with option to answer either I or II) from Module I.

Question nos. III and IV [with sub sections (a), (b), …] (12.5 marks each with option to answer either III or IV) from Module II.

Question nos. V and VI [with sub sections (a), (b), …] (12.5 marks each with option to answer either V or VI) from Module III.

Question nos. VII and VIII [with sub sections (a), (b), …] (12.5 marks each with option to answer either VII or VIII) from Module IV.

The maximum marks that can be awarded for the Semester End Examination (SEE) will be only 50

Note: Use of IS: 800 – 2007, IS:801 – 1975, IS:811 – 1987 and structural steel table are permitted in the examination hall.

23-201-0603 ADVANCED METHODS OF STRUCTURAL ANALYSIS

Course Outcomes:

On completion of this course the student will be able to:

1. Interpret the concepts of structure-based flexibility matrix method initiated from the compatibility equations in the method of consistent deformation for statically indeterminate plane structures.
2. Apply the element-based flexibility matrix approach to analyze rigid-jointed and pin- jointed plane structures.
3. Formulate stiffness matrices of basic beam and truss elements and analyze rigid and pin-jointed structures via structure-based and element-based stiffness methods, initiated from the equilibrium equations of the slope-deflection method.
4. Appreciate the direct stiffness method as a generalized approach which would in turn seed the concept of the finite element analysis of structures.
5. Develop knowledge on the procedure of finite element analysis and develop finite element formulations for 1-D and 2-D structures.

Course Articulation Matrix:

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

1–Slightly; 2–Moderately; 3-Substantially

Module I

Introduction to the Flexibility and Stiffness Matrix Methods: Concept of flexibility and stiffness coefficients, Review of determination of displacements and slopes in statically determinate beams, Development of the flexibility matrix

method from the method of consistent deformation – compatibility equations, Development of flexibility matrix – Structure/system approach, Concept of element approach, Force Transformation matrix, Element flexibility matrices for truss and beam elements, Equivalent joint load vector, Development of structure flexibility matrix through element approach, Analysis of pin-jointed plane frames by flexibility matrix approach, Analysis of statically indeterminate beams and rigid jointed plane frames by flexibility method.

Module II

Analysis by Stiffness Matrix Method: Development of stiffness matrix method from the slopedeflection method – equilibrium equations, Structure approach and Element approach, Element stiffness matrices for truss and beam elements, Displacement transformation matrix, Development of structure stiffness matrix by element approach, Analysis of statically indeterminate beams, rigid jointed and pin-jointed plane frames by stiffness matrix approach, effect of fabrication errors or temperature changes, effect of support settlement.

Module III

Analysis by Direct stiffness Method: Local and global coordinate systems, Transformation of element stiffness matrices from local to global co-ordinates, Equivalent nodal forces and load vector, Global stiffness matrix, Application of direct stiffness method to two span continuous beams, plane frames, space frames, Analysis of Column: buckling load as an eigenvalue problem, Advantages of direct stiffness method, Concept of finite element method introduced through the procedure of the direct stiffness method, Comparison of flexibility matrix and stiffness matrix methods**.**

Module IV

Basics of Finite Element Method: Concept of discretization of continuum - Finite element analysis procedure - Stress-strain relation (Constitutive relation)- Types of finite elements – Plane stress and plane strain problems – Displacement function – Convergence and compatibility requirements -natural coordinate system – shape functions – truss element, beam element and linear 2D element-Lagrange and Serendipity elements –- computation of element stiffness matrix and nodal load vector- Isoparametric element.

References:

1. Weaver, W. J. and Gere, J. M., Matrix analysis of framed structures, CBS Publishers, New Delhi.
2. Pandit, G. S. and Gupta, S. P., Structural analysis – A Matrix Approach. Tata McGraw Hill, New Delhi.
3. Kessimeli A. Matrix Analysis of Structures, Brooks/Cole Publishing Co.
4. Mukhopadhyay, M. and Sheik, A. H. (2009), Matrix and Finite Element Analysis of Structures, Ane Books Pvt. Ltd.
5. Wang, C. K.,Intermediate Structural Analysis. McGraw Hill International Edition.
6. Punmia, B. C. and Jain, A. K.,Theory of Structures. Laxmi Publications (P) Ltd.
7. Krishnamoorthy, C. S. Finite Element Analysis – Theory and Programming.,Tata McGraw Hill Publishing Company Limited, New Delhi, India.

23-201-0604 WATER RESOURCES AND IRRIGATION ENGINEERING

Course Outcomes:

On completion of the course, a student will be able to:

1. Analyse hydro meteorological data and components of hydrological cycle
2. Assess surface and groundwater resources
3. Identify basic requirements of irrigation and various irrigation techniques, water requirements of the crops
4. Perform investigation and planning of reservoirs also able to design head works, irrigation canals, spillways and energy dissipation structures

Course Articulation Matrix

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

1–Slightly; 2–Moderately; 3-Substantially

Module I

Hydrologic cycle, scope, application of hydrology, Precipitation: Formation of precipitation –forms of precipitation – type of precipitation - measurement of precipitation –recording and non recording gauges – gauge network - adjustments of precipitation data - average depth of precipitation over an area - Arithmetic mean, Theissen polygon and isohyetal method – Hyetograph – Mass curve – Depth area duration curves. Water Loses: Evaporation, transpiration and infiltration – Factors affecting evaporation-measurement of evaporation - Evaporation formulas – Infiltration, factors affecting infiltration, Determination of infiltration rate - Effect of infiltration on run–off - Recharge of ground water. Run off : Factors affecting run–off – Empirical formulae-runoff – hydrograph - Components of hydrograph - Separation of base flow - Hydrograph for isolated storm and complex storm – unit hydrograph - derivation of unit hydrograph for isolated and complex storm – Unit hydrograph for
different duration – S hydrograph.

Module II

Ground water Hydrology : Occurrence, distribution of ground water – Darcy' s law – Permeability, safe yield - Location and development of ground water supplies - Hydrology of well – Steady flow in confined and unconfined aquifers - open well – yield of an open well – Effect of partial penetration - Interference of wells - Boundary effect - Specific capacity of well – Tube wells –Yield from a tube well - Strainers – Site for a tube well Flow and lift Irrigation –Perennial and Inundation irrigation - Important Crops and crop seasons –Duty and delta – Method of Cultivation – Water requirement – Irrigation efficiency – Multipurpose projects. Reservoirs : Investigation and planning – Selection of site – Engineering, Geological, and hydrological Investigations - Fixation of storage capacity - Contours- Mass curve - operation of reservoirs - reservoirs sedimentation.

Module III

Head works : Storage and diversion works- Layout of head works - Selection of site – Weirs- Types of weirs – Weirs on permeable foundation – Uplift and piping – Bligh' s creep theory - Lane' s weighted creep theory – Khosla' s theory of independent variables - Design of aprons- Body wall – vertical drop weir - design of sloping glacis weir. River regulators - Silt excluder –Silt vane, Surplussing Arrangements: Spillways – Type and Functions – design of Ogee Spillway and Siphon Spillway - energy dissipation below spillways – stilling basin – spillway crest gates. Distribution works : Classification of canals – design of canals – erodible canals - canals in alluvial soils – regime theory – Kennedy, Lacey traction theories – Manning' s formula - Design. Non– erodible canals - Friction formula—Chezy, Manning's formula, Silting in canal and prevention – Scour-protection against scour.

Module IV

Storage works: Type of dams-Gravity dams –Forces acting on a gravity dam-Elementary profile- Single step method of design –Method of stability analysis-Zonal method of design safety criteria- Galleries in dams. Arch dams – Types-Thin cylinder theory. Earth and rockfill dams-Types of earthern dams.

References:

1. Subramanya, K. *Engineering Hydrology*, Tata McGraw-Hill.
2. Punmia, B. C. and Lal. *Irrigation and Water Power*. Laxmi Publications Pvt Ltd.
3. Modi, P. N. *Irrigation Water Resources and Water Power*, Standard Book House.
4. Sahasrabudhe, S. F. *Irrigation Engineering and Hydraulic Structures*. Kataria Publications.
5. Garg, S.K., *Irrigation Engineering and Hydraulic Structures*, Khanna Publishers.

23-201-0605 CONSTRUCTION MANAGEMENT

Course Outcomes:

On completion of the course, a student will be able to:

1. Understand principles of effective leadership.
2. Read and interpret construction documents and Create schedules; bar charts, critical path networks
3. Identify types of float and the use of float to manage projects. Also correlate manpower and cost loading to schedule.
4. Identify all activities and issues related to planning, financing, procuring, constructing, and managing the built environment. Also understand the uses and working of various equipments involved in construction.

Course Articulation Matrix

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

1–Slightly; 2–Moderately; 3-Substantially

MODULE I

Organization and Management: Concept of organization, characteristics of organization, elements of organization, organizational structures, organization charts, Types of organization formal line, military or scalar organization, functional organization, line and staff organization, project organization, matrix organization, management by objectives. Organizational conflict, group Dynamics, Organizational change, motivation and leadership, Authority and responsibility, span of control, Delegation of authority. – Centralization and decentralization.

Module II

Construction Planning: Objects of planning – stages of construction – Construction team – resources of construction industry – planning and scheduling – scheduling using bar charts - limitations of bar chart – Material, Labour, Equipment, Financial schedules.

Construction Contracts- Contracting procedure-Types of contracts-tenders–prequalification procedure - earnest money deposit – security deposit - contract document

Module III

Network Techniques– Difference between CPM and PERT – development of a network –representation of various activities and events in a CPM network – Network logic – network calculation-Float- Slack –Critical path– Crashing the programme – Time cost trade off – Resource Smoothing-leveling.

Module IV

Construction Equipments: Earth Moving and Excavating– Bull dozer, Scraper, power shovel, dragline, Clam shells, – Hauling and Conveying equipments – Trucks , Cranes, Pile driving Equipment, Aggregate crushers.

Introduction to Equipment Economics: Owning and Operating Costs, Factors for selection of equipment.

References:

1. Srinath, L. S. *An Introduction to Project Management*. Tata McGraw Hill publications
2. Arora and Bindra. *Building construction Planning Techniques and methods of construction*. Dhanpatrai & Sons.
3. Peurifoy and Schexnayder.*Construction Planning, Equipment and Methods*. Tata McGraw Hill.
4. Gahlot and Dhir. *Construction Planning and Management*. New Age International .
5. Khanna, O.P. *Industrial Engineering and Management*. Dhanapat Rai Publications.
6. Mazda, F.. *Engineering management*. Addison Wesley, Longman Ltd.

PROFESSIONAL ELECTIVE –II

23-201-0606(IE) CONSTRUCTION ENGINEERING AND MATERIALS MANAGEMENT

Course Outcomes: On completion of this course a student will be able to
1. Understand various type of temporary structures in construction.
2. Identify the quality standards in highway and general construction.
3. Demonstrate their abilities in key areas such as Purchase Management, Inventory Control, Logistics, Warehousing and Human Resource Management.
4. Demonstrate their abilities to organize Stores and warehouses, Monitor, identify and control inventory.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	3	-	-	-	-	2	1	-	-
CO2	3	2	1	-	1	-	3	1	-	-	-	2	-	2	-
CO3	3	2	3	1	1	-	3	-	-	1	1	2	-	2	2
CO4	3	2	3	1	2	-	3	1	-	1	1	2	-	1	-

1-Slightly, 2- Moderately, 3- Substantially

Module I

Formwork: Requirements of a good formwork – Loads on form work – guiding points in the design of form work – column form work –formwork for beams and floors – form work for deck slabs in bridges.

Scaffolding/ Falsework, Shoring and Underpinning: Scaffolding – parts of scaffolding – types of scaffolding – points to be kept in view of scaffolding – shoring – types of shoring – underpinning – methods of underpinning.

Construction dewatering- Coffer dams- Temporary sheeting and bracings.

Construction 3D printing (brief discussion only)

Module II

Quality control: Introduction to IRC and MOST standards – General system Requirements, Field Laboratory, Material specifications, Introduction to ISO 9000/IS 14000 Series – Relevance to Construction, Overview, Interpretation of important clauses, Elements / System Requirements of ISO 9001 – Quality Policy, Quality System, Contract Review Process, Design control Control of documents, Purchasing Standards, Product Identification and Traceability, Process Control Standards to prevent nonconformities, Inspection and Testing Standards, Standards for personnel training. Building the ISO System – Quality Manual, Procedure Manual, Quality Documentation. Implementation – Quality System Management, Auditing, follow up audits.

Module III

Materials Management Introduction: Scope, Objectives and functions, phases in materials management, requisition, procurement and distribution, Procurement: Purchase procedure, tender, earnest money, security deposit, purchase order, Vendor rating. Receipt: Invoice, cash memo, inspection. Storage: Methods of storage, bin, rack, piling and special arrangements, stock verification Issue: issue vouchers, FIFO & LIFO systems, imprest stores, consumable stores, custody stores.

Module IV

Materials Management and Inventory Control: Selective control techniques of inventory- Inventory, Inventory control, Inventory classification & Management, Inventory control, its objectives and how to achieve them, Functions

of inventories, Economics order Quantity, Inventory models- Simple EOQ model EOQ model with stock out, Inventory model under risk ABC analysis.

References:

1. Peurifoy, R. L., Ledbetter, W. B. and Schexnayder, C. J. *Construction planning equipment and method*. McGraw Hill Publishing company.
2. Singh, G. *Building construction Engineering*. Standard Book House.
3. Gopalakrishnan, P.and Sunderesan, M. *Materials Management- an Integrated Approach*. PHI Learning Pvt. Ltd.
4. Starr and Miller. *Inventory Control- theory and practice*. PHI Learning Pvt. Ltd.
5. MOST Standards Hand Book , RDSO Standards , CPWD Standards.
6. O'Brein. *Construction Inspection Hand Book*. Springer US.
7. Deb, A. *Materials Management*. Academic Publishers.
8. Khanna, O.P. *Industrial Engineering and Management*. Dhanpat Rai Publications

23-201-0607 PAVEMENT ANALYSIS AND DESIGN

Course Outcomes:

On completion of the course, a student will be able to:

1. Identify the pavement components and compare highway and airport pavements.
2. Calculate stresses and ESWL in flexible pavements and design the flexible pavement.
3. Calculate the combined stresses due to temperature and wheel load stress and design rigid pavements by IRC method.
4. Evaluate pavements.

Course Articulation Matrix

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

1. Slightly, 2- Moderately, 3- Substantially

Module I

Introduction: types and component parts of pavements - Functions of various layers of pavements-prime coat, tack coat, seal coat- warm mix and cold mix asphalt technologies-factors affecting design and performance of pavements - comparison between highway and airport pavements – functions and significance of sub grade properties – various methods of assessment of sub grade soil strength for pavement design - cause and effects of variations in moisture content and temperature - depth of frost penetration - design of bituminous mixes by Marshall method.

Module II

Stress analyses and methods of flexible pavement design: stresses and deflections in homogeneous masses - Burmister theory - wheel load stresses - ESWL of multiple wheels - repeated loads and EWL factors - empirical, semi - empirical and theoretical approaches for flexible pavement design - group index, CBR, -IRC method ,triaxial, Mcleod and Burmister layered system methods. Applications of pavement design software

Module III

Rigid Pavements: Westergaard's approach-Bradbury's stress coefficients-IRC method of design. Temperature Stresses in Concrete pavements-Warping stress-Frictional Stress-Combination of stresses. Joints in Concrete pavements-Necessity-requirements-Types-Expansion joints-Contraction Joints-Construction joints, Design of joints-dowel bars and tie bars. Applications of pavement design software

Module IV

Pavement evaluation: structural and functional evaluation of flexible and rigid pavements - pavement distresses - evaluation of pavement structural condition by Benkelman beam deflectometer and Falling weight deflectometer, design of flexible pavement overlay using BBD data.

References:

1. Huang, Y.H. Pavement Analysis and Design. Second Edition. Dorling Kindersley (India) Pvt. Ltd., New Delhi, India.
2. Khanna, S.K., Justo and Raghavan, V. Highway Engineering.NemChand and Bros.
3. IRC: 37-2018, Guidelines for the Design of Flexible Pavements, The Indian Roads Congress, New Delhi.
4. IRC: 58-2011 Guidelines for the Design of Plain Jointed Rigid Pavements for Highways, The Indian Roads Congress, New Delhi.
5. IRC 81-1981 Tentative Guidelines for Strengthening of Flexible Pavements by Benklman Beam Deflections Techniques.
6. Mallick, R.B. and T. El-Korchi.Pavement Engineering – Principles and Practice. CRC Press, Taylor and Francis Group, Florida, USA.
7. Ministry of Road Transport and Highways. Specifications for Road and Bridge Works, Fifth Edition, Indian Roads Congress, New Delhi, India.
8. Papagiannakis, A.T. and Masad, E.A. Pavement Design and Materials. John Wiley and Sons, New Jersey, USA.
9. Yoder, E.J. and Witczak, M.W. Principles of Pavement Design. Second Edition, John Wiley and Sons, New York.

23-201-0608 AIR POLLUTION CONTROL AND MANAGEMENT

Course Outcomes:

On completion of the course, a student will be able to:

1. Identify sampling and analysis techniques for air quality assessment
2. Identify the plume behaviour for atmospheric stability conditions
3. Demonstrate an ability to design various air pollution controlling devices
4. Assess the air quality monitoring and management
5. Recall the legislations and regulations in air pollution management

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12	PSO1	PSO2	PSO3
CO1	3	2	1	3	3	3	3	-	3	-	2	-	-	2	1
CO2	3	3	2	3	3	3	2	-	3	-	-	1	-	1	-
CO3	3	2	3	3	3	3	2	-	3	-	3	1	1	-	2
CO4	3	3	2	3	3	3	2	-	3	-	2	1	1	-	-
CO5	3	2	1	3	2	3	3	3	3	2	2	1	-	-	-

1. Slightly, 2- Moderately, 3- Substantially

Module I

Sources and effects of Air pollution: Classification of air pollutants – Particulates and gaseous pollutants – Sources of air pollution – Source inventory – Effects of air pollution on human beings, materials, vegetation, animals – global warming - ozone layer depletion, Sampling and Analysis – Basic Principles of Sampling – Source and ambient sampling – Analysis of pollutants – Principles.

Module II

Dispersion of Pollutants: Elements of atmosphere – Meteorological factors – Wind roses – Lapse rate – Atmospheric stability and turbulence – Plume rise – Dispersion of pollutants – Dispersion models - Applications.

Module III

Air Pollution Control: Concepts of control – Principles and design of control measures –
Particulates control by gravitational, centrifugal, filtration, scrubbing, electrostatic precipitation – Selection criteria for equipment - gaseous pollutant control by adsorption, absorption, condensation, combustion – Pollution control for specific major industries.

Module IV

Air Quality Management: Air quality standards – Air quality monitoring – Preventive measures - Air pollution control efforts – Zoning – Town planning regulation of new industries – Legislation and enforcement – Environmental Impact Assessment and Air quality.

References:

1. W.L. Heumann, Industrial Air Pollution Control Systems, McGraw-Hill, New Yark.
2. Mahajan S.P., Pollution Control in Process Industries, Tata McGraw-Hill Publishing Company, New Delhi.
3. Peavy S.W., Rowe D.R. and Tchobanoglous G. Environmental Engineering, McGraw Hill, New Delhi.
4. Garg, S.K., "Environmental Engineering Vol. II", Khanna Publishers, New Delhi.
5. Anjaneyulu, D., "Air Pollution and Control Technologies", Allied Publishers, Mumbai.
6. Rao, C.S. Environmental Pollution Control Engineering, Wiley Eastern Ltd., New Delhi.
7. Rao M.N., and Rao H. V. N., Air Pollution Control, Tata-McGraw-Hill, New Delhi.
8. Noel, D. N., Air Pollution Control Engineering, Tata McGraw Hill Publishers.
9. Stern, A.C., Fundamentals of Air Pollution, Academic Press.

23-201-0609 MACHINE LEARNING IN CIVIL ENGINEERING

Course Outcomes:

On completion of this course the student will be able to:

1. Demonstrate a solid understanding of foundational machine learning concepts.
2. Apply machine learning techniques to solve real-world problems in Civil Engineering.
3. Synthesize knowledge gained to evaluate and compare machine learning models critically.
4. Identify the challenges and future scope in applying machine learning in Civil Engineering problems.

Course Articulation Matrix:

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

1–Slightly; 2–Moderately; 3-Substantially

Module I

Machine Learning - Overview; Machine Learning Paradigms - Supervised, unsupervised and reinforcement learning; Application of Machine Learning – Agriculture, Healthcare, Environmental Science and Finance; Understanding the data – Data types, Sources of Data, Data Preprocessing and Data Exploration.

Module II

Machine learning algorithms - Supervised Learning: Linear Regression, Logistic Regression, Decision Trees, K-Nearest Neighbours, Support Vector Machines; Unsupervised Learning: K-Means Clustering, Principal Component Analysis.

Module III

Model selection and evaluation, overfitting and underfitting, cross-validation, hyperparameter tuning, and feature engineering. Introduction to artificial neural network and deep learning: Architecture of Neural Network, Feedforward Neural Network, Backpropagation algorithm, Activation function and Loss Function, Convolutional Neural Network, Recurrent Neural Network and Generative Adversarial Network.

Module IV

Importance and Applications of Machine Learning in Civil Engineering; Case study - Material property prediction, Structural health monitoring, Structural maintenance prediction, Environmental impact assessment, Challenges and Future scope.

References:

1. Alpaydin, E. Introduction to machine learning. MIT press.
2. Bishop, C. M. Pattern recognition and machine learning. Springer google schola, 2, 5-43.
3. Goodfellow, I., Bengio, Y., & Courville, A. (2016). Deep learning. MIT press.
4. Aggarwal, C. C. Neural networks and deep learning. Springer, 10(978), 3.
5. Mueller, J. P., & Massaron, L. (2021). Machine learning for dummies. John Wiley & Sons.
6. Naser, M. Z. . Machine Learning for Civil and Environmental Engineers: A Practical Approach to Data-Driven Analysis, Explainability, and Causality. John Wiley & Sons.

23-201-0610 ENVIRONMENTAL ENGINEERING LABORATORY

Course Outcomes:

On completion of the course, a student will be able to:

1. Analyse physico-chemical characteristics of water and wastewater
2. Examine the microbiological characteristics of water
3. Assess optimum dosage of coagulant
4. Assess available chlorine content in bleaching powder
5. Assess the quality of water and wastewater

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12	PSO1	PSO2	PSO3
CO1	3	-	-	3	2	3	3		3	-	-	1	3	3	3
CO2	3	2	-	3	2	3	2	-	3	-	-	1	3	-	2
CO3	3	3	2	3	2	2	2	-	3	-	1	1	2	1	2
CO4	3	2	-	3	3	1	-	2	3	-	-	1	2	1	2
CO5	3	3	2	3	3	3	3	1	3	-	-	1	3	3	3

1. Slightly, 2- Moderately, 3- Substantially

List of Experiments

1. Determination of solids (total, dissolved, organic, inorganic and settleable) in water.
2. Determination of turbidity and optimum coagulant dose.
3. Determination of acidity, alkalinity and pH of water.
4. Determination of hardness and chlorides in water.
5. Determination of iron in water.
6. Determination of sulphates and sulphides in water.

7. Determination of D.O and BOD of waste water.
8. Determination of COD of waste water
9. Determination of available chlorine in bleaching powder and the chlorine dose required to treat the given water sample.
10. Determination of residual chlorine in the water sample
11. Determination of coliforms in water.

- *Group Project based on the laboratory course*

References:

1. Standard methods for the examination of water and wastewater. 21st Edition,

Washington: APHA.

2. Sawyer, C. N., McCarty, P. L., and Perkin, G.F., Chemistry for Environmental Engineering and Science, 5th edition McGraw-Hill Inc.

3. B. Kotaiah and Dr. N. Kumara Swamy, Environmental Engineering Laboratory Manual, Charotar Publishing House Pvt. Ltd., 1st Ed.,

23-201-0611 MINI PROJECT-ARCHITECTURAL DESIGN STUDIO

Course Outcomes:

On completion of the course, a student will be able to:

1. Make use of with a civil engineering drawing software.
2. Draw all the relevant views of buildings using CAD software.
3. Outline the existing rules and regulations of buildings, stipulated by the National Building code and state building rules.
4. Prepare detailed structural drawings as per specifications given in the Indian codes.
5. Prepare an estimate of the materials required for construction from the CAD drawing.

Introduction of a Popular Drafting Package:Basic Commands and simple drawings.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12	PSO 1	PSO2	PSO3
CO1	3	-	1	-	-	-	1	1	1	-	-	2	3	-	1
CO2	3	2	1	-	1	-	1	1	1	-	-	2	3	-	1
CO3	3	2	3	-	1	-	-	-	1	2	-	2	3	-	1
CO4	3	-	3	-	2	-	-	1	1	2	-	2	3	-	1

1-Slightly, 2- Moderately, 3- Substantially

Module I

From the given line sketch and specification, develop working drawings (plan, elevation and section) of the following buildings using CAD.

1. Single storied residential building with flat roof
2. Single storied residential building with sloping roof
3. Double storied building

4. Public Building- Commercial complex/Hospital building/Institution Building
5. Preparation of structural drawings for slabs, beams and columns

Module II

Mini Project: Individual projects shall be done in groups. Each group shall identify a popular infrastructure such as shopping mall, bus stand, railway station, airport etc. and study about the facilities, compare with the NBC guidelines and prepare a CAD drawing incorporating the suggestions. The group shall present a seminar on the work carried out and a report shall be submitted.

References:

1. National Building Code of India
2. Kerala Municipal Building Rules
3. Shaw and Kale. Building Drawing.
4. Prabhu, B. T. S. Building Drawing and Detailing, Spades, Calicut.
5. Malik, R. S.and Meo, G. S. Civil Engineering Drawing.
6. Verma, B. P. Civil Engineering Drawing and House Planning. Khanna Publishers, Delhi

- **23-201-0612# BUILDING SERVICES ENGINEERING AND PLANNING/*MOOC-III(Minor Course)**

Students should take Massive Open Online Courses (MOOCs) approved by the concerned Division/Board of Studies (BoS)

- **23-201-0613 MINI PROJECT (Minor Course)**

The objective of this course is to apply the fundamental concepts of different courses learned in respective Minor Streams. Mini project enables the students to boost their skills, widen the horizon of thinking and their ability to resolve real life problems.

- **23-201-0614# CONTRACTS AND LEGAL ASPECTS IN CONSTRUCTION /*MOOC-I (Course for Honour)**

Students should take Massive Open Online Courses (MOOCs) approved by the concerned Division/Board of Studies (BoS)

- **23-201-0615#ADVANCED FOUNDATION ENGINEERING/ *MOOC-II (Course for Honour)**

Students should take Massive Open Online Courses (MOOCs) approved by the concerned Division/Board of Studies (BoS)

23-201-0701 ENVIRONMENTAL ENGINEERING – II

Course Outcomes:

On completion of the course, a student will be able to:

1. Demonstrate an ability to recognize different types of unit operations and processes involved in water and wastewater treatment plants
2. Able to design physio- chemical treatment methods for water and wastewater systems
3. Able to design biological waste water treatment systems
4. Demonstrate Sludge handling and disposal techniques
5. Able to design conventional and advanced anaerobic systems in sustainable manner

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12	PSO1	PSO2	PSO3
CO1	3	2	1	1	-	1	2	-	2	-	1	1	1	3	1
CO2	3	2	2	3	2	2	2	-	3	-	1	1	2	3	1
CO3	3	2	3	2	1	2	1	-	2	-	1	1	2	2	1
CO4	3	2	3	2	3	2	3	2	2	-	2	1	1	2	3
CO5	3	3	3	3	2	2	3	1	2	-	2	1	1	1	2

1. Slightly, 2- Moderately, 3- Substantially

Module I

General layout of water treatment plant. Sedimentation – plain sedimentation, theory of sedimentation, continuous flow sedimentation tanks. Theory of coagulation and flocculation, design of flash mixers, clarifiers and clarifloculators. Filtration - Theory of filtration, Classification of filters, design, construction, control, operation, and maintenance of these units. Disinfection, methods of disinfection, chlorination. Miscellaneous treatment methods: colour, odour and taste removal, iron and manganese removal, deflouridation, removal of hardness. Aeration, purpose of aeration.

Module II

Objectives of wastewater treatment - Effluent standards-BIS Standards. Layout of conventional treatment plant - preliminary, primary, secondary, and tertiary treatments in general. Preliminary process: screens - types of screens, design, disposal of screenings, grit chamber - function, design, construction and operation, disposal of grit, detritus tank, skimming tank function, design and operation, disposal, Sedimentation: Design, construction and operation, rectangular and circular tanks, disposal of sludge.

Module III

Biological process: principle and theory of biological treatment. Sewage filtration; Trickling filters - design, construction, and operation. Activated sludge process: Design, construction, and operation of conventional and extended aeration methods. Miscellaneous methods- Stabilization ponds, Oxidation ditch, Aerated lagoons, rotating biological contactors

Module IV

Sludge treatment and disposal: quantity of sludge, characteristics of sludge, sludge thickening, digestion, conditioning and disposal, design of sludge digesters only. Septic Tanks: Design (as per Ministry of urban development) construction, disposal of effluents, cleaning of tanks, Imhoff tanks. Sewage treatment by high rate anaerobic methods: Anaerobic digestion suspended growth, contact process, UASB, attached growth, filters, expanded bed- only basics.

References:

1. S.K. Garg , Sewage Disposal and Air Pollution Engineering – Environmental Engineering (Vol.II) – Khanna Publishers, New Delhi.
2. Metcalf & Eddy, Inc., Waste water Engineering Treatment and Reuse, McGraw Hill International Editions, New Delhi.
3. Sawyer and McCarty, Chemistry for Environmental Engineering, McGraw Hill Education.
4. Fair, Geyer & Okun, Water and Waste water Engineering, 3rd edition John Wiley & Sons.
5. Mark J Hammer, Water and Waste water Technology, Prentice Hall India Learning Private Limited.

6. Vesilind P.A & William A. Worrell. Solid waste Engineering, CL Engineering.
7. Punmia B.C., Water supply Engineering, Laxmi Publications.
8. Peavy, H.S, Rowe, D.R., and G. Tchobanoglous , Environmental Engineering, McGraw Hill Inc., New York.
9. P.N. Modi , Sewage treatment & Disposal and waste water Engineering – Environmental Engineering (Vol.II) – Standard Book House.

23-201-0702 QUANTITY SURVEYING AND VALUATION.

Course Outcomes:

On completion of the course, a student will be able to:

1. Estimate construction project costs using various methods
2. Efficiently manage construction project cost through the application of various methods ensuring precision in budgeting and financial planning.
3. Gain expertise in property valuation techniques.
4. Analyse the real estate market trends and dynamics, allowing them to make informed decisions regarding property valuation based on current market conditions.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12	PSO1	PSO2	PSO3
CO1	3	-	1	-	-	2	1	2	1	1	-	2	1	-	-
CO2	3	2	1	-	3	-	1	2	1	2	-	2	2	-	3
CO3	3	2	1	-	2	2	-	-	1	-	-	2	3	-	-
CO4	3	-	-	-	2	2	-	2	1	-	-	2	3	-	-

1. Slightly, 2- Moderately, 3- Substantially

Module I

Estimate-Types of estimate - Revised estimate, supplementary estimate, maintenance estimate, detailed estimate, approximate estimate - plinth area method, cubic rate method, unit rate method, bay method, approximate quantity from bill method, comparison method, Preparation of detailed estimates and abstracts for RCC single storey buildings - centre line method and long wall – short wall method, Detailed specifications for common building materials and items of work as per I.S specifications.

Module II

Estimation of earth work for road works - Preparation of bar bending schedule and estimation of quantities for R C.C footings -Columns – Beams and slabs, Calculation of quantities of materials and analysis of rates for various items of work in building construction-rubble work, brick work, PCC, RCC, plastering, pointing etc., Introduction to data book and schedule of rates, Preparation of abstract of estimate of buildings.

Module III

Valuation –purpose – principle, Explanation of different technical terms, Types of values. Gross income – net income – Outgoings, Depreciation – methods of calculating depreciation – straight line method – constant percentage method, sinking fund method – and quantity survey method.

Module IV

Methods of valuation of property – rental method – direct comparison with capital cost – valuation based on profit – valuation based on cost – development method – depreciation method valuation of land – comparative method – abstractive method- belting method- valuation of based on hypothetical building schemes. Valuation of agricultural land, Free hold and leasehold properties –gilt edged securities. Different forms of rent and rent fixation.

References:

1. Dutta, B.N. Estimating and Costing in Civil Engineering (Theory &Practice), UBS PUBLISHERS' DISTRIBUTORS (P) LTD
2. Chakraborti, M...Estimating, Costing, Valuation and Specifications in Civil Engineering, SatyaPrakashan, New Delhi;
3. Ranagawala. Valuation of Real Properties, Charotar Publishing House; 10 edition.

23-201-0703 DESIGN OF CONCRETE STRUCTURES-II

Course Outcomes:

On completion of the course, a student will be able to:

1. Recommend and design the type of footing based on load to be transferred and soil characteristics
2. Design retaining structures based on load to be retained and soil characteristics
3. Perform the design of water retaining structures.
4. Apply the concepts of prestressing and analyse prestressed concrete beams
5. Perform design of prestressed concrete beams

Course Articulation Matrix

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

1. Slightly, 2- Moderately, 3- Substantially

Module I

Footings- Design of Isolated footings- axial and eccentric loading- Design of Combined footings-rectangular and trapezoidal footings. Design of pile and pile cap Structural design of piles, pile caps.

Module II

Retaining walls – Types- cantilever and counterfort; Design of cantilever retaining walls

Water tanks – design of circular, square and rectangular water tanks at ground level- design of overhead water tank (excluding supporting structure).

Module III

Pre-stressed Concrete – General principles- systems of prestressing- materials for prestressing - Analysis of sections for flexure: Stresses in concrete due to prestress – stresses in concrete due to loads – stresses in steel due to loads – discussion on moment curvature relationship of a prestressed concrete beam

Module IV

Loss of prestress: Significance – Lump sum estimate – elastic shortening of concrete – time dependent losses – loss due to creep of concrete – loss due to shrinkage of concrete – loss due to steel relaxation – loss due to anchorage take up – loss or gain due to bending of members – practical considerations for frictional loss – theoretical considerations for frictional loss – total amount of losses elongation of tendons- Code provisions

Design of sections for flexure: Preliminary design – general concepts of elastic design – elastic design with no tension in concrete – elastic design allowing tension – elastic design allowing and considering tension – ultimate design – arrangement of steel and prestressing in stages.

References:

1. Varghese, P. C. Limit State Design of Reinforced Concrete. Prentice Hall of India Ltd.
2. Ashok K Jain, A. K. Reinforced Concrete - Limit State Design. Nem Chand Brothers, Roorkee.
3. Pillai, S.U. and Menon, D. Reinforced Concrete Design. Tata McGraw Hill Publishing Company Limited, New Delhi, India.
4. Varghese , P.C, Design of Reinforced Concrete Foundation PHI Learning Pvt Ltd.
5. Krishnaraju, N. Prestressed Concrete. Tata McGraw- Hill.
6. Lin, T.Y.and Burns, N.H. Design of prestressed concrete structures. John Wiley & Sons, New York,

Type of Questions for Semester End Examination

Question nos. I and II [with sub sections (a), (b),] (12.5 marks each with option to answer either I or II) from Module I.
Question nos. III and IV [with sub sections (a), (b), …] (12.5 marks each with option to answer either III or IV) from Module II.
Question nos. V and VI [with sub sections (a), (b), …] (12.5 marks each with option to answer either V or VI) from Module III.
Question nos. VII and VIII [with sub sections (a), (b), …] (12.5 marks each with option to answer either VII or VIII) from Module IV.
The maximum marks that can be awarded for the Semester End Examination (SEE) will be only 50
Relevant IS Codes are permitted in the Examination Hall

PROFESSIONAL ELECTIVE – III

23-201-0704 (IE) GROUND IMPROVEMENT TECHNIQUE

Course Outcomes

On completion of this course the student will be able to:

1. Identify challenging ground conditions and selection of proper site specific improvement method, acquiring knowledge about mechanical densification.
2. Selection and implementation of hydraulic ground improvement techniques.
3. Develop the technique of physical and chemical modification including grouting.
4. Promote wider use of techno – economical techniques such as reinforced soil structures and geosynthetics.

Course Articulation Matrix

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

1-Slightly; 2-Moderately; 3-Substantially

Module I

Introduction to Ground Modification: Need and objectives of Ground Improvement, Classification of Ground Modification Techniques – Geotechnical problems in alluvial, lateritic and black cotton soils - suitability and feasibility - Emerging Trends in ground improvement – Sustainable techniques for ground improvement.

Mechanical Modification**:** Methods of compaction, Shallow compaction, Deep compaction techniques – Vibro-flotation, Blasting, Dynamic consolidation, pre-compression and compaction piles, Field compaction control. Case studies / field Visits.

Module II

Hydraulic Modification: Methods of dewatering – open sumps and ditches, Well-point system, Electro-osmosis, Vacuum dewatering wells; Design of dewatering systems - pre-loading without and with sand drains, strip drains and rope drains, Construction of stone columns in soft clays, encased stone columns. Case studies / field Visits.

Module III

Physical and chemical modification: Stabilization with admixtures like cement, lime, calcium chloride, fly ash and bitumen - Case studies.

Introduction to grouts and grouting: basic functions -Classification of grouts -Groutability Ratio. Rheological properties of grouts - Methods of grouting – Permeation grouting, Compaction grouting, jet grouting, Hydro fracturing. Grouting technology – ascending and descending stages - Grouting applications: seepage control in soil and rock under dams- seepage control in soil for cut off walls –stabilization grouting for underpinning- case studies / field visits.

Module IV

Earth Reinforcement- Concept of reinforced earth –Reinforcing materials- Backfill – construction of reinforced earth wall- Stability analysis of reinforced earth retaining walls- external stability analysis, internal stability analysis (brief mention about the methods only) - application areas of reinforced earth structures - Case Studies.

In-situ ground reinforcement - Soil nailing, ground anchoring, rock bolts and micropiles.

Geosynthetics: Classification - functions – functional properties - applications - Case Studies / field visits.

References:

1. Bell F G, Engineering Treatment of Soils, E& FN Spon, New York.
2. Han, Jie. Principles and practice of ground improvement. John Wiley & Sons.
3. Jie Han, Advances in Ground Improvement, Allied Pub.
4. Koerner, R.M ,Designing with Geosynthetics, Prentice Hall.
5. Koerner, R.M, Construction and Geotechnical methods in Foundation Engineering, Mc.Graw-Hill Pub. Co., New York.
6. Manfred R. Haussmann, Engineering principles of ground modification, Pearson Education Inc. New Delhi.
7. Raj, P. Purushothama. Ground improvement techniques (PB). Firewall Media.

23-201-0705 BRIDGE ENGINEERING

Course Outcomes:

On completion of this course the student will be able to:

1. Carry out site investigations and propose suitable type of bridges according to the requirement.
2. Evaluate the forces to be considered for the design of bridge according to IRC specifications and code of practice.
3. Design of slab culverts and T-beam bridges based on IRC codes.
4. Carry out inspection and propose suitable strategies for the maintenance of bridges.

Course Articulation Matrix:

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

1–Slightly; 2–Moderately; 3-Substantially

Module I

Investigation for Bridges**:** Investigation stages – classification of bridges – investigations – estimates – Major bridges – coverage – topographic details – catchments area map – hydrologic particulars – geotechnical details – seismology of the area **-** navigation requirements – construction resources – particulars of nearest bridges – traffic forecast – factors for choice of ideal site –techno economic feasibility – project report preparation – preparation of drawings.

Module II

Loading standards: components of bridge structure – need for loading standard – loading requirement – railway loading standards – road bridge loadings.

Construction of bridges: S etting out of pier and abutments – setting out of single span bridge – setting out of multi span bridge – Open excavation in dry condition – foundation below water table – pile foundations – precast driven piles – cast in situ piles – load test on piles – well foundation – sinking of wells – construction of super structure.

Module III

Concrete Bridges for Road Transport: Design of simply supported solid slab bridge – Dispersion of load along the span – design of slab – Design of Girder Bridge – Design of deck slabs – design of longitudinal girders – Courbon's method – Design of bearings.

Module IV

Inspection of Bridges: Necessity for inspection of bridges – inspection procedures – aspects of inspection – testing of bridges – assessment of safe load bearing capacity Maintenance of Bridges: Substructure maintenance – super structure maintenance – bearings – girders.

References:

1. Ponnuswamy, S , Bridge Engineering. Tata McGraw Hill Publishing Company Ltd.
2. Aswani, M. G., Vazirani, V.N. and Ratwani, M.M, Design of Concrete Bridges. , Khanna Publishers.
3. Victor, D. J., Essentials of Bridge Engineering, S Chand.

23-201 -0706 RIVER ENGINEERING

Course Outcomes:

On completion of the course, a student will be able to:

1. Determine the characteristics of Rivers and Sediments
2. Comprehend the concept of incipient motion and bed load
3. Compute sediment load
4 **.** Practically Design river training works

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12	PSO1	PSO2	PSO3
CO1	3	2	1	1	-	1	2	-	2	-	1	1	1	3	1
CO2	3	2	2	3	2	2	2	-	3	-	1	1	2	3	1
CO3	3	2	3	2	1	2	1	-	2	-	1	1	2	2	1
CO4	3	2	3	2	3	2	3	2	2	-	2	1	1	2	3
CO5	3	3	3	3	2	2	3	1	2	-	2	1	1	1	2

1.Slightly, 2- Moderately, 3- Substantially

Module I

Introduction: Behaviour of Rivers: Introduction, River Channel patterns, Straight River channels, causes, characteristics and shapes of meanders and control, Braided Rivers, Bed forms, Instability of rivers.
Incipient Motion: Properties of sediment, Incipient motion and quantitative approach to incipient motion.

Module II

Bed forms and resistance to flow: Sediment transport and budgets, Bed forms and resistance to flow. Channel degradation and armouring.
Modes of sediment transportation: Various approaches for bed load transport, suspended load profile and suspended load equations, total load transport including total load transport equations. Comparison and evaluation of sediment transport equations. Sediment sampling.

Module III

River Models: Physical Models: Basic Scaling Laws, fixed and movable bed models; Sectional Models, Distorted Models; Mathematical models: 1D and 2D models for aggradations and degradation; 3D Models for turbulence and local scour
Bed level variation**:** Bed level variations, local scour, degradation, aggradation and reservoir sedimentation.
Design of stable channel**:** Stable channel design with and without suspended sediment and sediment control.

Module IV

River Protection and Training Works: Design of Revetments, Dikes, Gabions, Spurs, Bank Protective measures and Bed control structures; Design of river training and flood protection structures, material specifications; Diversion and Cofferdams; River regulations systems; Dredging and Disposal, River restoration

References

1. River Training Techniques: Fundamentals, Design And Applications By B. Przedwojski And R. Blazejewski And K. W. Pilarczyk, A.A.Balkema, Rotterdam, Netherlands.
2. Loose Boundary Hydraulics By Arved J Raudkivi, A.A. Balkema, Rotterdam, Netherlands.
3. Sediment And Contaminant Transport In Surface Waters By Wilbert Lick, Crc Press, Taylor And Francis Group.
4. Fluvial Hydraulics by Walter H. Graf, John Wiley and Sons.
5. Mechanics of Sediment Transportation and Alluvial Stream Problems, Garde, R. J. and Ranga Raju, K. G., New Age Publishers.
6. River Morphology. Garde, R. J., New Age Publishers.

23-201-0707 ARCHITECTURE AND URBAN PLANNING

Course Outcomes:

On completion of this course a student will be able to
1. Classify the elements of architecture and Fundamental principles of architectural design.
2. Gain knowledge in the basic concepts of vastuvidya and in applying the principles of vastuvidya in site selection residential building planning
3. Explain the evolution of Planning and Impact of urbanization.
4. Evaluate and assess the planning process and its legislation in India

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12	PSO1	PSO2	PSO3
CO1	3	-	1	-	-	2	1	2	1	1	-	2	-	-	1
CO2	3	2	1	-	3	-	1	2	1	2	-	2	2	-	-
CO3	3	2	1	-	2	2	-	-	1	-	-	2	-	2	-
CO4	3	-	-	-	2	2	-	2	1	-	-	2	1	1	-

1. Slightly, 2- Moderately, 3- Substantially

Module I

Principles of Architectural Design: Definition of Architecture – factors influencing architectural development, Creative and Design Principles in architecture – historical examples from Neolithic, Egyptian, Roman and Gothic architecture. Fundamentals in Design -Elements in composition: Point, Line, Plane, Volume, Colour, Texture. Analysing paintings, Compositions, murals, sculptures, building and nature.

Module II

Principles of design – Dominance, unity, balance, symmetry, hierarchy, rhythm, contrast, harmony, focus etc.

Forms - Colour and texture: Study of colour and colour schemes, texture and texture scheme.

Perception of colour and texture in light from natural and artificial sources. Study of openings for light, shadow, shades and sciography and their effect on spaces'

Introduction to fundamentals in drawing, composition and understanding graphic medium:

Basic exercises in drawing skill building, composition and design vocabulary

Field study and Group Assignment

Module III

Basics of planning:

Evolution of towns – problems of urban growth – Benefits of planning - urbanization, industrialization and urban development; push and pull factors; migration trends and impacts on urban and rural development – beginning of town planning acts – ideal towns – garden city movement – concept of new towns and conservative surgery - comprehensive planning of towns. Basics of town planning surveys – Land use surveys and analysis – Socio-economic surveys.

Module IV

Regional planning – Zoning and subdivision regulation – FSI/FAR – Neighbourhood planning – planning principles – site planning – site selection criteria for housing development – types – site analysis. Types of plans – master plans, development plans, etc. (introduction only). Spatial standards, performance standards, benchmarks, and variable standards; URDPFI guidelines, zoning regulations/ordinances and DCR and (development control rules and regulations). New Urbanism and Public participation in planning process.

References:

1. Pickering, E. Architecture Design. John Wiley and Sons.
2. Hiraskar, G.K. Great Ages of World Architecture. Dhanpat Rai Publishing Co Pvt Ltd.
3. Charles Wallschlaeger & Synthia Busic Snyder, Basic Visual Concepts & Principles for artists, architects & designers, McGraw hill, USA.
4. Joseph De Chiara, Michael J Crosbie, Time Saver Standards for Building Types, McGraw Hill Professional.
5. Francis D.K.Ching – Drawing – A creative Process, Van Nostrand Reinhold Co.,Canada.
6. Arthur L. Guptill and Susan E. Meyer, 'Rendering in Pen and Ink' , Watson-Guptill.
7. Eisner S, Gallion A and Eisner S., The Urban Pattern, Wiley.
8. Hiraskar G K, Fundamentals of Town planning, Dhanpat Rai publications.
9. N.K Gandhi – Study of Town and Country planning in India – Indian Town and Country planning Association.
10. Wilson, A.G, Urban and Regional Models in Geography and Planning, John Wiley and Sons.
11. Agarwala, S. C.Architecture & Town Planning. Dhanpat Rai & Co (P) Ltd.

OPEN ELECTIVE –I

23-201-0708 MODERN CONSTRUCTION MATERIALS

Course Outcomes:

On completion of this course the student will be able to:

1. Summarize the scientific basis for the development of construction materials
2. Explain material behaviour, failure theories and fracture mechanics
3. Elucidate different construction materials and their applications.
4. Exemplify various non structural materials, accessories and finishes

Course Articulation Matrix:

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

1–Slightly; 2–Moderately; 3-Substantially

Module I

The science and technology of construction materials - Review of atomic bonding - structure of solids and defects - movement of atoms and development of microstructure.

Module II

Review of surface properties - response of materials to stress - failure theories - fracture mechanics - rheology of liquids and solids - thermal properties - Criteria for selection of materials

Module III

Overview of construction materials and their applications - Brick, block and stone masonry - Timber and wood composites - Polymers and fibre reinforced polymers - Metals - Bituminous materials - Concrete - Glass

Module IV

Anchors - fittings - water proofing - floor finishes and other non-structural materials. Social perception of materials in construction.

References:

1. P.C. Varghese, Building Materials, Prentice-Hall India, 2555.
2. W.D. Callister, John Wiley, Materials Science and Engineering: An introduction,
3. V. Raghavan, Materials Science and Engineering, Prentice Hall.
4. R.A. Higgins, Properties of Engineering Materials,, Industrial Press.
5. Eds. J.M. Illston and P.L.J. Domone, Construction materials: Their nature and behaviour, 3rd ed., Spon Press, 2551.
6. J.F. Young, S. Mindess, R.J. Gray & A. Bentur, The Science and Technology of Civil Engineering Materials Prentice Hall.
7. M.F. Ashby and D.R.H. Jones, Butterworth Heinemann, Engineering Materials 1: An introduction to their properties & applications, 2553.

8. J.P. Schaffer, A. Saxena, S.D. Antolovich, T.H. Sanders and S.B. Warner, Irwin, The Science and Design of Engineering Materials.

9. P.K. Mehta and P.J.M. Monteiro, Concrete: Microstructure, properties and materials, McGraw Hill, 2556.

10. A.M. Neville, Properties of concrete, Pearson, 2554.

23-201-0709 HOUSING POLICY &PLANNING

Course Outcomes:

On completion of this course the student will be able to:

1. Summarize Housing and housing policy
2. Identify key issues in housing finance, affordability and technology systems in housing delivery.
3. Explain the planning principles for developing formal housing typologies like Group housing, Cooperative housing, Institutional housing, Rental housing, hostels and Service apartments
4. Explain the process of housing development (including Disaster prone areas) and list the actions and expected roles of various stake holders for effective housing management.

Course Articulation Matrix:

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

1–Slightly; 2–Moderately; 3-Substantially

Module I

Introduction to Housing - Housing Classifications - Housing Situation - Policy and Public intervention - Urban Reform - Housing Policy - Legal & Institutional Framework for Housing - Land for Housing

Module II

Affordability & Housing Finance - Technology Systems in Housing Delivery - Housing for All Mission (PMAY) & Technology Sub-mission.

Introduction to Housing Planning - Urban and Regional Planning - Development Controls - Housing Infrastructure and Services-Transport and Roads, Drainage, Sanitation, Electricity & SWM - Social Infrastructure and Facilities

Module III

Housing Strategy for City- An overview - Dealing with Core City Housing - Dealing with New Housing Areas - Planning for Plotted Housing and Group Housing - Community Development in Housing - Cooperative Housing - Institutional and rental housing - Working Person's hostel and Serviced Apartments

Module IV

Informal Housing Typologies - Approaches in Improving Slums and Squatters - Urban Village and Unauthorized Construction - Pavement Dwellers and Night Shelters - Old Age Home - Disaster Resistant Housing - Housing & Real Estate Development - Housing Management - Action Plan for housing.

References:

1. Balaji V. & Rajmanohar, "Housing Sector in India; Issues, Opportunities and Challenges", ICFAI University Press.
2. Christian Schittich(ed), "High Density Housing; Concepts, Planning, Construction", Birkhauser.
3. French H., "Key Urban Housing of the Twentieth Century", Lawrence King
4. Reeves P., "Introduction to Social Housing", Elsevier
5. Davis S., "The Architecture of Affordable Housing", University of California Press.
6. National Housing and Habitat Policies,(urban), Govt of India

23-201-0710 INDUSTRIAL WASTE ENGINEERING & MANAGEMENT

Course Outcomes:
On completion of the course, a student will be able to:
1. Identify the effects of industrial wastewaters and stream quality criteria for public water Supply and effluent standards.
2. Identify the characteristics of industrial wastewaters and formulate environmental Management plan
3. Recognize the importance on the effect of wastewater discharge on stream.
4. Identify and design treatment options for industrial wastewater

Course Articulation Matrix.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	3	-	-	-	-	2	-	1	-
CO2	3	2	1	-	1	-	3	1	-	-	-	2	1	2	1
CO3	3	2	3	1	1	-	3	-	-	1	1	2	-	-	1
CO4	3	2	3	1	2	-	3	1	-	1	1	2	-	1	1

1. Slightly, 2- Moderately, 3- Substantially

Module I

Introduction

Types of industries and industrial pollution – Characteristics of industrial wastes –Population equivalent – Bioassay studies – effects of industrial effluents on streams, sewer, land, sewage treatment plants and human health – Environmental legislations related to prevention and control of industrial effluents and hazardous wastes

Module II

Cleaner Production

Waste management Approach – Waste Audit – Volume and strength reduction – Material and process modifications – Recycle, reuse and by-product recovery – Applications.

Module III

Pollution From Major Industries

Sources, Characteristics, waste treatment flow sheets for selected industries such as Textiles, Tanneries, Pharmaceuticals, Electroplating industries, Dairy, Sugar, Paper, distilleries, Steel plants, Refineries, fertilizer, thermal power plants – Wastewater reclamation concepts

Module IV

Treatment Technologies

Equalisation – Neutralisation – Removal of suspended and dissolved organic solids - Chemical oxidation – Adsorption - Removal of dissolved inorganics – Combined treatment of industrial and municipal wastes – Residue management – Dewatering - Disposal

Hazardous Waste Management

Hazardous wastes - Physico chemical treatment – solidification – incineration – Secured land fills

References:

1. Metcalf and Eddy. *Wastewater Engineering, Treatment, Disposal and Reuse*. Tata McGraw-Hill Publications.
2. Nemerow, H. N. *Liquid Waste from Industry – Theory, Practice and Treatment*. Addison Wesley.
3. Rao, M.N. and Datta, A.K. *Waste Water Treatment*. Oxford IBH Publication.
4. Wark and Warner. *Air Pollution: Its Origin and Control*. Pearson.
5. Eckenfelder, W.W.*Industrial Water Pollution Control*. McGraw Hill Publication.
6. Vesilind, Worrell and Reinhart. *Solid Waste Engineering*. CL Engineering.
7. Arcevala and Asolekar.*Waste water Treatment for pollution control and Reuse*. Tata McGraw Hill Publications.
8. Nemerow, N. L. *Industrial Waste Treatment*. Butterworth-Heinemann.

23-201-0711 NON-DESTRUCTIVE TESTING AND EVALUATION OF STRUCTURES

Course Outcomes:

On completion of this course the student will be able to:

1. Explain the basic principles and the method of application of the different non-destructive techniques NDTs.
2. Apply different NDTs for analysing concrete structures and recognise various defects in concrete structures.
3. Apply different methods and inspection techniques required for assessing the safety/stability conditions of concrete structures.
4. Identify the intensity of the defects or any kind of damage using NDT and propose suitable restoration technique.

Course Articulation Matrix:

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

1–Slightly; 2–Moderately; 3-Substantially

Module I

Introduction: Importance and need of non-destructive testing (NDT), Basic methods for NDT of concrete structures, Qualification and Certification, Manufacturing processes and defects of concrete structures, Testing of Concrete, Comparison of NDT methods, Quality control.

Visual Inspection: Introduction, Tools and equipment for visual inspection, General procedure of visual inspection, Applications of visual inspection, Sketches of typical defects found by visual inspection.

Schmidt Rebound Hammer Test**:** Fundamental principle, Equipment for Schmidt/rebound hammer test, General procedure for Schmidt rebound hammer test, Applications of Schmidt rebound hammer test, Range and limitations of Schmidt rebound hammer test -Case study to demonstrate the method.

Module II

Permeability Test: Fundamental principle, General procedure for permeability test, Equipment for permeability test, Applications of permeability test, Range and limitations of permeability test.

Electromagnetic Methods of Testing Concrete: Fundamental principles, Equipment for electromagnetic inspection, General procedure for electromagnetic testing, Applications of electromagnetic testing method, Range and limitations of electromagnetic testing method, Work or site calibration.

Radiographic Testing: Fundamental principles, Equipment for radiographic testing method, General procedure for radiographic testing method, Radiation protection in industrial radiography, Applications of radiographic testing method, Radiographic application to post tensioned concrete bridges.

Suitable case studies to demonstrate the methods.

Module III

Ultrasonic Testing: Pulse velocity test - Fundamental principle, Equipment for pulse velocity test, Applications, Determination of pulse velocity, Factors influencing pulse velocity measurements - Detection of defects -

Developments in ultrasonic tomography, Ultrasound pulse echo - Thickness measurement of concrete slabs with one sided access – post-tensioned duct inspection.
Infrared Thermography: Fundamental principles, Equipment for infrared thermographic method, General procedure for infrared thermographic method, Some applications of the infrared thermographic method, Advantages and limitations of infrared thermography.
Real life examples for demonstrating the methods.

Module IV
Other Methods of NDT: Acoustic emission, Computer tomography, Strain sensing, Corrosion rate measurement.
Methods of Survey**:** Introduction and fundamental principles, Methods and inspection technique required - First survey (regular inspection), Second survey (specific/particular inspection), Third survey.

References:

1. No, T. C. S.Guidebook on non-destructive testing of concrete structures. Training Course Series.
2. Grandt Jr, A. F. (2003). Fundamentals of structural integrity: damage tolerant design and non-destructive evaluation. John Wiley & Sons.
3. Huston, D. Structural sensing, health monitoring, and performance evaluation. CRC press.
4. Ratay, R. T., & Heywood, R. J. Forensic Structural Engineering Handbook–Second Edition.
5. Davis, A. G., Ansari, F., Gaynor, R. D., Lozen, K. M., Rowe, T. J., Caratin, H., & Sansalone, M. J. Nondestructive test methods for evaluation of concrete in structures. American Concrete Institute, ACI, 228(4).

23-201 -0712 STRUCTURAL DESIGN STUDIO

Course Outcomes:
On completion of this course the student will be able to:
1. Identify the available open-source software tools used for specific problems in Civil Engineering.
2. Analyse and design multi storeyed concrete/steel structures using a structural analysis and design software.
3. Interpret the results available through computer output with the theory learnt in classrooms.

Course Articulation Matrix:

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

1–Slightly; 2–Moderately; 3-Substantially

Using STAAD/ETAB or Equivalent package
1) Analysis and design of simply supported, cantilever and continuous beams
2) Analysis and design of truss system
2) Analysis and design of steel frames
3) Analysis and design of multi-storeyed RC buildings
4) Analysis and design of buildings with combined steel truss and RC frame
5) Design of footings
- *Group Project based on the laboratory course*

Reference:
Reference Manual of software packages.

23-201-0713 STRUCTURAL ENGINEERING AND BUILDING TECHNOLOGY LABORATORY

Course Outcomes:

On completion of the course, a student will be able to:

1. Visualize the failure patterns of beams, column and walls, the information of which could be employed in building construction.
2. Practice certain non-destructive methods of testing strength of concrete structures.
3. Conceive the idea of comfort level in a room due to various factors, like temperature, humidity, radiation and ventilation.
4. Visualize at least three modes of oscillation of building frames subjected to base movement and hence study their dynamic characteristics

Course Articulation matrix:

	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011	P012	PS01	PS02	PS03
C01	1	-	-	3	-	1	-	-	-	-	1	-	-	1	-
C02	3	-	-	3	-	-	-	-	-	-	1	-	-	1	-
C03	3	-	-	3	-	-	-	-	-	-	1	-	-	1	-
C04	1	-	-	3	-	1	-	-	-	-	1	-	-	1	-

1–Slightly; 2–Moderately; 3-Substantially

LIST OF EXPERIMENTS

(Minimum of 10 experiments to be conducted)

1. Testing of under reinforced and over reinforced flexural reinforced concrete beams.
2. Non Destructive testing of Concrete – rebound hammer test.
3. Non Destructive testing of Concrete – ultrasonic pulse velocity test.
4. Dynamics of scaled building frame model subjected to harmonic base motion.
5. Dynamics of single storied building frame model having planar asymmetry subjected to harmonic base motion.
6. Testing of Masonry Column
7. Testing of Masonry Prism
8. Testing of Masonry prism
9. Testing of Wall panels
10. Determination of relative humidity using wet and dry bulb thermometer.
11. Determination of effective temperature in a room.
12. Determination of air circulation in a room
    a) Rate of Ventilation due to stack effect
    b) Rate of Ventilation due to wind effect
13. Determination of Intensity of Light.
14. Measurement of solar radiation using Pyranometer.
15. Measurements of sound levels in a hall

Group Project based on the laboratory course

23-201-0714 ENTREPRENEURSHIP DEVELOPMENT

Course Outcomes:

On completion of the course, a student will be able to:

1. Develop awareness about the importance of entrepreneurship opportunities available in the society.
2. Get acquainted with the challenges faced by the entrepreneur.

Course Articulation Matrix

	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011	P012	PS01	PS02	PS03
C01	3	3	3	3	1	-	-	1	-	1	-	1	3	3	1
C02	3	3	3	3	1	-	-	1	-	1	-	1	3	3	1

1–Slightly; 2–Moderately; 3-Substantially

Exercises:

1. To study the types of entrepreneurs and the factors affecting entrepreneurial growth.
2. To assess the major motives influencing an entrepreneur
3. To make an overview of the various stress management techniques
4. How to identify and select a good business opportunity.
5. Preparation of a techno-economic feasibility report for a given project
6. Preparation of a preliminary project report for a given project
7. To identify the various sources of finance and management of working capital
8. Carry out the costing and break-even analysis of a proposed project
9. Preparation of a PERT / CPM chart for the various activities involved in a project
10. To make a study of the various causes and consequences of sickness in small businesses and identify corrective measures.
11. To analyze logistics and supply chain processes for a proposed business venture.

References:

1. Rajeev, R. *Entrepreneurship*. Second edition. Oxford Latest Edition.
2. Gordon, E .and Natarajan, K. *Entrepreneurship Development*. Fourth edition, Himalaya.
3. Coulter. . *Entrepreneurship in Action*. Second edition, PHI.
4. Jain, P. C .*Handbook for New Entrepreneur*. Oxford University Press.
5. Khanka, S. S. *Entrepreneurial Development*. Fifth edition, S. Chand and Co.

Note: There will only be continuous evaluation for this course. The evaluation will be based on the performance of the student in the exercises given above. A minimum of 50% marks is required for a pass.

23-201-0715 PROJECT PHASE –I

Course Outcomes:

On completion of the Project, the student will be able to:

1. Conduct a comprehensive literature survey to identify and analyze a specific problem statement in Civil Engineering.
2. Formulate a well-structured project proposal by synthesizing literature insights and engaging with industry experts and academic mentors.
3. Develop a detailed execution plan for Phase II, including resource allocation, timeline, and risk management strategies.

4. Demonstrate technical communication skills through a properly formatted thesis document and professional PowerPoint presentations.

Course Articulation Matrix

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

1–Slightly; 2–Moderately; 3-Substantially

This course aims to equip undergraduate students in Civil Engineering with the essential skills and knowledge required to successfully navigate through the initial phases of a project. Students will learn to conduct a comprehensive literature survey, identify and focus on a specific problem, formulate a project proposal, develop an execution plan for Phase II, and enhance their technical communication skills through thesis preparation and presentation techniques.

Topics to be covered

Introduction to Literature Survey and Problem Identification: Understanding the significance of literature survey in research, Techniques for conducting a thorough literature review, identifying relevant areas of study within Civil Engineering, and narrowing down to a specific problem statement.

Formulating a Project Proposal: Guidelines for structuring a project proposal, the importance of consultation with industry experts and academic mentors, incorporating insights from the literature survey into the proposal, developing a clear and concise problem statement and objectives

Project Execution Planning: Principles of project management and planning, developing a detailed execution plan for Phase II of the project, identifying resources, timeline, and milestones.

Enhancing Presentation Skills: Understanding the elements of effective presentations, Techniques for engaging and communicating technical information, Hands-on practice sessions on preparing and delivering technical presentations, and Peer feedback and improvement strategies.

Technical Communication: Thesis Preparation- Structure and format of a thesis document, Guidelines for writing thesis chapters- introduction, literature review, methodology, results, discussion, conclusion, Typesetting using Word or LaTeX for professional thesis formatting. Prepare PPTs for technical presentation.

Assessment:

Guidelines for evaluation:		Marks
1	Attendance and Regularity	10
2	Literature Survey and Problem Identification	10
3	Project Proposal	10
4	Project Execution Plan	10
5	Thesis and Presentation Skills Assessment	10
	Total	50

Note: Points (1)-(3) are to be evaluated by the respective project guides and project coordinator based on continuous evaluation. (4)-(5) to be evaluated by the final evaluation team comprising of 3 internal Examiners.

References:

1. Jesson, J., Matheson, L., and Lacey, F. M., Doing Your Literature Review: Traditional and Systematic Techniques, Sage Publications Ltd.
2. Machi, L. A., and McEvoy, B. T., The Literature Review: Six Steps to Success, Corwin Press.
3. Friedland, A., and Folt, C., Writing Successful Science Proposals, Yale University Press.
4. Duarte, N., Slide:ology: The Art and Science of Creating Great Presentations, O'Reilly Media,
5. Joyner, R. L., Rouse, W. A., and Glatthorn, A. A., Writing the Winning Thesis or Dissertation: A Step-by-Step Guide, Corwin Press.

23-201-0716 INTERNSHIP-III

Course Outcomes:

On completion of this course the student will be able to:

1. Understand the real time technical/managerial skills required and relevant to the subject area of internship
2. Initiate a habit of proper daily diary writing with adequacy and quality of information recorded, drawing and sketches and data, thought process and the proper organisation of the information gained during the internship.
3. Conceive the pros and cons of working in a real time industrial environment and the wonderful results which could evolve through team-work.
4. Present and defend self-prepared and corrected internship report (with the help of internship guide/industry mentors) of a self-created work to a peer audience.

Course Articulation Matrix

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

1–Slightly; 2–Moderately; 3-Substantially

Topics for Internship: construction of special structures - tunnels-prestressed bridges, precast onstruction etc
Students have to visit at least one industry relevant to Civil Engineering as part of industrial training and spend a minimum duration of 2 weeks after the completion of 5th semester and before the commencement of 6th semester. A report of the same should be submitted at the beginning of the 4th semester and evaluation shall be conducted based on the report, presentation and viva.

Internship Guidelines

- An internship plan has to be prepared by the interns incorporating the job description/internship duties, name of the project, if any and internship schedule and expected learning outcomes in consultation with industry supervisor/mentor and institute faculty.
- A detailed training report in the prescribed format shall be submitted at the end of the internship.
- Training Certificate from the industry for the prescribed period shall be submitted at the end of the internship.
- The work shall be reviewed and evaluated periodically.
- Orientation of interns, resourse requirement of interns, monitoring of interns progress on a daily basis shall be carried out by the industry offering internship in addition to ensuring safety and welfare of the interns.

A committee consisting of the Internship Coordinator (nominated by the Head of the Department/Division), faculty mentor, and at least one senior faculty member at the level of Associate Professor or above will carry out the final review.

Guidelines for evaluation:

1.	Regularity and progress of work	10
2.	Work knowledge and Involvement	10
3.	Semester End presentation and oral examination	10
4.	Level of completion of internship	10
5.	Internship Report – Presentation style and content	10
Total		**50** Marks

- **23-201-0717#FINITE ELEMENT METHODS /*MOOC –III**

(Course for Honours)

Students should take Massive Open Online Courses (MOOCs) approved by the concerned Division/Board of Studies (BoS)

PROFESSIONAL ELECTIVE – IV

23-201-0801 DESIGN OF SPECIAL STRUCTURES

Course Outcomes: On completion of this course a student will be able to

1. Design special RC structures

2. Analyse and design flat slabs and folded plates and shell structures.

3. Design power plant and power transmission structures.

4. Design concrete members reinforced with non-corrosive FRP bars in place of steel as conventional bars.

5. Perform design of timber structures.

Course Articulation Matrix:

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

1-Slightly; 2- Moderately; 3- Substantially

Module I

Design of Special RC Elements: Design of RC walls - Ordinary walls and shear walls - Design of Corbels - Deep beams and grid floors.

Module II

Design of Flat Slabs and Folded Plates: Design of flat slabs. Design of folded plates- Folded Plate structures - structural behaviour - Types - Design by ACI - ASCE Task Committee method

Design of Shell Structures: Membrane theory of shells-Classification of shells - Types of shells - Structural Action-Membrane theory - Shells of revolution and shells of translation - Examples - Limitations of membrane theory.

Module III

Design of Power Plant Structures: Bunkers and Silos - Chimneys and Cooling Towers - High Pressure boilers and piping design – Nuclear containment structures.

Module IV

Structural design with FRP bars: Fibre Reinforced Polymer (FRP) bars-Introduction- Materials and manufacturing-Properties of FRP reinforcing bars-Design basis for FRP reinforced concrete, under reinforced section, over reinforced section, Design of FRP reinforced flexural members, Design procedure for Serviceability, design for shear and FRP reinforcement detailing.

Timber structures: Classification - allowable stresses - design of beams for flexure, shear and bearing - deflection criteria - design of solid and built-up columns-flitched beams – formwork design.

References:

1. Purushothaman, P. Reinforced Concrete Structure Structural Elements: Behavior Analysis and Design.TataMcGraw Hill.
2. Krishnaraju, N. Advanced Reinforced Concrete Design. CBS Publishers and Distributors.
3. Ramasamy, G. S. Design and Construction of Concrete Shells Roofs. CBS Publishers.
4. Subramanian, N. Principles of Space Structures. Wheeler Publishing Co.
5. Santhakumar, A. R. and Murthy, S. S. Transmission Line Structures. Tata McGraw Hill.
6. Thomlinson, M.J. and Boorman, R. Foundation design and construction. 4th edition, ELBS Longman.
7. Varghese , P.C., Design of Reinforced Concrete Foundation PHI Learning Pvt Ltd.

Type of Questions for Semester End Examination

Question nos. I and II [with sub sections (a), (b),] (12.5 marks each with option to answer either I or II) from Module I.

Question nos. III and IV [with sub sections (a), (b), …] (12.5 marks each with option to answer either III or IV) from Module II.

Question nos. V and VI [with sub sections (a), (b), …] (12.5 marks each with option to answer either V or VI) from Module III.

Question nos. VII and VIII [with sub sections (a), (b), …] (12.5 marks each with option to answer either VII or VIII) from Module IV.

The maximum marks that can be awarded for the Semester End Examination (SEE) will be only 50

Note: Relevant IS codes are permitted during the Examination

23-201-0802 BUILDING INFORMATION MODELLING

Course Outcomes:

On completion of this course the student will be able to:

1. Explain the concept and advantages of BIM.
2. Apply the various processes on a BIM model.
3. Appraise the collaborative and interoperability capabilities of BIM.
4. Apply BIM Software for executing various projects.

Course Articulation Matrix:

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

1–Slightly; 2–Moderately; 3-Substantially

Module I

Introduction to BIM: Traditional AEC Business Model and its inefficiencies, What is BIM? – BIM vs 3D vs 2D – BIM as a product vs BIM as a process, BIM as a lifecycle platform, Why BIM – incentives and benefits – technical and financial, the Evolution to Object-Based Parametric Modeling, BIM Model Quality and Model Checking.

Module II

BIM software training: Create Modeling Views - Model Layout - Architectural Modeling-Structural Modeling - MEP Modeling - Construction Modeling - Project Management - Revit Families - Tools and Techniques - Project Phasing - Document and Present the Design -Analyze the Design (Energy, solar, area, etc.) – Schedules - Rendering – Walkthroughs.

Module III

Collaboration, Interoperability and roles: BIM for stakeholders - Owners, Facility Managers and Government Institutions, Architects and Engineers, Contractors, Subcontractors and Fabricators. BIM Adoption, Maturity Levels BIM Guides (From countries like Finland, Denmark, Belgium etc) Data Exchange Methods – File based, Cloud based and local data exchange methods Product Data Models and Standardization File-Based Exchange and BIM Servers, IFC – Industry Foundation classes, COBie.

Module IV

BIM Execution Plan: Overview of the BIM Execution Planning Procedure for Building Information Modeling, Establish Project Modeling Goals, Select Model Uses, Design the BIM Process, Define the Information Exchanges, Plan Infrastructure, Implementing the BIM Project Execution Planning Procedure, BIM Project Execution Planning for Organizations, Conclusions and Recommendations.

**Mini project: Mini projects shall be done individually or in groups. Each individual/group shall identify a problem. The group/ individual shall present a seminar on the work carried out and a report shall be submitted.*

References:

1. Eastman, C. M. BIM handbook: A guide to building information modeling for owners, managers, designers, engineers and contractors. John Wiley & Sons.
2. Messner, J. BIM Project Execution Planning Guide, Version 3.0.
3. Autodesk Revit: User Guide by Autodesk.

23-201-0803 CONSTRUCTION SAFETY AND FIRE ENGINEERING

Course Outcomes:
On completion of this course, a student will be able to:
1. Recognize the importance of managing safety in workplace accidents and health in construction.
2. Identify types of hazards and ways to prevent accidents in different types of construction.
3. Understand the chemistry of fire and fire prevention methods.
4. Understand various standards to protect building and human life from fire hazards.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12	POS1	POS2	POS3
CO1	2	2	-	-	-	2	2	2	-	-	-	1	-	2	-
CO2	3	1	1	-	1	1	1	1	-	-	-	1	-	1	-
CO3	3	2	2	-	1	2	1	2	1	1	-	1	-	2	-
CO4	3	1	2	1	1	1	1	1	1	1	-	1	-	2	1

1- Slightly, 2- Moderately, 3- Substantially

Module I

Introduction to Construction Industry and Safety:

Basic concepts – accident – injury –lost time accidents, reportable accident, frequency rate, severity rate, incidence rate. Technological, Organization and Behavioural Aspects of safety in construction, Human factors that are Impediments to safety in construction, Roles of different groups in ensuring safety, health, welfare and social security, Steps to be taken in construction sites in case of accidents, Introduction to ergonomics and its relevance to construction.

Module II

Safety in various construction operations such as soil excavation, rock blasting, dewatering, piling, demolition, working at heights-ladders and scaffolds, working in confined spaces, Safety in electrical works at construction site. Safety in storage, stacking and handling of construction materials-cement, lime, aggregates, brick sand blocks, steel, glass, paint and varnish, flammable and hazardous materials used at sites. Safety in the operation of construction equipment's- excavators, trucks, tower cranes, mobile cranes, lifting tackles, chain and pulley, Personal protective equipment's for construction.

Module III

Classification of fire. Effect of high temperature on the properties of concrete, steel, masonry, wood, Fire damage to concrete, steel, masonry and timber, Repair techniques to the fire damaged reinforced concrete columns, beams, slabs and to the steel structural members.

Module IV

Design principles of fire resistant walls. Classification of buildings based on occupancy, types of construction as per National Building code of India; Fire zones; General Requirements of fire protection for all individual occupancies. Life safety aspects of building fires – Exit Requirements as per NBC of India. Requirements other than general requirements for buildings of different occupancy classification.

References:

1. Vaid, K. N. *Construction Safety Management*. National Institute of Construction Management and Research.
2. Smith and Harmathy. *Design of Buildings for Fire Safety*. ASTM International.
3. National Building Code of India, Part –IV and VII
4. Linger, L. *Modern Methods of Material Handling*.
5. Merchant, E. W. *A Complete Guide to Fire and Buildings*.
6. Jain, V. K.*Fire Safety in Buildings*. New Age International (p) Ltd., New Delhi.

23-201-0804 REMOTE SENSING AND GIS

Course Outcomes:
On completion of the course, a student will be able to

1. Comprehensively understand remote sensing and its principles, including the electromagnetic radiation spectrum.
2. Gain knowledge in satellite classification, sensor technologies, and resolution parameters.
3. Develop a comprehensive understanding of electromagnetic radiation interactions with the atmosphere and Earth materials.
4. Gain proficiency in Geographic Information Systems (GIS).
5. Students will proficiently interpret satellite images, apply image enhancement and classification techniques.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12	PSO1	PSO2	PSO3
CO1	3	2	2	3	3	3	2	-	3	-	1	1	-	2	-
CO2	3	2	3	3	3	2	3	1	2	2	3	1	-	2	-
CO3	3	2	3	3	3	2	2	-	3	2	3	1	-	-	2
CO4	3	2	3	3	2	3	1	1	2	-	3	1	1	-	2
CO5	3	3	3	3	3	3	2	-	3	3	3	1	1	-	-

1-Slightly, 2- Moderately, 3- Substantially

Module I

Remote sensing: Definition-Components of Remote sensing Introduction to Remote Sensing-Energy source and its characteristics-Electromagnetic remote sensing process, Microwave remote sensing - Energy, Sensor, Interacting Body - Active and passive Remote Sensing – Platforms - Aerial and Space Platforms-Balloons, Helicopters, Aircraft and Satellites –

Electro Magnetic Radiation (EMR) - EMR spectrum-visible, Infra Red (IR), near IR, Middle IR, Thermal IR and Microwave- Black Body Radiation – Planck's law - Stefan-Boltzmann law.

Satellites – Classification based on orbits - Sun Synchronous and Geo Synchronous - based on purpose - Earth Resources Satellites, communication satellites, weather satellites, spy satellites – Various satellites around the world with details including IRS satellites including current satellite- Satellite sensors - Resolution-Spectral, Spatial Radiometric and Temporal Resolution, Description of sensors in Landsat , SPOT, IRS series- Current Satellites– description of Multispectral Scanning, Along and Across Track Scanners

Module II

EMR Interaction with Atmosphere and Earth Materials : Atmospheric characteristics Scattering of EMR - Raleigh, Mie, Non–selective and Raman Scattering - EMR Interaction with Water vapour and ozone – Atmospheric Windows – Significance of Atmospheric windows - EMR interaction with Earth Surface Materials, Radiance, Irradiance, Incident, Reflected, Absorbed and transmitted energy -Reflectance – Specular and diffuse reflection surfaces - Spectral Signature – Spectral Signature curves EMR interaction with water, soil and earth surface
Optical and Microwave Remote Sensing-RADAR- Radar Speckle-Back Scattering – Side Looking Airborne Radar - Synthetic Aperture Radar – Radiometer - Geometrical characteristics.

Module III

Geographic Information system (GIS) : GIS – Components of GIS – Hardware, Software and Organizational Context - Data-Spatial and Non – Spatial, Maps - Types of maps, and map projection, comparison, classification of maps, map scale, spatial referencing system- Grid Systems, Global Positioning System-Introduction-principle-components-applications
Data Input – Digitizer, Scanner – Editing – Raster and Vector data structure, Analysis using Raster and Vector data-retrieval, Reclassification, Overlaying , Buffering – Data Output – Printers and Plotters.

Module IV

Visual Interpretation of Satellite Images – Elements of Interpretation - Interpretation Keys Characteristics of Digital Satellite Images, Image enhancement, Filtering, Classification – Integration of GIS and Remote Sensing – Application of Remote Sensing and GIS, Urban Applications – Water resources – Urban Analysis - Watershed Management - Resources Information systems. Integration of GIS and Remote sensing -Applications in various fields of civil engineering-Transportation-Geological mapping-Lanslide engineering -Identification of soil types

References:

1. Lillesand, T. M., Kiefer, R. W.and Chipman, J. W. Remote Sensing and Image Interpretation. John Wiley & Sons.
2. Sabins, F.F. Remote Sensing Principles and Interpretation. W.H. Freeman & Co.
3. Burrough and McDonnel. Principles of GIS. Oxford University Press.
4. Heywood, J., Cornelius, S. and Carver, S. An Introduction to GIS. Pearson Education.
5. Anji Reddy, M Remote Sensing and Geographical Information sytems, B S Publication, Hyderabad,
6 .Burrough P A principles of GIS for land resource mangement, Oxford University,
7. Jensen J R Introductory Digital Image Processing, Prentice Hall.
8. NRC, Fundamentals of Remote sensing, Natural resources CANADA

PROFESSIONAL ELECTIVE – V

23-201-0805 CONSTRUCTION ECONOMICS AND FINANCE

Course Outcomes:

On completion of this course the student will be able to:

1. Understand the basic principles of engineering economics
2. To analyse available alternatives and propose best among them
3. Understand basics of equipment economics
4. Understand various models of financial management and accounting

Course Articulation Matrix

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

1-Slightly; 2-Moderately; 3-Substantially

Module 1

Engineering economics:

Basic principles - Time value of money, Quantifying alternatives for decision making, Cash flow diagrams, Equivalence-Single payment in the future (P/F, F/P), Present payment compared to uniform series payments (P/A, A/P), Future payment compared to uniform series payments (F/A, A/F), Arithmetic gradient, Geometric gradient.

Module 2

Comparison of alternatives:

Present, future and annual worth method of comparing alternatives, Rate of return, Incremental rate of return, Break-even comparisons, Capitalized cost analysis, Benefit-cost analysis. Depreciation, Inflation and Taxes

Module 3

Equipment economics:

Equipment costs, Ownership and operating costs, Buy/Rent/Lease options, Replacement analysis.

Module 4

Financial management:

Construction accounting, Chart of Accounts, Financial statements Profit and loss, Balance sheets, financial ratios, Working capital management

Reference

1. Bose, D. C., Fundamentals of Financial management, 2nd ed., PHI, New Delhi.
2. Blank, L.T., and Tarquin,A.J Engineering Economy,4th Edn. Mc-Graw Hill Book Co.
3. Collier C and GlaGola C Engineering Economics & Cost Analysis, 3nd Edn. Addison Wesley Education Publishers.
4. Patel, B M Project management- strategic Financial Planning, Evaluation and Control, Vikas Publishing House Pvt. Ltd. New Delhi.
5. Steiner, H.M. Engineering Economic principles, 2nd Edn. Mc-Graw Hill Book Co.

23-201-0806 RETROFITTING AND REHABILITATION OF STRUCTURES

Course Outcomes:

On completion of the course, a student will be able to:

1. Assess knowledge on the materials and techniques used in the repair of structures.
2. Suggest methods and techniques used for repairing / strengthening masonry structures.
3. Suggest methods and techniques used for repairing / strengthening concrete structures.
4. Apply effective retrofitting strategies for repairs of floors and steel structures.

Course Articulation Matrix:

1-Slightly; 2- Moderately ;3- Substantially

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

Module I

Concept of Repairing – retrofitting – strengthening – rehabilitation – restoration – remoulding -maintenance- necessity of maintenance-classification of maintenance. Repair materials/ methods: – Repair methodology, issues related to material Technology - Desired properties of repair materials – materials for repair – new repair systems / products. Distresses in concrete structures – Deterioration of structures – causes and prevention – crack repair techniques – Repair techniques/ materials for structures – repair of structural components.

Module II

Retrofitting of Masonry buildings: Failure mode of masonry buildings – out-of-plane failure – in - plane failure – diaphragm failure – failure of connection – methods of retrofitting – cement or epoxy injection– using wire mesh and cement mortar – re construction of bulged portion of masonry wall – grouting with cement – pointing with mortar – shotcreting – using FRP fabric – using RC and steel frames – adding reinforcements to masonry – stitching of wall corners – use of tie rods – Prestressing of masonry – external binding or jacketing – Splint and bandage technique – Inserting new walls – exterior supplemental elements – strengthening of parapets.

Module III

Retrofitting of RC structure: Global retrofitting methods – adding new shear walls – adding steel bracing – adding infill walls – non-conventional methods – seismic base isolation – Supplemental damping devices; Member or local retrofit methods – jacketing/confinements –jacketing of columns using steel sections – reinforced concrete jacketing – FRP jacketing – beam jacketing – beam column joint jacketing – slab column connection – foundation.

Module IV

Repair of Concrete Floors: Surface preparation – thin bonded toppings – reinstating joint sealants – Crack repair – crack cleaning and resin injection – crack cutting and mortar filling – application of cement/sand screed – use of toppings Retrofitting of Steel Structure: Rain water protection – drainage in structural members – preparation of surface by sand blasting – protective coatings – Cathodic protection – Sacrificial metal – adding additional plates strengthening the joints – concrete jacketing.

References:

1. Agarwal, P. and Shrikhande, M. Earthquake Resistant Design of Structures. Prentice Hall of India Pvt Ltd, New Delhi.
2. Balachandran and Margrab. Vibrations. Thomason Books Cole.
3. Santhakumar, A. R. Concrete Technology. Oxford University Press, New Delhi.

23-201-0807 GEO-ENVIRONMENTAL ENGINEERING

Course Outcomes:

On completion of the course, a student will be able to:

1. Classify the different types of waste and predict its impact on the environment
2. Distinguish the various contaminant transport mechanisms
3. Design waste containment facilities based on norms and site requirements
4. Apprehend risk assessment and remediation of contaminated sites.

Course Articulation Matrix

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

1-Slightly; 2- Moderately; 3- Substantially

Module I

Fundamentals of Geoenvironmental Engineering: multiphase behaviour of soil – role of soil in geoenvironmental applications – importance of soil physics, soil chemistry, hydrogeology, biological process – case histories on geoenvironmental problems.

Wastes: sources, generation and classification of wastes- physical, chemical and geotechnical characterization of waste - characteristics and classification of hazardous wastes- generation rates. Ground water contamination- sources of ground water contamination- potential problems in soils due to contaminants.

Module II

Soil-Water-Contaminant Interaction:Soil minerology characterization and its significance in determining soil behavior – soil-water interaction and concepts of double layer – forces of interaction between soil particles.

Concepts of unsaturated soils – importance of unsaturated soil in geoenvironmental problems – measurement of soil suction – water retention curves – water flow in saturated and unsaturated zone.
Soil-water-contaminant interactions and its implications – Factors effecting retention and transport of contaminants.

Module III

Waste Containment System: Evolution of waste containment facilities and disposal practices – Site selection based on environmental impact assessment – different role of soil in waste containment – different components of waste containment system and its stability issues – property evaluation for checking soil suitability for waste containment – design of waste containment facilities.

Module IV

Contaminant Site Remediation: Site characterization – risk assessment of contaminated site – remediation methods for soil and groundwater – selection and planning of remediation methods – some examples of in-situ remediation.

References

1. Daniel D.E,"Geotechnical Practice for Waste Disposal" ,Chapman and Hall.
2. Koerner, R.M ,"Designing with Geosynthetics", Prentice Hall.
3. Reddi L.N and Inyang H. I,"GeoenvironmentalEngineering : Principles and Applications", Marcel Dekker Inc Publication,2000
4. Yong.R.N,"Geoenvironmental Engineering: Contaminated soils, Pollutant Fate, Mitigation", Lewis Publications.
5. Sarsby R,"Environmental Geotechnology", Chapman and Hall.
6. Bachi A ,"Design Construction and Monitoring of landfills", John Wiley and Sons.
7. Rao .G. Vand Sasidhar R.S, "Solid Waste Management and Engineered Landfills".SaimasterGeoenvironmental Services Pvt. Ltd. Publications.
8. Datta M,"Waste disposal in engineered landfills', Narosha publications.
9. Gulathi S. and Datta M,"Geotechnical Engineering" ,Tata MC Graw-Hill.
10. Gopal Ranjan, Rao, A.S.R,"Basic and Applied Soil Mechanics" , New Age International Pvt. Ltd.

23-201-0808 DESIGN OF HYDRAULIC STRUCTURES

Course Outcomes:
On completion of the course, a student will be able to:

1. Perform the stability analysis of gravity dams
2. Explain the causes of failure of different types of dams and their design criteria
3. Design minor irrigation structures such as regulators, cross drainage works and canal falls
4. Able to design structures on pervious formations.

Course Articulation Matrix:

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

1- Slightly; 2- Moderately ;3- Substantially

Module I

Reservoir Planning: Investigations, Capacities, Zones of storage, Mass Inflow and Mass Demand curves, Life of Reservoir. Earth Dams: Types, causes of failure and design criteria, soils suitabllity for earth dam construction, construction methods, foundation requirements, typical earth dam sections, estimation of seepage through and below

the dam, seepage control, stability of slopes by slip circle method of analysis, pore pressures, sudden draw down, steady seepage and construction pore pressure condition.

Module II

Gravity dams: Design Criteria, forces acting on gravity dams, elementary profile, low and high gravity dams, stability analysis, practical profile, evaluation of profile by method of zoning, foundation treatment, construction joints, galleries in gravity dams.

Module III

Spillways and energy dissipation systems Spillways: Ogee spillway and its design, details of syphon, shaft, chute and side channel spillways, emergency spillways. Design of outlets and rating curves Energy dissipators: Principles of energy dissipation Energy dissipators based on tail water rating curve and jump height curves Spillway crest gates - vertical lift and radial gates, their design principles. Design of canal regulating structures, Design of Channel transitions, Design of Sarda type Falls, Design of cross drainage works viz Syphon aquaduct and Canal syphon.

Module IV

Surface and Subsurface Flow Analysis in Hydraulic Structures Structures on Pervious formations: Bligh's creep theory, limitations, Khoslas's theory of independent variable, Khosla's corrections, Design of Weir and Barrages: design of waterways and crest levels, design of impervious floors and protection works.
Design of Canal Structures: Canal regulators, Types of canal falls, Design of Sarda type fall,
Design of straight glacis fall, Types of cross drainage works, Design of canal fluming, Design of aqueduct/ syphon aqueduct.

References

1. Engineering for Dams (Volumes I, II & III) by Creager, Justin & Hinds
2. Hydroelectric Hand Book by Creager
3. Hydraulic Structures by Varshney
4. Irrigation Water Resources and Hydropower Engineering, Modi, P. M., Standard Book Publishing Company, 9th Edition
5. Irrigation, Water Power and Hydropower Engineering, Arora K. R., Standard Book Publishing,5th Edition
6. Irrigation and Water Resources Engineering, Asawa G.L., New Age International Publishers.
7. Water Resources Engineering – Principles and Practice, Murthy, C.S.N., New Age International Publishers, 2nd Edition

Type of Questions for Semester End Examination

Question nos. I and II [with sub sections (a), (b),] (12.5 marks each with option to answer either I or II) from Module I.
Question nos. III and IV [with sub sections (a), (b), …] (12.5 marks each with option to answer either III or IV) from Module II.
Question nos. V and VI [with sub sections (a), (b), …] (12.5 marks each with option to answer either V or VI) from Module III.
Question nos. VII and VIII [with sub sections (a), (b), …] (12.5 marks each with option to answer either VII or VIII) from Module IV.

The maximum marks that can be awarded for the Semester End Examination (SEE) will be only 50

PROFESSIONAL ELECTIVE – VI

23-201-0809 EARTHQUAKE ENGINEERING

Course Outcomes: On completion of this course a student will be able to

1. Explain basics of seismology, magnitude and intensity of earthquake.

2. Analyse the structural configurations of earthquake resistant buildings

3. Perform dynamic analysis of structures.

4. Apply general principles of seismic design of buildings based on relevant design standard.

Course Articulation Matrix:

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

1-Slightly; 2- Moderately ;3- Substantially

Module I

Earthquake Ground Motion: Causes of earthquake- Seismic Waves-Intensity and Magnitude of earthquake-seismic zones in India.
Strong motion-source effect-path effect-site effect-use of strong motion data; strong motion characteristics.
Response spectrum-types of response spectra-design spectrum-Damage potential of Earthquakes- Seismic Test Methods.

Module II

Seismic Damage in RC buildings: Causes – Damage to Structural and non-structural Elements.
Seismic Resistant Building Architecture: Seismic effects on structures-Inertia forces-deformations-horizontal and vertical shaking-Importance of architectural features-effects of irregularity-Lateral load resisting systems-Building Characteristics-Mode shapes and fundamental period, Building frequency and ground period, Damping, Ductility, Seismic weight, Hyperstaticity, Non structural elements, foundation soil/Liquefaction, foundations-Quality of construction and materials.
Seismic protection methods: base isolation- energy dissipating devices- Codal provisions.

Module III

Structural Dynamics: Dynamic analysis, Types of dynamic loading, Structural vibrations, Free vibrations and forced vibrations- Response of the system towards loading, Degrees of freedom, SDOF and MDOF systems-Vibration analysis of SDOF systems- Free vibration of un-damped SDOF system- free vibration of viscously damped SDOF systems - Forced vibration of SDOF systems-harmonic excitation-base motion-principles of vibration isolation-determination of damping coefficient, Vibration measuring instruments, Response of a system to support motion.

Module IV

Concept of seismic design: Approach to seismic design- general principles of a seismic design- relevant IS codes-conceptual design- design earthquake loads- load combinations and permissible stresses- equivalent static analysis-vertical distribution of seismic forces and horizontal shears.

Soil structure interaction effects: direct approach-sub structure approach (description only).
Ductility requirements of RC buildings: displacement ductility-rotational ductility considerations based on IS13920 in flexural members, columns, joints of frames (description only).

References:

1. Agarwal, P. and Shrikhande, M.Earthquake Resistant Design of Structures. Prentice Hall of India Pvt Ltd, New Delhi.
2. Duggal. Earthquake Resistant Design of Structures. Oxford University Press.
3. Park, R. and Paulay, T. Reinforced Concrete Structures. John Wiley.
4. Chopra, A. K. Dynamics of Structures. Pearson Education Pvt. Ltd.
5. Paz, M. Structural Dynamics: Theory and Computation. CBS Publishers & Distributors, New Delhi.

23-201-0810 DESIGN OF MASONRY STRUCTURES

Course Outcomes:

On completion of this course the student will be able to:

1. Elucidate theories on mechanical behaviour of masonry assemblages under different actions
2. Make use of working stress and limit state approaches to analysis and design of unreinforced, reinforced, confined masonry structures for gravity and lateral loads, including earthquake loads
3. Briefly address behaviour of masonry infill walls and procedures for structural assessment and strengthening of existing masonry structures
4. Interpret the behaviour of structural masonry under different loads, and be able to estimate capacities and design masonry walls and systems.

Course Articulation Matrix:

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

1–Slightly; 2–Moderately; 3-Substantially

Module I

Materials Used in Masonry Construction- Basic Components of Masonry- Masonry Mortar- Masonry Grout- Clay Masonry Units- Concrete Masonry Units - Properties of Masonry Assemblages- Masonry Accessory Materials- Design of Masonry Structures - How to Increase Resistance of Masonry to Water Penetration

Module II

Basic Mechanical Behaviour of Masonry - Classification of Masonry Elements - Classification of Masonry Elements by Structural Function - Classification of Masonry Elements by Design Intent -- Design Approaches for Masonry Elements-How Reinforcement Is Used in Masonry Elements

Module III

Strength Design of Unreinforced Masonry Elements- Strength Design of Unreinforced Panel Walls-Strength Design of Unreinforced Bearing Walls -Strength Design of Unreinforced Shear Walls -- Strength Design of Anchor Bolts - Required Details for Unreinforced Bearing Wallsand Shear Walls

Module IV

Strength Design of Reinforced Masonry Elements- Strength Design of Reinforced Beams and Lintels-Strength Design of Reinforced Curtain Walls -Strength Design of Reinforced Bearing Walls -Strength Design of Reinforced Shear Walls --Required Details for Reinforced Bearing Walls and Shear Walls.

References:

1. National Building Code of India ,Vol.1, Part 6 Section 4 Structural Design - Masonry
2. R E Klingner , Masonry structural design, McGrawHill Companies, Inc. New York, pp. 588.

3. M Tomazevic, Earthquake-resistant design of masonry buildings, Series on Innovation in Structures and Construction, Vol. 1, Imperial College Press, London, pp. 268.
4. MJN Priestley and T Paulay, Seismic design and assessment of reinforced concrete and masonry buildings, John Wiley and Sons.
5. RG Drysdale, AA Hamid, LR Baker 1994 Masonry Structures: Behaviour and design, Prentice Hall, New Jersey, USA, pp. 784.
6. AW Hendry, Structural Brickwork, The Macmillan Press Ltd. pp. 209.

23-201-0811 WATERSHED MANAGEMENT

Course Outcomes:
On completion of this course the student will be able to:

1. Understand the fundamental principles and concepts of watershed management.
2. Apply various approaches towards storm water management, rainwater harvesting, and flood and drought management.
3. Apprehend soil erosion, watershed modelling, and water quality problems.
4. Attest the concept of integrated watershed management and Corroborate for development and planning of watershed.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12	PSO1	PSO2	PSO3
CO1	3	2	2	-	-	-	-	-	-	-	-	-	-	2	-
CO2	3	3	2	-	-	-	-	-	-	-	-	-	-	2	1
CO3	3	3	3	-	-	-	-	-	-	-	-	-	1	2	-
CO4	3	2	3	-	-	-	-	-	-	-	-	-	-	1	1

1–Slightly; 2–Moderately; 3-Substantially

Module I

Introduction and basic concepts- Watershed, watershed behaviour, effects of land use and its change on hydrological cycle components, Land capability and suitability classi, Human interventions to manage water flow or quality

Watershed modelling - Standard modelling approaches and classifications, System concept for watershed modelling, Modelling of Runoff with SCS methodology, subsurface flows and groundwater flow

Module II

Soil Erosion Modelling - Soil Erosion, Soil water Relationship, Types and causes of soil erosion, Estimation of soil erosion, Different methods to control soil erosion, Erosion by Wind and Water – Processes, Models for Erosion Prediction, Sediment Transport

Management of Water Quality - Water quality and pollution, types and sources of pollution, Water quality modelling, Environmental guidelines for water quality

Module III

Storm Water and Flood and Drought Management - Storm water management, design of drainage system, Estimation of design flood and design droughts in a watershed, Flood routing through channels and reservoir, flood control and reservoir operation, Drought assessment and classification, drought analysis techniques, Drought mitigation planning Integrated Watershed Management - 6.1 Introduction to integrated approach, conjunctive use of water resources, 6.2 Rainwater harvesting, Different methods of water harvesting Proposed water harvesting in India through interlinking of rivers

Module IV

Urban Storm water Management -Issues pertaining to watershed management in urban Environments, Methods to control pollution from urban storm water,Measures to control urban storm water pollution

Use of modern techniques in watershed management - Applications of Geographical Information System(GIS) and Remote Sensing(RS) in Watershed Management, Role of RS and GIS in in Watershed -Management and Decision Support System

References:

1. Hydrology and the Management of Watersheds.4th Edition. K.N. Brooks, P.F. Ffolliott, J.A. Magner. John Wiley & Sons, Inc. 533 pp.
2. Integrated Watershed Management: Principles and Practice.2nd Edition. Isobel W. Heathcote. John Wiley & Sons, Inc.
3. Integrated Watershed Management: Connecting People to their Land and Water. H.M. Gregersen, P.F. Ffolliott, and K.N. Brooks. CAB International.
4. Watershed management: Guidelines for Indian Conditions by E.M. Tideman, Omega Scientific Publishers.
5. Hydrology and Soil Conservation Engineering by Ghanshyam Das, Prentice Hall India.
6. Watershed Planning & Management by Dr. Rajvir Singh, Yash Publishing House.
7. Watersheds - Processes, Assessment and Management by Pau A.Debarry, John Wiley & Sons.
8. Watershed Management by J.V.S. Murthy New Age Publishers
9. Watershed Management by Madan Mohan Das, PHI Publication

23-201-0812 SOLID WASTE MANAGEMENT

Course Outcomes:

On completion of the course, a student will be able to:

1. Identify the sources and composition of solid waste and integrated waste management approach which is beneficial for society.
2. Demonstrate an ability to choose sustainable technologies for storage, transport and processing of solid wastes.
3. Identify the types and design of cost-effective technologies for landfill disposal and its operation
4. Develop a student's skill in hazardous waste management.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12	PSO1	PSO2	PSO3
CO1	3	2	-	2	3	3	2	2	3	-	2	1	-	2	-
CO2	3	2	2	2	3	1	3	1	2	1	3	1	-	2	1
CO3	3	1	3	2	3	1	2	1	3	-	3	2	1	2	-
CO4	3	2	3	3	2	3	1	1	2	-	3	1	-	1	1

1. Slightly, 2- Moderately, 3- Substantially

Module I

Solid wastes: Types and sources – need for solid waste management – Elements of integrated waste management – Salient features of Indian legislations on management and handling of municipal solid wastes, Solid Waste generation rates and variation: Composition, physical, chemical and biological properties of solid wastes –waste sampling and characterization plan – Source reduction of wastes – Recycling and reuse – waste exchange

Module II

Storage, Collection and Transport of wastes: Handling and segregation of wastes at source – storage and collection of municipal solid wastes – analysis of collection systems – need for transfer and transport – transfer stations - Optimizing waste allocation. Waste Processing Technologies : Objectives of waste processing – material separation and processing technologies – biological and chemical conversion technologies – methods and controls of composting – thermal conversion technologies and energy recovery – incineration.

Module III

Municipal Solid Waste Disposal : Waste disposal options – Disposal in landfills – Landfill Classification, types and methods – site selection – design and operation of sanitary landfills, secure landfills and landfill bioreactors – leachate and landfill gas management – landfill closure and environmental monitoring – closure of landfills- landfill remediation

Module IV

Household hazardous waste management: Definition and identification of hazardous wastes, sources and characteristics-hazardous wastes in municipal waste-minimization of hazardous waste- compatibility, handling and storage of hazardous waste-collection and transport, Regulatory requirement for identification, characterization and disposal of hazardous, nonhazardous and domestic wastes. Elements of Integrated Waste Management.

Solid waste management statutes in India- Solid Waste Management Rules 2016, Construction and Demolition Waste Management Rules, 2016

References:

1. Tchobanoglous, G., Theisen, H. and Vigil, S. A. Integrated Solid Waste Management. McGraw-Hill International edition, New York.
2. CPHEEO. Manual on Municipal solid waste management. Central public Health and Environmental Engineering Organization, Government of India, New Delhi.
3. Michael, D. LaGrega, Buckingham, P. L.and Jeffrey, C.E. Environmental resources Management, Hazardous waste Management. McGraw-Hill International edition, New York.
4. Peavy, H.S., Rowe, D. R. and Tchobanoglous, G. Environmental Engineering. McGraw Hill, New York.
5. Vesilind, P. A., Worrell, W. and Reinhart, D.Solid Waste Engineering. Brooks/Cole Thomson Learning Inc.
6. Wentz, C. A. Hazardous waste Management. McGraw-Hill Publication.

OPEN ELECTIVE – II

23-201-0813 BUILDING SERVICES ENGINEERING

Course Outcomes:

On completion of this course the student will be able to:

1. Calculate energy costs per standard units, the annual energy cost and the economic thickness of the thermal insulation in Buildings
2. Calculate energy requirement for heating, ventilation, air conditioning, and determination of air flow rates, air changes, size of air ducts and heater-cooler loads
3. Demonstrate an ability to design various services like hot and cold water supply systems, drainage systems for soil and storm water.
4. Assess the natural and artificial illumination requirements to minimize total energy consumption and environmental noise impact and its control.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	-	-	2	-	-	-	-	-	-	-	2	-
CO2	2	2	2	-	-	2	-	-	-	-	-	-	-	2	-
CO3	2	2	2	-	-	2	-	-	-	-	-	-	-	2	-
CO4	2	2	2	-	-	2	-	-	-	-	-	-	-	2	-

1–Slightly; 2–Moderately; 3-Substantially

Module I

Built environment: comfort equation – comfort measurement – external environment – environmental measurements –temperature – dry temperature – comfort criteria. Energy economics: energy audits – unity brackets – calorific value of fuel – energy cost – fuel cost – economic thickness and thermal insulation – accounting energy economic system – low energy building. Heat loss calculation: thermal resistance of materials – thermal transmittance – heat loss from building – thermal transmittance measurements.

Module II

Ventilation and air conditioning: requirements – natural and mechanical system – removal of heat gains – psychometric cycles – air conditioning systems – vapor compression refrigeration – absorption refrigeration cycle – ventilation rate measurements – ventilation duct works – chlorofluorocarbons – sick building syndrome – air temperature profile. Hot and cold water supply: water treatment – service lines – pipe sizing – allocation of sanitary appliances – materials – solar heating. Soil and waste system: fluid flow in waste pipes – pipework design – discharge unit per pipe sizing – materials – testing – maintenance.

Module III

Surface water drainage: flow load – roof drainage – disposal of surface water. Below ground drainage: design principle – access provisions – external load on buried pipe lines – materials – sewage lifting pump. Condensation in buildings: sources – condensation and mould growth – vapour diffusion – temperature gradient – dew point temperature – installation. Gas piping: sizing – flue system – ignition and safety controls.

Module IV

Lighting: natural and artificial illumination – maintenance – utilization factor – glare and reflection – lumen design method – air handling luminaries – colour temperature – lamp types – control. Room acoustics: acoustic principles – sound power and pressure level – absorption of sound – reverberation time – plant sound power level – transmission of sound – outdoor sound pressure level – sound pressure level in the intermediate space and target room – noise rating.

Fire protection of buildings: Important considerations in fire protection, Fire resisting, Properties of common building materials, Fire safety and exit requirements.

References:

1. Chadderton D.V.Building Services Engineering, Taylors & Francis Group.
2. Macquiston, Faye C.Heating, Ventilating and Air Conditioning Analysis and Design, John Wiley.
3. Cavanaugh W.J.Architectural Acoustics: Principles and Practice, John Wiley.
4. Hand Book on Water Supply and Drainage With Special Emphasis on Plumping, Bureau of Indian Standards, SP 35
5. V. K Jain .Hand Book on Design and Installation of Services in Building Complexes and High Rise Buildings, Khanna Publications, Delhi.
6. Panchdhari, A.C. Water Supply and Sanitary Installations, Design, Construction and Maintenance, New Age International Publishers, New Delhi.
7. S. K Garg . Water Supply Engineering, Khanna Publications, Delhi.

23-201-0814 ENVIRONMENTAL IMPACT ASSESSMENT

Course Outcomes:

On completion of the course, the student will be able to:

1. Identify the environmental attributes to be considered for the EIA study.
2. Formulate objectives of the EIA studies.
3. Identify the methodology to prepare rapid EIA.
4. Prepare EIA reports and environmental management plans.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12	PSO1	PSO2	PSO3
CO1	3	2	-	2	2	2	2	1	3	-	2	1	-	1	-
CO2	3	2	2	2	3	2	2	1	2	-	3	1	1	2	-
CO3	3	2	3	3	2	2	2	1	3	-	3	2	-	1	1
CO4	3	2	3	3	3	3	3	2	3	2	3	1	1	-	1

1. Slightly, 2- Moderately, 3- Substantially

Module I

Introduction: Concepts of environmental impact analysis, key features of National environmental policy act, Environmental protection acts, EIA methodologies – Screening and scoping - matrix and network methodologies for impact identification, description of the affected environment – environmental indices, Rapid EIA and Comprehensive EIA.

Module II

Prediction and Assessment of Impact on Air and Water Environment: Basic information on air quality, sources and effects of air pollutants, key legislations and regulations, impact prediction approaches, assessment of significance of impacts, identification and incorporation of mitigation measures Assessment of impact on water quality (surface and ground water), Vegetation and wildlife.

Module III

Prediction and Assessment of Impact on Noise & Social Environment: Basic information on noise, key legislation and guidelines, impact prediction methods, assessment of significance of impacts, identification and incorporation of mitigation measures, Environmental Risk Analysis, Definition of Risk, Consequence Analysis.

Module IV

Decision Methods for Evaluation of Alternative: Development of decision matrix.
Public participation in environmental decision making, techniques for conflict management and dispute resolution, verbal communication in EIA studies.

References:

1. Canter, L.W. Environmental impact assessment. McGraw-Hill.
2. Marriott, B. Environmental Impact Assessment: A Practical Guide. McGraw-Hill Professional.
3. Peter Morris, P.and Therivel, .Methods of Environmental Impact Assessment. Routledge.
4. Denver Tolliver, D.Highway Impact Assessment. Greenwood Publishing Group.
5. Jain, R. K., Urban, L. V., Stacey, G. S. and Balbach, H. E. Environmental Assessment. McGraw-Hill Professional.,
6. Relevant IRC and CPCB codes.
7. Anjaneyalu, Y. Environmental Impact Assessment Methodologies. B.S. Publications, Hyderabad.2002
8. Canter, R.L. Environmental Impact Assessment. McGraw Hill Inc., New Delhi.
9. Environmental Assessment Source book ,Vol.I, II & III., The World Bank, Washington, D.C.
10. Judith Petts, J.Hand book of Environmental Impact Assessment. Vol. I& II, Blackwell Science.

23-201-0815 SUSTAINABLE BUILT ENVIRONMENT

Course outcomes:

On completion of this course, the student will be able to:
1. to apply the concept of sustainability and the global initiatives in this
Direction
2. Demonstrate the broad perspective of sustainable practices by utilizing engineering
knowledge and principles.
3. Gain knowledge and understanding of world water problems, Sustainable water, waste management and resource recovery in achieving sustainability

4. Identify challenges and strength of various energy conservation technologies and provide solutions to use resources efficiently and effectively to solve sustainability challenges and to manage risk to minimize adverse impact to people or the environment from local, national and global perspectives

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12	PSO1	PSO2	PSO3
CO1	3	2	-	1	-	1	1	2	-	1	-	2	-	1	1
CO2	3	2	1	-	3	-	1	2	-	1	-	2	-	2	-
CO3	3	2	1	-	2	1	-	-	-	-	-	2	-	2	-
CO4	3	-	-	1	2	2	1	2	-	-	-	2	-	1	-

1. Slightly, 2- Moderately, 3- Substantially

Module I

Evolution of sustainable development

Sustainability: Introduction, concept, evolution of the concept; Social, environmental and economic sustainability concepts; Sustainable development, Nexus between Technology and Sustainable development; Millennium Development Goals (MDGs) and Sustainable Development Goals (SDGs), Clean Development Mechanism (CDM).

Module II

Sustainable Construction

Sustainability practices: Sustainable habitat, Methods for increasing energy efficiency in buildings, Green Engineering, Sustainable urbanisation, Sustainable cities, Sustainable transport. Various rating systems for the assessment of sustainability- LEED, GRIHA, BEE, ECBC, Life cycle Analysis.

General cost Reduction Techniques in building projects- Locally available building materials and their usability - Innovative techniques for foundation-Innovative techniques for walls Innovative techniques for roofing.

Module III

Sustainable water and waste management

Surface water hydrology: hydrological cycle- different types of freshwater resources, their usage - critical issue of water quality - water pollution problems- concept of sustainable management of water resources- integrated water resources management- world demand for water, water conflicts and future perspectives

Waste minimization and pollution prevention strategies- Waste management hierarchy emerging issues –municipal solid waste- management and techniques- zero waste- life cycle assessment reuse and resource recovery - Environmental Protection Act (1986); Regulatory standards for industrial wastewaters and atmospheric emissions; Hazardous and biomedical waste management- Integrated waste management.

Module IV

Sustainable energy and environment

Introduction to Energy Conservation- Need for Energy Conservation -Energy Sources, Supply & Demand-Buildings & Lighting Systems – energy auditing Biomass technology- Liquid biofuels-Other Renewable Energy Technologies. Energy, environment & climate change -Regional and global environmental issues. Green House Gases Emission, Environmental and ecological audits; Environmental performance assessment- Environmental Pollution & Control Technologies. Environmental management standards: ISO 14001:2015 frame work and benefits, Scope and goal of Life Cycle Analysis (LCA), Circular economy, Bio-mimicking, Environment Impact Assessment (EIA), Industrial ecology and industrial symbiosis.

References

1. Montoya, Michael. Green Building Fundamentals: Practical Guide to Understanding and Applying
2. Fundamental Sustainable Construction Practices and the LEED® System, Second Edition. Publisher: Prentice Hall

3. Manual of Tropical Housing & Buildings -Climatic Design (Part-II)" by Koenigsberge.
4. S K Jain and V P Singh. 'Water Resources Systems: Planning and Management'. Elsevier.
5. Christensen, T.H. (ed.) Solid Waste Technology and Management. Wiley, Chichester, West Sussex, UK.
6. WC Turner and Steve Doty: Energy Management Handbook, Fairmont Press Inc.
7. Energy & Environment – J.M. Fowler, (McGrawHill)
8. Allan Johansson, Clean Technology, 1st edition CRC Press.

23-201-0816 EXPERIMENTAL STRESS ANALYSIS

Course Outcomes:

On completion of this course the student will be able to:

1. Develop the concept of stress-strain tensors and apply it to coordinate system
2. Measure the strains using strain gauges, recording and data analysis of strains
3. Apply the principle and theory of brittle coating method
4. Apply the principle of optics for stress analysis

Course Articulation Matrix

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

1-Slightly; 2-Moderately;3-Substantially

Module I

Overview of theory of elasticity: Analysis of stress at a point and strain at a point, governing equations for three-dimensional elasticity problem, solution to plane stress and plane strain problems, Airy's stress function approach for solving plane elasticity problems, forms of stress function in polar coordinates, principal stresses and principal strains, prediction of failures.

Module II

Strain measurements: Strain and its relation to experimental determinations, types of strain gauges: mechanical strain gauges, optical strain gauges, inductance strain gauges, electrical resistance strain gauges, strain sensitivity in metallic alloys, gauge sensitivities and gauge factors; strain gauge circuits: potentiometer, Wheatstone bridge circuits; strain rosettes: rectangular and delta rosette.

Module III

Theory of brittle coating method: Coating stresses, failure theories, brittle coating patterns, crack detection, ceramic based and resin based brittle coatings, test procedures for brittle coating analysis, analysis of brittle coating data.

Module IV

Basic Optics for Stress Analysis: The nature of Light-Wave theory of Light-Reflection and Refraction Image Formation by Lenses and Mirrors-Optical diffraction and Interference-Optical Instruments

Theory of Photoelasticity: Introduction, Temporary double refraction - The stress optic law - Effects of stressed model in a Polariscope for various arrangements

References:

1. J. W. Dally and W. E. Riley, Experimental Stress Analysis, 3rd ed. McGraw-Hill.
2. R. G. Budynas, Advanced Strength and Applied Stress Analysis, 2nd ed. McGraw-Hill.

3. L. S. Srinath, M. R. Raghavan, K. Lingaiah, G. Garghesha, B. Pant, and K. Ramachandra, Experimental Stress Analysis. Tata McGraw-Hill.
4. S. P. Timoshenko and J. N. Goodier, Theory of elasticity, 3rd ed. McGraw-Hill.

23-200-0817 CONSTITUTIONAL LAW

Course Outcomes:
On completion of this course the student will be able to:

1. Configure the preamble and fundamental rights.
2. Actuate the governance and functioning of constitutional functionaries.
3. Describe the functions of legislative bodies.
4. Decipher the judiciary system and its role in governance.

Course Articulation Matrix

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

1-Slightly; 2-Moderately; 3-Substantially

Module I
Introduction
Constitution Law – Constitutional Assembly Debates – Constitution of India – Basic Features of Indian Constitution – Preamble of Constitution – Structure and Content of Indian Constitution

Module II
Fundamental Rights
Fundamental Rights – Definition of State – Fundamental Rights under Indian Constitution – Right to Equality – Untouchability – Right to Life Cultural and Educational Rights of Minorities - Enforcement of Fundamental Rights

Module III
Directive Principles of State Policy & Fundamental Duties
DPSP's – Relationship between DPSP and Fundamental Rights – Conversion of DPSP into Fundamental Rights – Role of Judiciary – Judicial Activism – Public Interest Litigation (PIL) - Fundamental Duties

Module IV
Constitutional Organs
Legislative Organs – Parliament – Lok Sabha, Rajya Sabha - State Legislatures - Executive Organs - President, Vice President, Council of Ministers - Judicial Organs – Supreme Court and High Courts – Other Constitutional Bodies – Election Commission - Comptroller and Auditor General of India.

References:
1. Durga Das Basu, Introduction to the Constitution of India, 24th Edition. Prentice – Hall of India Pvt. Ltd. New Delhi.
2. D.C. Gupta, Indian Government and Politics, 8th Edition. Vikas Publishing House.
3. H.M. Sreevai, Constitutional Law of India, 4th edition in 3 volumes. Universal Law Publication.

23-201-0818 SEMINAR

Course Outcomes:
On completion of this course, the student will be able to:

1. Identify and familiarize with some of the good publications and journals in their field of study.
2. Acquaint oneself with the preparation of independent reports, name them based on a central theme and write abstracts, main body, conclusions and references identifying their intended meaning and style.
3. Understand effective use of tools of presentation, generate confidence in presenting a report before an, audience and improve their skills in the same.
4. Develop skills like time management, leadership quality and rapport with an audience.

Course Articulation Matrix

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

1-Slightly; 2-Moderately; 3-Substantially

Students shall individually prepare and submit a seminar report on a topic of current relevance related to the field of Civil Engineering. The reference shall include standard journals, conference proceedings, reputed magazines and textbooks and technical reports. The references shall be incorporated in the report following International standards reflecting the state-of-the-art in the topic selected. Each student shall present a seminar for about 30 minutes duration on the selected topic. The report and presentation shall be evaluated by a team of internal experts comprising of 3 teachers based on style of presentation, technical content, adequacy of references, depth of knowledge and overall quality of the seminar report.

23-201-0819 PROJECT PHASE-II

Course Outcomes:
On completion of this course, the student will be able to:

1. Realize various steps involved in conducting a project work, like literature survey, the methodology adopted – field study/survey/experiments / numerical work, analysis of the data to arrive at final results and conclusions, etc.
2. Initiate a habit of proper report writing with all of its major components, proper style of writing and preparation of distinct abstract and carved-out conclusions.
3. Conceive the pros and cons of working in a team and the wonderful results which could evolve through teamwork.
4. Present and defend a self-prepared and corrected report (with the help of a project guide) of a self-created work to a peer audience.

Course Articulation Matrix:

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

1-Slightly; 2-Moderately; 3-Substantially

Each batch of students shall develop the project designed during the VII semester. The implementation phase shall proceed as follows:

1. A detailed project report in the prescribed format shall be submitted at the end of the semester. All test results and relevant design and engineering documentation shall be included in the report.
2. The work shall be reviewed and evaluated periodically A committee consisting of the Project Coordinator (appointed by the Head of the Department / Division), project guide and at least one senior faculty member will carry out the assessment based on at least one interim review and a final review just before the submission of the project report.

The final evaluation of the project shall include the following.
1. Presentation of the work
2. Oral examination
3. Demonstration of the project against design specifications
4. Quality and content of the project report.

Guidelines for evaluation		Marks
1.	Regularity and progress of work	20
2.	Work knowledge and Involvement	50
3.	Semester End presentation and oral examination	50
4.	Level of completion and demonstration of Functionality / Specifications	50
5.	Project Report – Presentation style and content	30
	Total	200

Note: Points (1) and (2) are to be evaluated by the respective project guide and the project coordinator based on continuous evaluation. (3)- (5) to be evaluated by the final evaluation team.

23-201-0820 COMPREHENSIVE VIVA VOCE

Course Outcomes:
On completion of this course, the student will be able to:

1. Refresh all the subjects covered during the programme
2. Gain good knowledge of theory and practice
3. Develop oral communication skills and a positive attitude
4. Face technical interviews with confidence

Course Articulation Matrix:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	3	1	-	-	1	-	1	-	1	3	3	1
CO2	3	3	3	3	1	-	-	1	-	1	-	1	3	3	1
CO3	3	3	3	3	1	-	-	1	-	1	-	1	3	3	1
CO4	3	3	3	3	1	-	-	1	-	1	-	1	3	3	1

1-Slightly; 2-Moderately; 3-Substantially

Each student is required to appear for a comprehensive viva voce examination at the end of the complete coursework. The examination panel shall comprise of a minimum of one internal examiner and one external examiner, both appointed by the University. The examiners shall evaluate the students in terms of their conceptual grasp of the entire course of study and practical/analysis skills in the field.

23-201-0821 INTERNSHIP - IV

Course Outcomes:

On completion of this course the student will be able to:

1. Understand the real time technical/managerial skills required and relevant to the subject area of internship

2. Initiate a habit of proper daily diary writing with adequacy and quality of information recorded, drawing and sketches and data, thought process and the proper organisation of the information gained during the internship.

3. Conceive the pros and cons of working in a real time industrial environment and the wonderful results which could evolve through team-work.

4. Present and defend self-prepared and corrected internship report (with the help of internship guide/industry mentors) of a self-created work to a peer audience.

Course Articulation Matrix

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

1–Slightly; 2–Moderately; 3-Substantially

Internship Guidelines

1. An internship plan has to be prepared by the interns incorporating the job description/internship duties, name of the project, if any and internship schedule and expected learning outcomes in consultation with industry supervisor/mentor and institute faculty.
2. A detailed training report in the prescribed format shall be submitted at the end of the internship.
3. Training Certificate from the industry for the prescribed period shall be submitted at the end of the internship.
4. The work shall be reviewed and evaluated periodically.
5. Orientation of interns, resource requirement of interns, monitoring of interns progress on a daily basis shall be carried out by the industry offering internship in addition to ensuring safety and welfare of the interns.

A committee consisting of the Internship Coordinator (nominated by the Head of the Department/Division), faculty mentor, and at least one senior faculty member at the level of Associate Professor or above will carry out the final review.

	Guidelines for evaluation	Marks
1.	Regularity and progress of work	20
2.	Work knowledge and Involvement	50
3.	Semester End presentation and oral examination	50
4.	Level of completion and demonstration of Functionality / Specifications	50
5.	Project Report – Presentation style and content	30
	Total	200