Academic Program: UG

Academic Year 2023-24

Syllabus

V & VI Semester B.E.

Civil Engineering

SHRI DHARMASTHALA MANJUNATHESHWARA COLLEGE OF ENGINEERING & TECHNOLOGY,

DHARWAD – 580 002

(An Autonomous Institution approved by AICTE & Affiliated to VTU, Belagavi)

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SDM College of Engineering & Technology, Dharwad

It is certified that the scheme and syllabus for V & VI semester of UG program in Civil Engineering is recommended by Board of Studies of Civil Engineering Department and approved by the Academic Council, SDM College of Engineering & Technology, Dharwad. This scheme and syllabus will be in force from the academic year 2023-24 till further revision.

Principal Chairman BoS & HoD

SDM COLLEGE OF ENGINEERING & TECHNOLOGY, DHARWAD

Vision and Mission of the Institute

Vision

To develop competent professionals with human values.

Mission

- To have contextually relevant Curricula.
- To promote effective Teaching Learning Practices supported by Modern Educational Tools and Techniques.
- To enhance Research Culture.
- To involve the Industrial Expertise for connecting Classroom contents to real-life situations.
- To inculcate Ethics and soft-skills leading to overall personality development.

DEPARTMENT OF CIVIL ENGINEERING

Vision and Mission

Vision:

To be the center of excellence providing the state of art civil engineering education developing competent engineers responsible for serving the society.

Mission:

The stated vision can be achieved through:

- The development of robust curricula to meet industrial expectations.
- Interactive teaching-learning process with modern educational tools and soft skills.
- Establishing synergy between teaching and research with ethical values
- Industry-Institute interaction.

Program Educational Objectives (PEOs)

I. Technical adeptness: The Civil Engineering Graduates will be technically adept to specific fields and other disciplines. Management towards Planning, Design, and Costing. Their technical skills and knowledge will enable them to perform their work with a commitment and quality, timeliness with continuous improvement.

II. Interpersonal Skills: Civil Engineering Graduates will exhibit effective interpersonal skills in teams and at workplace.

III. Awareness of Social impact: Graduates will be made aware of causes of impacts due to the development and to identify remedial measures if necessary.

IV. Professionalism: Understanding of professionalism, ethics, quality performance, sustainability and allow them to be professional leaders and contributors to society through their problem-solving capabilities and executing the work.

V. Continuous Learning: Civil Engineering Graduates will exhibit interest in lifelong learning including studies leading to professional licensure or higher studies in engineering that provides for continued development of their technical ability and management skills

Program Outcomes (POs)

Engineering Graduates will be able to:

PO1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

PO2. **Problem analysis**: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.

PO3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety and the cultural, societal, and environmental considerations.

PO4. **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.

PO5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7. **Environment and sustainability**: Understand the impact of professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. **Ethics**: Apply ethical principles and commit to professional ethics and

responsibilities and norms of engineering practice.

PO9.**Individual and teamwork**: Function effectively as an individual, and as a member or leader in diverse teams, and in multi-disciplinary settings.

PO10.**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11.**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply the set one's own work, as a member and leader in a team, to manage projects and in multi-disciplinary environments.

PO12.**Lifelong learning**: Recognize the need for and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

PSO13.**Project inception and design**: Conceptualize projects related to different fields of Civil Engineering, collect relevant data by direct and indirect methods, analyze the project requirement and design the project.

PSO14.**Draft specification**: Select material, prepare estimates/costing, schedule work plans.

PSO15.**Experimentation**: Apply knowledge of different fields of Civil Engineering, conduct experiments, analyze, interpret data, and design the system components.

SDM COLLEGE OF ENGINEERING AND TECHNOLOGY DHARWAD

Department of Civil Engineering

Fifth Semester

Scheme of Teaching and Examinations 2023-24

Course Code	Course Category	Course Title	Teaching		Examination				
			L-T-P (Hrs/Week)	Credits	CIE	Theory (SEE)		Practical (SEE)	
					Max. Marks	*Max. Marks	Duration in Hrs.	Max. Marks	Duration in Hrs.
21UHUC510	HU	Management, Entrepreneurship and IPR	3 - 0 - 0	3	50	100	3	--	--
21UCVC500	PC	Structural Analysis-II	3 - 0 - 0	3	50	100	3	--	--
21UCVC501	PC	Design of RC Structural Elements	3 - 0 - 0	3	50	100	3	--	--
21UCVC502	PC	Geotechnical Engineering – I	3 - 0 - 0	3	50	100	3	--	--
21UCVE5XX	PE	Program Elective - 1	3 - 0 - 0	3	50	100	3	--	--
21UCVL504	PC	Computer Aided Design Laboratory	0 - 0 - 2	1	50	--	--	50	3
21UCVL505	PC	Concrete and highway Laboratory	0 - 0 -2	1	50	--	--	50	3
21UAEE510	AE	Hydrology	2 - 0 – 0	2	50	50	2	--	--
21UCVL506	PC	Minor Project-1	0 - 0 -2	1	50	--	--	--	--
21UHUL507	HU	Internship – 1	Minimum 2 weeks	1	50	--	--	--	--
Total			**17- 0 - 6**	**21**	**500**	**550**		**100**	

HU- Humanities, PE-Program Elective, PC- Program Core

List of Program Elective - 1

Course Code	Course Title
21UCVE515	Design of Masonry Structures
21UCVE516	Harbour, Dock & Tunnel Engineering
21UCVE517	Railway and Airport Engineering
21UCVE518	Watershed Management

SDM COLLEGE OF ENGINEERING AND TECHNOLOGY DHARWAD

Department of Civil Engineering

Sixth Semester

Scheme of Teaching and Examinations 2023-24

Course Code	Course Category	Course Title	Teaching		Examination				
			L-T-P (Hrs/Week)	Credits	CIE	Theory (SEE)		Practical (SEE)	
					Max. Marks	*Max. Marks	Duration in Hrs.	Max. Marks	Duration In Hrs.
21UCVC600	PC	Quantity Surveying and Estimation	3 - 0 - 0	3	50	100	3	-	-
21UCVC601	PC	Geotechnical Engineering - II	3 - 0 - 0	3	50	100	3	-	-
21UCVC602	PC	Design of steel structure – I	3 – 0 – 0	3	50	100	3	-	-
21UCVE6XX	PE	Program elective - 2	3 - 0 - 0	3	50	100	3	-	-
21UCVE6XX	PE	Program elective - 3	3 - 0 - 0	3	50	100	3	-	-
21UCVO6XX	OE	Open Elective 1	3 - 0 - 0	3	50	100	3	--	--
21UCVL603	PC	Geotechnical Engineering Laboratory	0 - 0 - 2	1	50	--	--	50	3
21UCVL604	PC	Software Laboratory	0 - 0 - 2	1	50	--	--	50	3
21UCVL605	PC	Minor Project 2 (Extensive Survey project)	0 - 0 - 2	1	50	--	--	50	3
21UHUL606	HU	Soft skills and Aptitude	0 - 0 -2	1	50	--	--	--	--
Total			**18 - 0 - 8**	**22**	**500**	**600**		**150**	

PC- Program Core, PE-Program Elective, HU- Humanities

List of Program Electives

Course Code	Course Title
21UCVE615	Matrix Method of Structural Analysis
21UCVE616	Design of Special RC Structures
21UCVE617	Open channel Hydraulics
21UCVE618	Advanced Concrete Technology
21UCVE619	Advanced Surveying
21UCVE620	Alternative Building Materials

List of Open Elective (For all branches)

Course Code	Course Title
21UCVO601	Traffic Engineering

21UHUC510	Management, Entrepreneurship & Intellectual Property Rights	(3-0-0) 3

Contact Hours:39

Course Learning Objective (CLOs): Management, Entrepreneurship & Protection of Intellectual Property is taught as one of the core subjects in Civil Engineering program. In this course, topics on Management, Planning, Organizing, Staffing, Directing and Controlling, SSI, Government/ Institutional support and Project Formulation, Copyright, Patent, Trademark and Industrial Design and their protection through the intellectual property laws are dealt.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs (1-12)/ PSOs (13-15)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Define and explain the management and concepts of planning, forecasting and decision making.		11	
CO-2	Define and explain the concepts of organizing, staffing, motivating and controlling.		9,11	
CO-3	Define and explain the concepts of entrepreneurship and the small-scale industries (SSI).		6,8,11	
CO-4	Explain the Government and institutional support to SSI, formulate a project report by identifying the business opportunities.		11	
CO-5	Define and explain the different forms of intellectual properties viz. copy right, patent, trademark and industrial design.		6,8	

POs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Mapping Level						2		2	2		2				

Contents:

Unit–I

Introduction to Management: Definition, functions of Management.

Planning, Forecasting and Decision Making: Nature of Planning, Planning concepts, Forecasting, Decision making, Tools for decision making. **8 Hrs.**

Unit–II

Organizing and staffing: Nature of organizing, Concepts of Organization, Technical and Modern organization structures, Staffing process in technical organizations, Authority and Power; Delegation, Meeting & Committees.

Motivating and Controlling: Motivation, Process of Motivation, Motivational theories, Leadership and styles, Process of control, Requirements of Effective control system. **8 Hrs.**

Unit–III

Foundations of Entrepreneurship: Meaning of entrepreneur, Functions of entrepreneur, Types of entrepreneur, Concept of entrepreneurship, Role of entrepreneurs in economic development, Barriers of entrepreneurship.

Small Scale Industry (SSI): Definition, Characteristics, Objectives, Role of SSI in economic development, Advantages of SSI, Steps to start SSI, Definition of Ancillary and Tiny industry. **7 Hrs.**

Unit–IV

Government and Institutional Support: Government and Institutional support to SSI, Objectives and functions of MSME Development Institute, SIDBI, DIC, Single window agency, KIADB, KSSIDC, KSFC.

Preparation of Project: Meaning of project, Importance of project report, Contents of a standard project, Identification of business opportunities, Feasibility studies, Types and purpose. **7 Hrs.**

Unit–V

Introduction: Meaning and forms of intellectual property right, World court.

Copyright and Patent: Meaning and content of copyright, Ownership and rights, Period of copyright, Assignment and relinquishment of copyright, License, Infringement of copy right, Offenses and penalties, Fair use. Concept of patent, Patentable and non-patentable inventions, Procedure for obtaining patent, Rights and obligations of patent holder, Infringements, Remedies, Offenses and penalties.

Industrial Design and Trademark: Concept and significance of Industrial Design and Trademark. **9 Hrs.**

Reference Books:

1) Naidu N.V.R. and T. Krishna Rao, “Management and Entrepreneurship”, I.K. International Publishing House, Bangalore. 1st Edition, 2009.
2) Babcock Daniel L., “Managing Engineering and Technology”, PHI. 6th Edition, 2014.
3) Drucker Peter, “The Practice of Management”, Harper Business. Latest Edition,

2006.
4) Acharya N.K., "Textbook on Intellectual Property Rights", Asia Law House. 4th Edition, 2007.

21UCVC500	Structural Analysis-II	(3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs): Structural Analysis-II is taught as a core course in Civil Engineering program. In this course, topics on redundant trusses, Moment Distribution Method, Slope Deflection Method, Analysis of multi-storey frames, Matrix Methods are dealt.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1-12)/ PSOs (13-15)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Analyze statically indeterminate structures by strain energy method.	1,2		
CO-2	Analyze redundant trusses with lack of fit and temperature stresses.	1,2		
CO-3	Analyze statically indeterminate beams, rigid plane frames by slope deflection method and moment distribution method.	1,2		
CO-4	Analyze statically indeterminate beams, rigid plane frames by rotation contribution method.	1,2		
CO-5	Analyze statically determinate beams, rigid plane frames by matrix method.	1,2		

POs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Mapping Level	3	3													

Contents:

Unit - I

Redundant Trusses: Introduction, analysis of statically indeterminate structures using strain energy method, analysis of trusses (Redundant up to second degree), lack of fit in member of indeterminate trusses, temperature stress in redundant trusses. **8Hrs.**

Unit - II

Moment Distribution Method: Non-sway and sway analysis for continuous beams

and frames. **8 Hrs.**

Unit - III

Slope Deflection Method: Introduction, sign convention, deflection equations, analysis of continuous beams and frames. **8 Hrs.**

Unit - IV

Flexibility Matrix Method: Introduction, analysis of beams and frame by flexibility matrix method. **8 Hrs.**

Unit - V

Stiffness Matrix Method: Introduction, analysis of beams and frames by Stiffness matrix method. **7 Hrs.**

Reference Books:

1) Ramamruthum and R Narayan, “Theory of structures”, published by Dhanpat Rai Publishing company, 9th Edition, 2014.
2) S S Bhavikatti “Structural analysis vol 1 and 2 “, published by Vikas publishing House pvt.ltd, 5th edition, 2021.
3) R vaidyanathan and P Perumal,” Structural analysis vol 2 and 3”, published by Laxmi Publications, 3rd edition, 2016
4) A Ghali and A M Naville and T G Brown, “Structural analysis –a unified classical matrix approach” published by Taylor and Francis ltd, 6th edition, 2009.

21UCVC501	**Design of RC Structural Elements**	**(3-0-0) 3**

Contact Hours: 39

Course Learning Objectives (CLOs): Design of reinforced concrete structures is taught as a core course in Civil Engineering program. In this course, introduction to Working Stress Method and Limit State Method of design for design of beams, slabs, columns, footings, staircases are dealt with.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1-12)/ PSOs (13-15)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Explain working stress method and limit state method.		1	
CO-2	Design and detail different types of beams for different support conditions.	1,3	2	6,8
CO-3	Design and detail different types of slabs.	1,3	2	6,8
CO-4	Design and detail columns and	1,3	2	6,8

	footings.			
CO-5	Design different types of staircases.	1,3	2	6,8

POs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Mapping Level	2.8	2	3			1		1							

Contents:

Unit - I

General features of Reinforced Concrete: Introduction, design loads, materials for reinforced concrete, code requirements of reinforcements, elastic theory of RC sections, moment of resistance of section, balanced, under reinforced and over reinforced sections.

Principles of Limit State Design and Ultimate Strength of RC Section: Philosophy of limit state design, principles of limit states, factor of safety, characteristic and design loads, characteristic and design strength, Analysis of sections for flexure and shear. **9 Hrs.**

Unit - II

Design of Beams: Practical requirements of an RCC beam, designing and detailing of singly reinforced, doubly reinforced and flanged beams. **8 Hrs.**

Unit - III

Design of Slabs: Introduction, general consideration of designing and detailing of slabs, spanning in one direction, spanning in two directions for various boundary conditions and for different support conditions. **7 Hrs.**

Unit - IV

Design of Columns: General aspects, effective length, loads on columns, slenderness limits for columns, minimum eccentricity, design of short axially loaded columns. **3 Hrs.**

Design of Footings: Introduction, loads on foundation, design of isolated footings subjected to axial load. **5 Hrs.**

Unit - V

Design of Staircase: General features, types of staircase, loads on staircases, effective span as per IS code provisions, distribution of loading on stairs, design of staircases. Straight, dog legged and open well stairs. **7 Hrs.**

Reference Books:

1) IS 456-2000 “Plain and Reinforced Concrete Code of Practice”.
2) SP16 - 1980 “Design Aids for Reinforced Concrete”
3) Pillai and Menon, “Reinforced Concrete Design”, McGraw-Hill, 4th Edition, 2021.
4) Varghese P.C., “Limit State Design of Reinforced Concrete”, Prentice Hall of India, New Delhi, 2nd Edition, 2008.
5) Karve S R. and Shah V.L., “Limit state theory and design of reinforced

concrete", Vidyarthi Prakashan, Pune, 8th edition.
6) Jain A.K., "Limit state method of design," Nemichand and Bros, Roorkee. 7th Edition, 2012.
7) Krishnaraju N., "Reinforced concrete design", New Age Publication. 4th Edition, 2019.

21UCVC502 Geotechnical Engineering – I (3-0-0) 3

Contact Hours: 39

Course Learning Objective (CLOs): Geotechnical Engineering – I is taught as one of core subject for Civil engineering program. It consists of various engineering properties of soil and the principles of soil mechanics are imparted to the students. Topics covered include the index properties of soil, soil classification, flow of water through soils, compaction/ consolidation of soils and shear strength of soil along with numerical problems.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1-12)/ PSOs (13-15)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Explain the soil formation, phase diagram, derive inter relations, identify soils in the field, explain various index properties of soil.		4	1, 2
CO-2	Explain soil classification, compute the permeability of soils, explain the laboratory methods for determination of permeability, explain seepage / superficial velocity and the quicksand phenomenon.	4		1,2
CO-3	Describe the compaction of soils, Explain the laboratory methods for determining the compaction parameters, explain the field compaction control.	4	2	1
CO-4	Explain the consolidation and its characteristics of soils.		2, 4	1
CO-5	Explain the shear strength of soil, Mohr Coulomb strength theory, explain various laboratory shear tests.		2, 4	1

POs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Mapping Level	1	1.6		2.4											

Contents:

Unit - I

Introduction: Origin and formation of soil, phase diagram, inter relations of soil properties, field identification of soils.

Index Properties of Soils: Definition and importance of Index properties of soils, viz., specific gravity, water content, particle size distribution, consistency limits and indices, in situ density, and density index etc. Determination of specific gravity, particle size distribution and consistency limits. **8Hrs.**

Unit - II

Classification of Soils: Particle size classification, MIT classification, textural classification, unified soil classification and IS classification, plasticity chart and its importance.

Permeability: Darcy's law, assumptions and validity; coefficient of permeability and its determination in laboratory, Factors affecting permeability, Permeability of stratified soils, Seepage velocity, Superficial velocity and coefficient of percolation, quicksand phenomenon, Capillary phenomenon. **8Hrs.**

Unit - III

Compaction of Soils: Definition, standard and modified Proctor's compaction tests, factors affecting compaction, effect of compaction on soil properties, field compaction methods, rollers and vibrators, field compaction control, Procter's needle **8Hrs.**

Unit - IV

Consolidation of soils: Definition, mass-spring analogy, Terzaghi's one dimensional consolidation theory, assumptions, and limitations, normally consolidated, under consolidated and over consolidated soils, pre-consolidation pressure and its determination by Casagrande's method, consolidation characteristics of soil viz., co-efficient of consolidation, co-efficient of volume change, co-efficient of compressibility, compression index. Foundation Settlement, ill effects of settlement of soil on buildings, immediate, primary, and secondary settlements. **8Hrs.**

Unit - V

Shear Strength of Soil: Concept of shear strength, Mohr's strength theory, Mohr Coulomb theory, measurement of shear parameters, direct shear test, unconfined compression test, triaxial compression test and vane shear test, Factors affecting shear strength of soils. **7Hrs.**

Reference Books:

1) B. C. Punmia, "Soil Mechanics and Foundations", 17th edition, 2017, Laxmi Publications (P) Ltd., New Delhi.
2) Gopal Ranjan and A.S.R Rao., "Basic and applied soil mechanics", 4th edition, 2022, New Age International Publishers, Bangalore.
3) Narasimha Rao A.V. and Venkatramaiah C., "Geotechnical Engineering", 2nd edition, 2007, University Press (India) Ltd., Hyderabad.
4) IS 1498: 2002, "Classification and identification of soils for general engineering purposes".

21UCVL504	Computer Aided Design Laboratory	(0-0-2) 1

Contact Hours: 26

Course Learning Objectives (CLOs): Computer Aided Design Laboratory deals with application of computers in solving Civil Engineering related problems. In this course, topics on spread sheets for Civil Engineering problems, C- Programming for analysis and design of beams are dealt. The evaluation will be carried out through continuous evaluation & Semester End practical examination.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1-12)/ PSOs (13-15)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Develop spread sheets for: design of horizontal and vertical alignment, computation of earthwork volume and calibration of notches & weirs.	**3**	**5**	**1**
CO-2	Develop C programs for calculation and drawing of BM and SF diagrams for beams.	**3**	**5**	**1**
CO-3	Use Civil Engineering software.	**3**	**5**	**1**

POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Mapping Level	1		3		2										

Contents:

1) Spread sheet for design of horizontal and vertical alignment, computation of earthwork, calibration of notches and weirs, problems on mechanics of materials.
2) Design RC beam using C programming.

21UCVL505	Concrete & Highway Laboratory	(0-0-2) 1

Contact Hours: 26

Course learning objectives (CLOs): In this course, characteristics of cement, strength of aggregate, shape tests on aggregate, strength parameters of concrete, properties of bitumen are dealt.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1-12)/ PSOs (13-15)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Perform tests on cement and coarse aggregate.		15	9
CO-2	Perform tests on fresh and hardened concrete.	3	15	9
CO-3	Perform tests on bitumen.		15	9

POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Mapping Level			3						1						2

Contents:

1. **Cement:** Determination of grade of Cement.
2. **Aggregates:** Abrasion**,** Impact, crushing strength, shape tests - Flakiness & Elongation.
3. **Fresh concrete:** Concrete Mix design, workability - slump, compaction factor and Vee-Bee test.
4. **Hardened concrete:** Compressive strength and NDT.
5. **Bituminous materials and mixes:** Specific Gravity, Penetration, Ductility, Softening point, Flash and fire point, Viscosity. Marshall Stability tests, bitumen extraction. Sub grade Soil CBR Test.

Reference Books:

1) Gambhir. M.L., “Concrete Manual”, Dhanpat Rai & sons New Delhi. 5th Edition, 2017.
2) Relevant IS Codes and IRC Codes.

21UAEE510	Hydrology	(2-0-0)2

Contact Hours: 26

Course Learning Objective (CLOs): Hydrology is taught as a core course for Civil Engineering Program. In this course, topics on precipitation, losses, runoff, stream flow measurement and ground water hydrology are dealt.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs (1-12)/ PSOs (13-15)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Summarize the importance of hydrology, water availability, Explain Horton's hydrological cycle, types of precipitation and estimation.	1		
CO-2	Calculate different losses such as evaporation, infiltration and runoff.		1,2	
CO-3	Analyze and draw different hydrographs.		1,2	
CO-4	Explain different methods of stream flow measurement.		1	
CO-5	Understand ground water hydrology.		1,2	

POs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Mapping Level	2.2	2													

Contents:

Unit - I

Introduction: Definition of hydrology, importance of hydrology, global water availability, India's water availability, practical applications of hydrology, hydrology cycle (Horton's) qualitative and engineering representations.

Precipitation: Definition, types of precipitation, measurement of rain fall using Symon's and Syphon type of rain gauges, optimum number of rain gauge stations, consistency of rainfall data (double mass curve method), computation of mean rainfall, estimation of missing data, presentation of precipitation data, mass curve, rainfall hyetographs, intensity duration frequency curves. **5 Hrs.**

Unit - II

Losses: Introduction, evaporation process, factors affecting evaporation, measurement using IS class-A Pan, estimation using empirical formulae, Infiltration, factors affecting infiltration capacity, double ring infiltrometer, Horton's infiltration equation, infiltration indices.

Runoff: Definition, concept of catchment, geomorphology of catchment, water budget equation, components, factors affecting runoff, rainfall - runoff relationship using regression analysis. **5 Hrs.**

Unit - III

Theory of Hydrographs: Definition, components of hydrograph, base flow separation, unit hydrograph and its derivation from simple storm hydrographs, S-curve and its computations. **6 Hrs.**

Unit - IV

Stream Flow Measurement: Introduction, measurement of stage, measurement of discharge by Area – Velocity method, stage discharge, introduction to moving boat only, simple stage discharge relation. **5 Hrs.**

Unit - V

Ground Water Hydrology and Well Hydraulics: Scope and importance of ground water hydrology, occurrence of ground water. Definitions: Aquifers, aquitard, aquifuge, aquiclude, perched aquifer. Aquifer parameters. **5 Hrs.**

Reference Books:

1. Jayarami Reddy, “A Textbook of Hydrology”, Lakshmi Publications, New Delhi.: 3rd Edition, 2011.
2. H. M. Raghunath, “Hydrology”, New Age International Private Limited, New Delhi. 4th edition, 2022.
3. Ven Te Chow, “Applied Hydrology”, Tata McGraw Hill Publishers, New Delhi. 1st Edition, 2017.
4. K. Subramanya, “Engineering Hydrology”, Tata McGraw Hill Publishers, New Delhi.David K. Todd and Larry W. Mays, “Ground Water Hydrology”, Wiley Publications. 5th Edition, 2020.

21UCVL506	Minor Project–1	(0-0-2) 1

Contact Hours:26

Course Learning Objective (CLOs): Minor Project–1 is carried out under the guidance of a faculty. In this course, the students will finalize the project title, collect the data required by indirect and direct methods and carry out literature review and formulate the methodology.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1-12)/ PSOs (13-15)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Identify the project area.	13	1	9,12
CO-2	Collect data by direct and indirect methods.	2	13	9,12
CO-3	Collect required literature survey and organize them.	1		9,12
CO-4	Define the problem definition from research gap and formulate the methodology.	2		9,12
CO-5	Interpret the test data/ results, draw conclusions and suggest strategies.	15	5	9,12

POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Mapping Level	2.5	3			2				1			1	2.5		3

Contents:

Domain-related problems, technical solutions, and recommendations.

Evaluation:

The team consisting of 10-12 students shall be asked to identify the problems related to the community and try to propose a solution. The faculty members handling the courses for that semester shall guide the students. A committee consisting of a minimum of 3 faculty members shall evaluate at the end for CIE. There is no SEE for Minor project 1.

21UHUL507	Internship - 1	(0-0-2) 1

Duration: 2 Weeks

Course Learning Objective (CLOs): Internship 1 is carried out in a construction company/ organization/ Civil Engineering Department of State or Central Governments. Students during their vacation at the end of their IV semester, will approach a construction company/ organization/ industry/ Relevant Government

Departments/ PSUs and will undergo internship. During this process, they understand the functioning of a construction company. The students should visit construction sites and understand drawings and construction procedures. They present the study in the form of an internship report under guidance of the faculty member during their V semester.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1-12)/ PSOs (13-15)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Identify and define the problem.	13	1	9,12
CO-2	Will collect data by direct and indirect methods.	2	13	9,12
CO-3	Collect required literature survey and organize them.	1		9,12
CO-4	Formulate the methodology	2	2	9,12
CO-5	Conduct required experiment.		15	9,12
CO-6	Interpret the data/ results, draw conclusions and suggest strategies.	15	5	9,12

POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Mapping Level	2.5	2.66							1			1	2.5		2.5

Electives

21UCVE515	**Design of Masonry Structures**	**(3-0-0)3**

Contact Hours: 39

Course Learning Objective (CLOs): Design of Masonry Structures is taught as one of elective subjects for civil engineering program. In this course, types of materials, masonry units, masonry construction, strength and stability of masonry construction, permissible stresses, design of masonry construction and gravity retaining walls are dealt with.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1-12)/ PSOs (13-15)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Summarize engineering properties and uses of masonry units. Explain masonry construction strength and stability. Identify defects and	1		

	crack in masonry and its remedial measures.			
CO-2	Explain permissible stresses in masonry construction, calculate slenderness ratio of columns and walls and load distribution on lintels and arches.	1		
CO-3	Design free standing walls and walls subjected to axial/eccentric load with and without openings	1,3	4	
CO-4	Design solid and cavity walls subjected to concentrated axial load as per IS: 1905.	1,3	4	
CO-5	Design walls subjected to eccentric loads with and without openings.	1,3	4	

POs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Mapping Level	3		3	2											

Contents:

Unit - I

Masonry Units, Materials and Masonry Construction: Brick, stone and block masonry unit, strength, modulus of elasticity, water absorption, masonry materials, classification and properties of mortars, selection of mortars. Defects and errors in masonry construction, cracks in masonry, types, reasons for cracking, methods of avoiding cracks.

Strength and Stability: Concentrically loaded masonry walls, effect of unit strength, mortar strength, joint thickness, rate of absorption, effect of curing, effect of ageing, workmanship, strength formulae and mechanism of failure for masonry subjected to direct compression. **10Hrs.**

Unit - II

Permissible Stresses: Permissible compressive stress, reduction and shape reduction factors, increase in permissible stresses for eccentric vertical and lateral loads, permissible tensile, shear stresses.

Design Considerations: Effective height of walls and columns, opening in walls, effective length, effective thickness, slenderness ratio, eccentricity, load dispersion, arching action in lintels. **7Hrs.**

Unit - III

Design of Structural Masonry: Wall carrying axial load, eccentric load with different eccentricity ratios, walls with openings, free standing wall, design of load bearing masonry for building up to 2 storeys using IS: 1905 and SP: 20 procedures. **7Hrs.**

Unit - IV

Design of walls subjected to concentrated axial loads: Solid walls, cavity walls, solid wall supported at the ends by cross wall, walls with piers, design of wall with openings. **8Hrs.**

Unit - V

Design of walls subjected to eccentric loads: Design criteria – stress distribution under eccentric loads – problems on eccentrically loaded solid walls, cavity walls, walls with piers. **7Hrs.**

Reference Books:

1) Hendy A W., - "Structural Masonry", Macmillan Education Ltd. 2nd Edition, 1998.
2) Dayaratnam P., "Brick and Reinforced Brick Structures", Oxford & IBH. 2nd Edition, 2017.
3) Sinha B. P.,Davies S R., "Design of masonry structures" E&FN spon. 3rd Edition, 2004.
4) IS Codes: IS 1905-1987, "Code of practice for structural use of un-reinforced masonry.

21UCVE516 Harbour, Dock, and Tunnel Engineering (3-0-0)3

Contact Hours: 39

Course Learning Objectives (CLOs): Harbour, Dock and Tunnel Engineering is taught as one of the elective courses in Civil Engineering program. In this course, harbour layout, natural phenomena viz. winds, waves and tides, Harbour components viz. Breakwaters, Approach Channel, Wharves, Jetties, Quays, Warehouses, Wet and Dry Docks, Navigational Aids viz. Light House, Buoys, Beacons, Sound Signals and Tunnel Surveys, Soft Soil Tunneling methods, Tunneling in Rock, Explosives for Rock Tunneling, Tunnel Lining, Tunnel Ventilation are dealt.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1-12)/ PSOs (13-15)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Define components of harbours and natural phenomena.		2	1
CO-2	Classify and describe types of harbours and docks.		2	1
CO-3	Classify and characterize signals		2	1

	and navigational aids.			
CO-4	Define, classify and describe components of tunnels and methods of tunneling in rock.		2	1,6
CO-5	Describe and discuss modern tunneling, mucking, ventilation and drainage methods.		2	1,6

POs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Mapping Level	1	2				1									

Contents:

Unit - I

Harbours: Definition of Harbour, classification of Harbours (with sketches), general design features, definition of various terminology. Natural forces on Harbours, winds, waves, tides, currents, effects of each on the Harbour structures. **7Hrs.**

Unit - II

Harbour structures and docks: Breakwaters, quays and jetties (with sketches). Types (sketches), differences of Harbours and Docks, construction details of dry docks, wet docks-operation, self-docking docks. **8 Hrs.**

Unit - III

Signals: Bouys and Bouyage systems, Light house purpose, construction details, sound signals. **7 Hrs.**

Unit - IV

Tunnels: Definition, components, advantages and disadvantages, Cross sections of tunnels for various purposes (with sketches). Tunnel surveying, transfer of level and grade on surface survey, equipment used, methods of Rock tunneling, drilling patterns, explosives, blasting. **9 Hrs.**

Unit - V

Modern Tunneling methods: Shield tunneling, lining of tunnels, tunnel ventilation and drainage. **8 Hrs.**

Reference Books:

1) Srinivasan R., “Harbours Docks and Tunnel Engineering”, Charotar Publishing House Pvt. Ltd. 30th Revised and Enlarged Edition, 2022.
2) Oza and Oza, “Harbours and Docks”, Charotar Publishing House Pvt. Ltd. 17th Edition.

21UCVE517	Railway and Airport Engineering	(3-0-0)3

Contact Hours: 39

Course Learning Objectives (CLOs): Railway and Airport Engineering is taught as one of the elective courses for Civil Engineering program. In this course, salient features of permanent way, geometric design of railway, design of turnout are dealt. Further, aspects related to airport planning, design of runway and taxiway are taught.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1-12)/ PSOs (13-15)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Explain the importance of rail transport, qualities of ideal permanent way and calculate the quantity of materials to lay railway track.			1,2
CO-2	Design the geometrical elements of railway track.		1,2	
CO-3	Design turnouts, points and crossings and state types of stations, yards and signal systems.			1,2
CO-4	Identify the ideal site for airport construction and design the geometrical elements of runway.		1,2	
CO-5	Design the geometrical element of taxiway and illustrate the various Airport Markings.		1,2	

POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Mapping Level	1.6	1.6													

Contents:

Unit - I

Introduction: Role of railways in transportation, selection of routes.

Permanent way: Gauges in railways, railway track, cross sections, coning of wheels, rails, rail sections, ballast, sleepers, wear on rails, rail joints, welding of rails, creep of rails, rail fixtures, calculation of quantity of materials required for laying of tracks, traction and tractive resistances, tractive power, hauling capacity. Problems on above. **9 Hrs.**

Unit - II

Geometric design of track: grade, ruling gradient, minimum gradient, pusher grade, speed of train, super elevation, cant deficiency, negative cant, speed calculation based on IR formulae for high speed tracks only. Problems on above. **7 Hrs.**

Unit - III

Points and Crossing: turnout, design of turnout, stations, and yards, signaling and interlocking, track defects, track maintenance, level crossing, Indian Railway standards and relevant problems. **7 Hrs.**

Unit - IV

Airport planning: Characteristics of aircraft, Airport- classifications and site selection, regional planning .

Runway design: Analysis of wind data, determination of the best orientation of the runway configurations, basic length of the runway, corrections to runway length by ICAO and FAA specification, runway cross sections. Windrose type I & II diagrams. Problems on above. **9 Hrs.**

Unit - V

Taxiway design: Taxiway-Factors affecting the layout of the taxiway, geometrics of taxiway, design of exit taxiways.

Visual aids: Airport Marking**,** Lightings, ILS. **7 Hrs.**

Reference Books:

1. Saxena S.C and Arora S. P., "Railway Engineering", Dhanpat Rai Publications, New Delhi,2018.
2. Agarwal M.M., "Indian Railway Track", Prabha& Co., New Delhi, 20th Revised Edition, 2018.
3. Khanna S.K., AroraM.G and Jain S.S, "Airport Planning and Design", Nemchand Roorkee, Sixth Edition, 2012.
4. Mundrey J. S.**, "**Railway Track Engineering", Tata McGraw Hill Publications, New Delhi. Fourth Edition, 2017.
5. Horenjeff, "Planning and Design of Airports", McGraw Hill Publications, New Delhi, Fourth Edition, 2010.

21UCVE518	Watershed Management	(3-0-0)3

Contact Hours: 39

Course Learning Objective (CLOs): Watershed Management is taught as one of the elective courses in Civil Engineering program. In this course, topics like the concept of watershed management, water demand, water conservation methods, water harvesting, sustainable watershed approach, coastal watersheds, application of Remote Sensing and GIS in watershed management etc. are dealt.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs (1-12)/ PSOs (13-15)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Discuss surface and ground water resources system and, human influences.		1,13	
CO-2	Integrate water resources system in arid and semi-arid regions and explain watershed aquifer for management.		2	13
CO-3	Analyze water resources related issues for conservation and synthesize augmentation of water resources.		3,13	6
CO-4	Design integrated watershed management system.		7,15	
CO-5	Apply modern tools in watershed management.		5	

POs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Mapping Level	2	2	2		2	1	2						1.67		2

Contents:

Unit - I

Principles of Watershed Management: Basics concepts, hydrology and water availability, surface water, ground water, conjunctive use, human influences in the water resources system. **6 Hrs.**

Unit - II

Water resources systems: Integrated water resources system, river basins, watershed management practices in arid and semi-arid regions, watershed management through wells, management of water supply, case studies, short term and long-term strategic planning. **7 Hrs.**

Unit - III

Conservation of Water: Perspective on recycle and reuse, wastewater reclamation, social aspects of watershed management, community participation, private sector participation, institutional issues, socio-economy, integrated development, water legislation and implementations, case studies.

Water Harvesting: Rainwater management, conservation, storage and effective

utilization of rainwater, structures for rainwater harvesting, roof catchments system, check dams, aquifer storage. **11 Hrs.**

Unit - IV

Sustainable Watershed Approach: Sustainable integrated watershed management, natural resources management, agricultural practices, integrated farming, soil erosion and conservation. **6 Hrs.**

Unit - V

Applications of RS and GIS in Watershed management: Role of decision support system in watershed management, watershed characteristics of coastal regions, coastal aquifer tor management, uniqueness of coastal water resources. **9 Hrs.**

References Books:

1. Singh Vir, Raj., "Watershed Planning and Management", Yash Publishing House, Bikaner.3rd Revised Edition, 2016.
2. Murthy, J. V. S., "Watershed Management in India", New Age Publishers, New Delhi. 2nd Edition, 2017.
3. "Decision Support System for Integrated Watershed Management", Colorad State University. 2012.
4. Tideman, E. M., "Watershed Management", Omega Scientific Publishers, New Delhi, 2002.
5. Madan Mohan Das and Mimi Das Saikia, "Watershed Management", Prentice Hall India Learning Private Limited, Eastern Economy Edition, 2012.

6th Semester

21UCVC600	Quantity Surveying and Estimation	(3-0-0) 3

Contact Hours: 39

Course Learning Objective (CLOs): Quantity Surveying and estimation is taught as core course in Civil Engineering program. In this course, estimate and types, method of taking out quantities of various items of works for buildings, RCC slab, septic tank, brief and detailed specifications and rate analysis for items of works etc are dealt.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1-12)/ PSOs (13-15)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level(1)**
CO-1	Explain different types of estimates, units of measurement, sizes and dimensions of various works.	1		
CO-2	Calculate the quantities of various items of works.	1		
CO-3	Calculate the quantities of small civil works - Septic tanks.	1		
CO-4	Evaluate rates for the standard items of works for buildings.	1		6,7
CO-5	Explain brief and detailed specifications for various items of works for building.	14		6,7

POs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Mapping Level	3					2	1		1			1		3	

Contents:

Unit - I

Introduction to building Estimate: Importance of preparing estimates, Procedure & types of estimates, units of measurement, sizes and dimensions of various works. **8 Hrs.**

Unit - II

Estimation of buildings: Methods of taking out quantities by center line method and / or long wall and short wall method for load bearing buildings with flat RCC roofs. **8 Hrs.**

Unit - III

Estimation of minor civil works: Methods of taking out quantities for Septic tank and its types. **7 Hrs.**

Unit - IV

Rate Analysis: Definition and purpose, working out rates for standard items of works for a building. **8 Hrs.**

Unit - V

Specifications: Definition of specification, objective of writing specifications, essentials in specifications, general and detailed specifications of standard items of works in buildings. **8 Hrs.**

Reference Books:

1) Dutta B.N., "Estimating and Costing in Civil Engineering", UBS Publishers and Distributors, New Delhi. 28th Edition, 2020.
2) Chakraborti N., "Estimating and Costing in Civil Engineering", Published by author, Calcutta. 24th Edition, 2010.
3) Schedule of Rates of PWD and Irrigation Department, GOK.
4) Karnataka Public Works Departmental Code.

Pattern of question paper for SEE: There shall be one question from each unit. The question from Unit II to find out quantities of selected items of work for a given residential building shall carry 30 marks. The question from Unit III shall carry 10 marks. The remaining questions shall be from Unit I, IV, and V for 20 marks each.

21UCVC601	**Geotechnical Engineering–II**	**(3-0-0) 3**

Contact Hours:39

Course Learning Objective (CLOs): Geotechnical Engineering – II is taught as one of core courses for Civil engineering program. In this course, topics on principles of soil mechanics in different soil engineering problems, subsurface exploration, dewatering, stresses in soil, lateral earth pressure, stability analysis of earth slopes, bearing capacity of soils, Pile foundations and foundation settlements along with the typical field problems and their solutions are dealt.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1-12)/ PSOs (13-15)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Explain various methods of sub-surface exploration and determine the type of method to be employed.			1
CO-2	Explain the different methods of dewatering, calculate the stress components at a point below the loaded soil mass, explain the pressure distribution diagrams.	3	1,2	
CO-3	Calculate the lateral earth pressure	3	1,2	

	on retaining walls for different backfills and loading conditions, explain the causes / types of slope failures and examine safety of slope.			
CO-4	Derive the general bearing capacity equation and calculate the safe bearing capacity of soil under different conditions of loading and water table.		1,2	
CO-5	Classify piles, calculate bearing capacity of single pile and pile group, explain settlements and their ill effects on the buildings.		1,2	

POs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Mapping Level	1.8	2	3												

Contents:

Unit - I

Subsurface Exploration: Importance, exploration program, methods of exploration, boring, sounding tests, geophysical methods, electrical resistivity and seismic refraction methods, types of samples, undisturbed, disturbed and representative samples, samplers, sample disturbance, area ratio, recovery ratio, clearance, stabilization of bore holes, typical boring log. **8 Hrs**.

Unit - II

Drainage and Dewatering: Necessity and importance, sumps and ditches, well point systems, shallow well and deep well. Vacuum and electro osmosis methods.

Stresses in soils: Boussinesq's and Westergard's theories for concentrated and circular loads. Comparison of Boussinesq's and Westergard's analysis. Pressure distribution diagrams, contact pressure, Newmark's chart. **7 Hrs.**

Unit - III

Lateral Earth Pressure: Active and Passive Earth pressures, earth pressure at rest, earth pressure coefficients, earth pressure theories –Rankine's and Coulomb's –assumptions and limitations, graphical solutions for active earth pressure (cohesion less soils only), Cullman's and Rebhan's methods.

Stability of Earth Slopes: Types of slopes, causes and types of failure of slopes, definition of factor of safety, stability of finite slopes, method of slices, Fellineous method, Taylor's stability number. **8 Hrs**.

Unit - IV

Bearing Capacity: Definitions of ultimate, net and safe bearing capacity, allowable bearing pressure, Terzaghi's bearing capacity equation & derivation, assumptions and limitations, bearing capacity of footings subjected to eccentric loading, effect of ground water table on bearing capacity, plate load test and its limitations. **8Hrs.**

Unit - V

Pile Foundations: Introduction, types of piles, load carrying capacity of piles, group action in piles, laterally loaded piles, under reamed piles. **8 Hrs.**

Reference Books:

1) B C Punmia, "Soil Mechanics and Foundations", Laxmi Publications (P) Ltd., New Delhi. 17th edition, 2017.
2) Gopal Ranjan and A.S.R Rao., "Basic and applied soil mechanics", New Age International Publishers, Bangalore. 4th edition, 2022.
3) Narasimha Rao A.V. and Venkatramaiah C., "Geotechnical Engineering", University Press (India) Ltd., Hyderabad. 2nd edition, 2007.
4) IS 2131: 2002 - Method for standard penetration test for soils.
5) IS 2132: 2002 - Code of practice for thin-walled tube sampling of soils.
6) IS 2911: 2010 - Design and Construction of Pile Foundations - code of practice, part 1: concrete piles, section 1: driven cast in-situ concrete piles.
7) IS 1892: 2021 - Code of practice for subsurface investigation for foundations.
8) IS 4968: 2007 - Method for subsurface sounding for soils, Part 3: Static cone penetration test.

21UCVC602	Design of Steel Structures - I	(3-0-0)3

Contact Hours: 39

Course Learning Objectives (CLOs): Design of steel structures is taught as a core course in Civil Engineering program. In this course, topics on steel connections-bolted and welded, tension members, truss ties, compression members, struts, columns, built-up column sections, column splices, slab bases, and beams are dealt, based on limit state method of design.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1-12)/ PSOs (13-15)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Define design stresses in structural steel and fasteners as per IS:800-2007 and analyze / design of Bolted connections.	3,4		
CO-2	Analyze / design welded connections and design tension	3,4		

	members with bolted or welded end connections.			
CO-3	Analyze / design simple compression members and column splices.	3,4		
CO-4	Design of built-up columns and column bases.	3,4		
CO-5	Analyze / design laterally supported beams subjected to low and high shear by Plastic Analysis method as per IS:800-2007.	3,4		

POs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Mapping Level			3	3											

Contents:

Unit - I

Introduction: Advantages and disadvantages of Steel structures, Loads and load combinations, Structural forms, Discussions of design concepts. IS code provisions.

Structural Fasteners: Bolted connections, strength of bolts, design of bolted connections, lap joints and double cover butt joints, **7 Hrs**

Unit - II

Welds: Fillet and Butt welds — Strength and design of connections.

Design of Tension Members: Axially loaded tension members and their connections, design of lug angles-Comparison, Design of truss ties-Single and Double Angle- and joints **8 Hrs**

Unit - III

Design of Compression Members: Effective length, Radius of gyration, Design Compressive Stress, Single and Double Angle struts, I-Section Columns

Column splicing: Type-1 and Type-2 **8 Hrs**

Unit - IV

Built-up Columns, I-Sections with Cover Plates on Flanges.

Double Channel Built-up Column: Back-to-Back.

Steel Foundations: Column bases-simple slab-base. **8 Hrs**

Unit - V

Design of beams: Introduction to Plastic Analysis, Plastic Section Modulus, Low Shear and High Shear Beams, moment of resistance of low shear and high shear beam as per IS 800:2007.

Design of Laterally supported beams: Low and High shear Beams **8 Hrs**

Reference Books:

1) N Subramanian, “Steel Structures: Design and practice”, Oxford Publishers. 2018.
2) Bhavikatti S.S., “Design of Steel Structures”, I.K. Publishers. 5th Edition, 2019.
3) IS 800: 2007, “Code of construction – Steel Structures”, BIS.
4) Pramod K.V., “Steel Data Handbook”, I.K. International, New Delhi.

21UCVL603 Geo-technical Engineering Lab. (0-0-2)1

Contact Hours: 24

Course Learning Objective (CLOs): Geotechnical Engineering Laboratory is taught as one of laboratory for Civil engineering program. In this course, topics on specific gravity of soil, moisture content of soil, grain size analysis and consistency of soil, compaction parameters, shear strength, relative density and various index of soil are dealt.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1-12)/ PSOs (13-15)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Determine index properties of soils and interpret the results.	3	1,4	9,4,15
CO-2	Determine engineering properties of soils and interpret the results.	3	1,4	9,4,15

POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Mapping Level	2		3	1.5					1						1

Contents:

Tests for the determination of:

1) Specific gravity by density bottle, by pycnometer.
2) Moisture content by oven drying method and pycnometer.
3) Grain size analysis of soil (Sieve analysis).
4) In situ density by core cutter and sand replacement methods.
5) Consistency limits, liquid limit (Casagrande and cone penetration methods), plastic limit and shrinkage limit.
6) Compaction parameters by Standard Proctor compaction test and modified Proctor compaction test.
7) Coefficient of permeability by constant head and variable head methods.
8) Shear strength by unconfined compression test, Direct shear test, Triaxial test (undrained), Vane shear test.

9) Relative density

Reference Books:

1) Lambe T.W., "Soil testing for engineers", Wiley Eastern Ltd., New Delhi.
2) IS 2720 – 1983, "Methods of test for soils", Part 1 to 36.

21UCVL604	Software Laboratory	(0-0-2)1

Contact Hours: 24

Course Learning Objective (CLOs): Software Laboratory is taught as a laboratory course for Civil Engineering Program. In this course, analysis and design of RC building using FEM based software, plotting of survey data using Survey software, preparation of shape and thematic maps using GIS software package are dealt.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs (1-12)/ PSOs (13-15)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Design a RC building using FEM based software.	5	6	9
CO-2	Preparation of maps using Total Station/GPS data.	5	6	9
CO-3	Prepare shape and thematic files of features using GIS software.	5	6	9

POs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Mapping Level					3	2			1						

Contents:

1) Analysis and design of framed structure using FEM based software package.
2) Preparation of maps using Total Station and GPS data in a GIS software.

References:

1. User manual of software package.

21UCVL605	Minor Project–2	(0-0-2) 1

Contact Hours: 24

Course Learning Objective (CLOs): Extensive survey is carried out as a project work for Civil Engineering program. In this project work students will formulate, organize and carry out the project work related to water supply, highway, restoration of old tank and new tank projects. The project will be carried out through

field surveys and office work. The evaluation will be carried out through presentations and viva voce.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs(1-12)/ PSOs (13-15)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Use Surveying equipment, schedule and conduct necessary field surveys.	5,9,11		
CO-2	Collect data by direct and indirect methods.	9,13,15		
CO-3	Plan, organize and prepare project reports.	9,13		

POs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Mapping Level					3				3		3		3		3

(Any two of the following projects in detail is to be carried out between fifth & sixth semester for a period of 2 weeks; Viva voce conducted along with sixth semester exams). An extensive survey training involving investigation and design of the following projects is to be conducted for 2 weeks. The students shall submit a project report consisting of designs & drawings. (Total station and GPS to be used). General instructions, Reconnaissance of the sites and fly leveling to be used to establish benchmarks.

1. **New Tank Project**: Alignment of center line of the proposed bund, longitudinal and cross sections of center line, capacity surveys, details at waste weir and sluice points, canal alignment.
2. **Restoration of an Existing Tank**: Alignment of center line of the existing bund, longitudinal and cross sections along the center line, capacity surveys, details at sluice and waste weir.
3. **Water Supply Project:** Examination of sources of water supply, calculation of quantity of water required based on existing and projected population, preparation of village map by any suitable method of surveying (like plane tabling), location of sites for ground level and overhead tank.
4. **Highway Project:** Preliminary and detailed investigations to align a new road between two obligatory points. The investigations shall consist of topographic surveying of strip of land for considering alternate routes and for final alignment. Report should justify the selected alignment with details of all geometric designs for traffic and design speed assumed. Drawing shall include key plan initial

alignment, final alignment, longitudinal section along final alignment, typical cross sections of road.

References:

1. Instrument training manuals or user manuals.
2. IRC 72 – 2015, “Guidelines for the design of flexible pavements for low volume rural roads”.
3. IRC 20 – 2002, “Rural roads manual”.
4. IS: 10500- 2012, “Drinking water — specification”.

21UHUL606	Soft Skills/ Aptitude	(0-0-2) 1

Contact Hours:24

Course Learning Objectives (CLOs): This is included with the objective of improving the communication skills, proficiency in English language and aptitude ability of the student to enhance the employability.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1-12)/ PSOs (13-15)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Explain the significance of communication in the profession.		10	
CO-2	Use the English language with proficiency		10	12
CO-3	Solve Aptitude related problems		9	12
CO-4	Demonstrate the competency in the placement activities.		9	

POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Mapping Level									2	2		1			

Contents:

Training on communication skills, proficiency in English language and aptitude ability involving the internal and external resource.

Evaluation:

Both the internal and external resource persons shall be engaged in imparting the related knowledge and shall have only CIE as the evaluation component. There

shall be one test conducted at the end for 25 marks in Aptitude testing and there shall be one presentation by the student for 25 marks or any other suitable testing components. The arrangement for CIE evaluation is to be made by the department and maintain the relevant documents.

Electives

21UCVE615	Matrix Method of Structural Analysis	(3-0-0) 3

Contact Hours: 39

Course Learning Objective (CLOs): Matrix Method of Structural Analysis is taught as one of elective subject for civil engineering program. In this program, advanced concepts of structural analysis using matrix method are provided.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1-12)/ PSOs (13-15)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Formulate flexibility matrix.	2		1
CO-2	Analyze indeterminate structures such as beams, trusses and frames (element approach) using matrix flexibility method.		2	
CO-3	Formulate stiffness matrix.	2		1
CO-4	Analyze indeterminate structures such as beams, trusses and frames (element approach) using matrix stiffness method		2	
CO-5	Formulate and solve trusses and beams using direct stiffness method		2	1,5

POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Mapping Level	1	2.4			1										

Contents:

Introduction to flexibility method: Element flexibility matrix, Principle of contra gradience, and Force Transformation Matrix, Member Flexibility matrix, Construction of structure flexibility matrix, Matrix determination of the displacement vector, Determination of member forces and analysis of indeterminate beam problems. **7 Hrs.**

Element flexibility matrix: Principle of contra gradience, and Force Transformation Matrix, Member Flexibility matrix, Construction of structure flexibility matrix, Matrix determination of the displacement vector, Determination of member forces and analysis of trusses and frames. **8 Hrs.**

Fundamentals of the stiffness method: Displacement Transformation matrix. Member stiffness matrix, Total or System stiffness matrix, Truss analysis by stiffness method using Displacement Transformation matrix. **8 Hrs.**

Element stiffness matrix: Equivalent joint loads, Displacement Transformation matrix. Member stiffness matrix, Total or System stiffness matrix, Continuous beams and rigid frame analysis by stiffness method using Displacement Transformation matrix. **8 Hrs.**

Direct Stiffness Method: local and global coordinate systems, direct assembly of element stiffness matrices, analysis of indeterminate structures, trusses, continuous beams & Simple frames. **8 Hrs.**

Reference Books:

1. Weaver W and Gere J H., "Matrix Analysis of Framed Structures", CBS Publications, New Delhi
2. Rajasekaran S, "Computational Structural Mechanics ", PHI, New Delhi
3. Pandit and Gupta, "Theory of Structures", Vol II, TMH Publications, New Delhi
4. Amin Ghali and Adam Neville, "A unified classical and Matrix Approach", CRC Press.
5. C S Reddy, "Basic Structural Analysis", TMH Publications, New Delhi.

21UCVE616	Design of Special RC Structures	(3-0-0)3

Contact Hours: 39

Course Learning Objective (CLO): Design of Special R.C. Structures is taught as one of the elective courses for the Civil Engineering program. In this course design of flat slabs, grid floors, continuous beams, bunkers and silo's, yield line analysis of slabs and curved beams is dealt.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs (1-12) / PSOs (13-15)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Analyze, design and detail the reinforcement for different types of	2,3		8

	flat slabs.			
CO-2	Analyze, design grid floors as per IS code and Rankin's methods and detail the reinforcement.	2,3		8
CO-3	Determine moment capacities and ultimate load carrying capacities by yield line method, design slabs using Yield Line Method.	2,3		8
CO-4	Differentiate between bunkers and silos and design bunkers and silos.	2,3		8
CO-5	Analyze and design continuous beams and beams curved in plan.	2,3		8

POs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Mapping Level		3	3					1							

Unit - I

Design of Flat Slabs: Analysis and design of square and rectangular Flat slabs using direct design method - with and without column head and slab drop. **09 Hrs.**

Unit - II

Design of Grid Floors: Analysis and design of grid floors using Rankine's Method and Approximate method. **09 Hrs.**

Unit - III

Yield Line Analysis of Slabs: Virtual and equilibrium methods, design of square, rectangular, triangular, circular slabs using yield line theory. **07 Hrs.**

Unit - IV

Design of Bunkers and silos: Design of RC bunkers and silo's using Johnson's and Airy's Theorem. **06 Hrs.**

Unit - V

Design of Continuous Beams: Design of continuous beam, bending moment envelops, moment redistribution, IS Code provisions. **06 Hrs.**

Beams curved in plan: Introduction and Design of beams curved in plan. **02Hrs.**

Reference Books:

1. IS 456-2000 "Plain and Reinforced Concrete Code of Practice".
2. SP16 - 1980 "Design Aids for Reinforced Concrete"
3. Krishna Raju N., "Advanced Reinforced Concrete design", New Age Publication. 3rd Edition, 2020.
4. B C Punmia, Ashok Jain, Arun Jain, "Reinforced Concrete Structures", Laxmi Publication, New Delhi. 1st Edition, 2015.
5. S S Bhavikatti, "Advanced RCC Design", 2nd Edition, 2016.
6. Varghese P.C., "Advanced Reinforced Concrete", PHI, New Delhi. 2nd Edition,

2011.

21UCVE617	Open Channel Hydraulics	(3-0-0)3

Contact Hours:39

Course Learning Objectives (CLOs): Open channel hydraulics is taught as one of the elective courses in the Civil Engineering program. In this course, difference between pipe and open channel flow, momentum equation, uniform flow, design of channel sections, gradually varying flow, and rapidly varied flow along with sediment transport are dealt with.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs (1-12)/ PSOs (13-15)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Differentiate between pipe flow and open channel flow, energy and momentum equations.		1,2	
CO-2	Design channel for uniform, critical flow.	3		
CO-3	Explain different forms of gradually varied flow and their profiles.	2	5	
CO-4	Compute gradually varied flow by using direct integration, Bresse's and Chow's solution.	3	5	
CO-5	Explain length, height, location of hydraulic jump and application.	3	5	

POs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Mapping Level	2	2.5	3		2										

Contents:

Unit - I

Introduction: Introduction, difference between pipe flow and open channel flow, classification of flow, energy equation, momentum equation, kinetic energy and momentum factors.

Uniform Flow: Concepts, uniform flow equations, conveyance, hydraulic exponent for uniform flow, design of channels for uniform flow. **9 Hrs.**

Unit - II

Critical Flow: Concepts, specific energy, classification of flow, design of channels, section factor, hydraulic exponent for critical flow, and critical depth as a flow measuring

consent. **7 Hrs.**

Unit - III

Gradually Varied Flow: Concepts, GVF equation, its different forms, classification and analysis of flow profiles, control sections. **8 Hrs.**

Unit - IV

Gradually Varied Flow Computations: Different methods, direct integration method, Bresse's & Chow's solution, direct step method, standard step method. **8 Hrs.**

Unit - V

Rapidly Varied Flow: Concepts, hydraulic jump in rectangular channels, classification of jumps, characteristics of hydraulic jumps, length, location, height, applications of hydraulic jump. **7 Hrs.**

Reference Books:

1. Henderson, "Open Channel Flow", Pearson Publication, (1966).
2. Chow V.T., "Open-Channel Hydraulics", The Blackburn Press; Illustrated edition (2009).
3. Subramanya K., Flow in open channel, McGraw-Hill Publication, 5th Edition, 2019.
4. Ranga Raju K.G., Flow through open channels, Tata-McGraw Hill, 5th Edition, 2019.
5. Das M. M., Open Channel Flow, Phi Learning India Pvt. Ltd., 3rd Edition, 2011.

21UCVE618 Advanced Concrete Technology (3-0-0)3

Contact Hours: 39

Course Learning Objective (CLOs): Advanced Concrete Technology is taught as one of elective courses for Civil Engineering Program. In this course, topics on ingredients of concrete, rheology of concrete, properties of fresh and hardened concrete, special concrete, microstructure of concrete and high strength and high-performance concrete are dealt.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1-12)/ PSOs (13-15)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Explain the constituents and properties of cement and polymers, fibers, adhesives and sealants		1,2,6	
CO-2	Explain the concept of Rheology of fresh concrete and its applications.	3,4	9	7,12
CO-3	Explain the microstructure of aggregate phase and its importance in concrete.	3,4,5	9	12
CO-4	Explain the special concrete and	13	6,7	12

	high performance/high strength concrete.			
CO-5	Explain methods for special curing, Shotcreting, under water concreting and formwork.	3,13	4	6,12

POs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Mapping Level	2	2	3	2.66	3	1.67	1.5		2			1	3		

Contents:

Unit - I

Introduction: Concrete and reinforcement, constituent materials, composite cement and properties. Types of reinforcements, corrosion of reinforcing steel - electro-chemical process, measures of protection. Polymers, fibers, adhesives and sealants - types and uses. **10 Hrs.**

Unit - II

Properties of fresh concrete: Rheology of Concrete - Introduction, factors affecting rheology of concrete, equation for measuring the rheological parameters, rheometer. **07 Hrs.**

Unit - III

Properties of hardened concrete: Microstructure of the aggregate phase, microstructure of the hydrated cement paste, Interfacial Transition Zone (ITZ) in concrete -microstructure, strength influence of the interfacial transition zone on properties of concrete. Quantitative estimation of product of hydration by Mercury Intrusion Porosimetry, X-Ray Diffraction Analysis (XRD Analysis) and Scanning Electron Microscopy (SEM). **06 Hrs.**

Unit - IV

Special Concretes: Self compacting concrete, High performance and High strength concrete, Bacterial Concrete, Ferro-cement - Definition, fresh & hardened Properties, applications. **07 Hrs.**

Unit - V

Special Topics: 3D printing using Concrete, Curing methods - Steam, water curing. vacuum dewatering of concrete. Shotcrete - definition, wet mix and dry mix process, general use and advantages. Underwater concreting - Introduction, basic requirements, strength, workability. **09 Hrs.**

Reference Books:

1. Shetty M.S., “Concrete Technology -Theory and Practice”, S. Chand and company, New Delhi. 8th Edition, 2018.
2. Neville A.M. & Brooks J.J., “Concrete Technology”, Tans-Atlantic Publications, Philadelphia, USA, 5th Edition, 2011.
3. Gambhir M.L., “Concrete Technology”, Tata McGraw Hill, Education, New Delhi, 5th Edition, 2017.
4. John Newman and Ban Seng Choo, "Advanced Concrete Technology – Process", ISBN 0 7506 51059, Elsevier Ltd

5. IS 456: 2000 – “Plain and reinforced concrete – Code for practice”.
6. IS 10262: 2019 – “Concrete mix proportioning – Guidelines”.
7. IS 383: 2016 – “Coarse and fine aggregate for concrete – Specification”.

21UCVE619	Advanced Surveying	(3-0-0)3

Contact Hours: 39

Course Learning Objective (CLO): Advanced surveying is taught as one of the elective courses for Civil Engineering program. In this course, topics on traversing, errors in surveying, vertical curves, calculating areas and volumes and arial survey are dealt.

Course Outcomes (CO):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1-12)/ PSOs (13-15)**		
		3	**2**	**1**
CO-1	Carryout traversing to establish control networks	1		
CO-2	Estimate the accuracy and errors in surveyed data	1		
CO-3	Design vertical curves based on suitability	3	9,6,15	
CO-4	Calculate areas and volumes from survey data	5		
CO-5	Estimate the distance and area from aerial photographs	5	9,8	10

POs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Mapping Level	3		3		3	2		2	2	1					2

Contents:

Unit - I

Traversing: Traverse Survey and Computations: Latitudes and departures, rectangular coordinates, Traverse adjustments, Bowditch rule and transit rule, Numerical Problems. **8 Hrs.**

Unit - II

Theory of errors: Theory of probability, Accuracy in surveying, errors in computed results, standard error, most probable error, weight, precision and accuracy, propagation of error. **8 Hrs.**

Unit - III

Vertical curve: Types, assumptions, length of vertical curve, change of grade, sight distance, computations and setting out method. **7 Hrs.**

Unit - IV

Areas and Volume: Measurement of area by dividing the area into geometrical figures, area from offsets, mid ordinate rule, trapezoidal and Simpson's one third rule, area from co-ordinates, Measurement of volumes- trapezoidal and Prismoidal formula. **8 Hrs.**

Unit - V

Arial Survey: Introduction, Uses, Aerial photographs, Definitions, Scale of vertical and tilted photograph (simple problems), Ground Co-ordinates (simple problems), Relief Displacements (Derivation), Ground control, Procedure of aerial survey, overlaps and mosaics, Stereoscopes, Derivation Parallax. **8 Hrs.**

Reference Books:

1. Punmia B.C., Jain Ashok K., Jain Arun K "Surveying (Volume-1)," Laxmi Publications, Seventeenth Edition, (2018).
2. Punmia B.C., Jain Ashok K., Jain Arun K., „'Surveying (Volume-2)," Laxmi Publications, Sixteenth Edition, (2019).
3. Arora K.R., "Surveying (Volume – 1)," Standard Book House, Seventeenth Edition, (2019).
4. Duggal, S. K., „'Surveying - Vol. 1," McGraw Hill Education, Fourth edition, (2017).
5. Chandra A. M. Plane Surveying, New Age International Private Limited, Third Edition, (2015).

21UCVE620	Alternative Building Materials	(3-0-0)3

Contact Hours: 39

Course Learning Objectives (CLOs): Alternative Building Materials is taught as one of the elective courses in the Civil Engineering program. In this course, the students understand environmental issues due to building materials and the energy consumption in manufacturing building materials. The course also exposes the students to the study the various masonry blocks, masonry mortar and the study the alternative building materials in the present context. Students shall also understand the alternative building technologies which are followed in present construction field.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1-12)/ PSOs (13-15)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Explain the facts of energy, environment, cost effectiveness of different building materials.			1
CO-2	Explain the elements of structural			1

	masonry.			
CO-3	Explain the types, characteristics and strength of mortars.			1
CO-4	Explain and apply the concepts of alternative building materials, types, properties.		1,2,7	
CO-5	Discuss the equipment for production of alternative materials and cost concepts.			1

POs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Mapping Level	1.2	2					2								

Contents:

Unit - I

Introduction: Energy in building materials, environmental issues concerned to building materials, Global warming and construction industry, environment friendly and cost-effective building technologies, requirements for building of different climatic regions. **6 Hrs.**

Unit - II

Elements of Structural Masonry: Elements of Structural Masonry, Masonry materials, requirements of masonry units, characteristics of bricks, stones, clay blocks, concrete blocks, stone boulders, laterite blocks, Stabilized mud block. Manufacture of stabilized blocks, cementations materials, sand, natural & manufactured. **8 Hrs.**

Unit - III

Mortars: Types of mortars, classification of mortars as per BIS, characteristics and requirements of mortar, selection of mortar, uses of masonry, masonry bonding, Compressive strength of masonry elements, Factors affecting compressive strength, Bond strength of masonry, Flexure and shear, Elastic properties of masonry materials. **8 Hrs.**

Unit - IV

Conventional and Non-conventional Materials: Lime, Pozzolana cement, Raw materials & Manufacturing process, Properties and uses. Fibers- metal and synthetic, Properties and applications. Fiber reinforced plastics, Matrix materials, Fibers organic and synthetic, Properties and applications. Building materials from agro and industrial wastes, Types of agro wastes, Types of industrial and mine wastes, Properties and applications. Masonry blocks using industrial wastes. Construction and demolition wastes. **9 Hrs.**

Unit - V

Equipment for Production of Alternative Materials and cost concepts: Machines for manufacture of concrete, Equipment for production of stabilized blocks, Moulds and methods of production of precast elements, Cost concepts in buildings, Cost saving techniques in planning, design and construction, Cost analysis, Case studies using alternatives. **8 Hrs.**

Reference Books:

1) K. S. Jagadish, B.V Venkatarama Reddy and K.S Nanjunda Rao, "Alternative Building Materials and Technologies", New Age International Pvt. Ltd.
2) Arnold W Hendry, "Structural Masonry", Macmillan Publishers. 2nd Edition, 1998.
3) S. K. Duggal, "Building Materials", New Age International Pvt. Limited. 5th Edition, 2019.

21UCVO601	Traffic Engineering	(3-0-0)3

Contact Hours: 39

Course Learning Objectives (CLOs): Traffic Engineering is taught as one of open elective course for Civil Engineering Program. In this course, students are given exposure to measure various traffic flow parameters, design traffic control devices, apply statistical methods for transport planning.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1-12)/ PSOS (13-15)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Apply Engineering science to determine the power performance of the vehicle under various resisting forces.			1,2
CO-2	Illustrate and apply traffic flow parameters to develop an efficient transport system.	1,2,3		
CO-3	Summarize Traffic Flow theories to understand the traffic pattern.			1,2
CO-4	Examine the transport system problems and apply statistical methods to overcome.		1,2	
CO-5	Illustrate various traffic regulation and control devices and develop suitable traffic signal system.	1,3,12		

POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Mapping Level	2	1.75	3									3			

Contents:

Unit - I

Introduction: Definition, Objectives, Scope of Traffic Engineering.

Road User and Vehicle Characteristics: Static and Dynamic characteristics, Power performance of vehicles, Resistances to the motion of vehicles, Reaction time of driver, Problems on above **7 Hrs.**

Unit - II

Traffic Parameter Studies and Analysis: Objectives and Method of study, Definition of study area, Sample size, Data Collection and Analysis Interpretation of following Traffic Studies, Volume, Spot Speed, Origin and Destination, Speed and Delay, Parking on Street and off-Street Parking, Accidents, Causes, Analysis (right angle collision only with parked vehicle), Measures to reduce Accident, Problems. **10 Hrs.**

Unit - III

Traffic Regulation and Control: Vehicle and Road controls, Traffic Regulations, One Way, Traffic Signs, Traffic signals, Vehicle actuated and synchronized signals, Webster's method of signal Design, IRC Method, Problems. **7 Hrs.**

Unit - IV

Traffic Island: Traffic Rotary elements and traffic operation, Relevant Problems on above. Traffic markings. **7 Hrs.**

Unit - V

Probability Distribution: Poisson's Distribution and application to Traffic Engineering, Normal Distribution, Significance tests for observed Traffic Data, Chi square test, Problems on above, Sample size. **8 Hrs.**

Reference Books:

1. Kadiyali L.R., "Traffic Engineering and Transport Planning", Khanna Publishers, New Delhi, Ninth Edition, 2017.
2. Khanna S.K. and Justo C E G.,"Highway Engineering", Nemchand and Bros, Roorkee, Revised Tenth Edition, 2017.
3. Papacostas C.S., Prevedouros P.D., "Transportation Engineering and Planning", Prentice-Hall of India, Pvt. Ltd, New Delhi, Third Edition, 2009.