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PANDIT DEENDAYAL PETROLEUM UNIVERSITY

Recognised by UGC

NAAC 'A' Grade Accredited with 3.39 CGPA out of 4.0

SOT

SCHOOL OF TECHNOLOGY

SYLLABUS FOR BATCH- 2018-22

CIVIL ENGINEERING DEPARTMENT

2018-22: 1ST TO 4TH YEAR

PANDIT DEENDAYAL PETROLEUM UNIVERSITY - GANDHINAGAR

Departmental Vision and Mission

Vision of Department

To prepare competent Civil Engineers through technovations, research and excellence in education for serving evolving human needs and infusing sustainable developments.

Mission of Department

1. To ignite and energize young minds and arm them with the roots of knowledge and wings of creativity.
2. To Excel as a problem solver by promoting and supporting cutting edge research, innovations and excellence in education.
3. To unfold new realms of Civil Engineering addressing the needs of the Industry and Society for Sustainable Development.

Program educational objectives (PEOs) of Department

1. To provide solutions to civil engineering problems and cater for evolving needs of the society through engineering practice and/or research of their choice and pursuance

2. To serve mankind in their endeavour by designing and analysing of civil engineering structures engrossing its, aesthetics, safety, functionality and sustainability

3. To work ethically and professionally in the chosen professional carrier

4. To be affiliated with professional bodies and continuing education schemes for their lifelong learning and growing towards leadership roles and also strive for addition of new knowledge.

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, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified need with appropriate considerations for 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 modelling to complex engineering activities with an understanding of the limitations.

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

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

8. **Ethics**: Apply ethical practices and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams and in multidisciplinary settings.

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

11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one′s own work, as a member and leader in the 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 of broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

Engineering Graduates will be able to:

PSO 1: UNDERSTANDING: Graduates shall demonstrate sound knowledge in analysis, design, laboratory investigations and construction aspects of civil engineering infrastructure, along with good foundation in mathematics, basic sciences and technical communication.

PSO 2: BROADNESS AND DIVERSITY: Graduates will have a broad understanding of economic, environmental, societal, health and safety factors involved in infrastructural development, and shall demonstrate ability to function within multidisciplinary teams with competence in modern tool usage.

PSO 3: SELF-LEARNING AND SERVICE: Graduates will be motivated for continuous self-learning in engineering practice and/or pursue research in advanced areas of civil engineering in order to offer engineering services to the society, ethically and responsibly

Course structure of B.Tech (Civil Engineering) for batch 2018-22

Semester	Category Code	Course Code	Course Name	Theory	Tutorial	Practical	Hrs	Credits
Semester 1	BSC	16MA101T	Mathematics - I	3	1	0	4	4
	ESC	16CE106T	Elements of civil engineering & mechanics	4	0	0	4	4
	ESC	16EE102T	Basic electronics	3	0	0	3	3
	BSC	16SC102T	Physics	3	0	0	3	3
	BSC	16SC102P	Physics lab	0	0	2	2	1
	HSC	16HS108T	Environmental studies	3	0	0	3	3
	ESC	16MA106P	Computer programming	0	0	2	2	1
	ESC	16ME101T	Engineering graphics	1	0	0	1	1
	ESC	16ME101P	Engineering graphics lab	0	0	2	2	1
	HSC	16SP101/102/103P	NCC/NSS/Sports-I	0	0	2	2	1
				17	**1**	**8**	**26**	**22**
Semester 2	BSC	16MA103T	Mathematics – II	3	1	0	4	4
	BSC	16SC101T	Chemistry	3	0	0	3	3
	BSC	16SC101P	Chemistry Lab	0	0	2	2	1
	ESC	16ME106T	Element of Mechanical Engineering	3	0	0	3	3
	ESC	16EE106T	Element of Electrical Engineering	3	0	0	3	3
	HSC	16HS109T	Professional Ethics and Human Values	1	0	0	1	1
	ESC	16ME103P	Workshop practice	0	0	2	2	1
	HSC	16HS103P	Communication skills Practices	0	0	2	2	1
	HSC	16TP110	Civic Services and Social Internship	0	0	0	0	1
				13	**1**	**6**	**20**	**18**

Course structure of B.Tech (Civil Engineering) for batch 2018-22

Semester 3	**BSC**	16MA201T	Mathematics-III	3	1	0	4	4
	OE	16CV203T	Building Material and Construction	4	0	0	4	4
	PC	16CV214T	Concrete Technology	2	0	0	2	2
	PC	16CV214P	Concrete Technology Lab	0	0	2	2	1
	PC	17CV204T	Fluid Mechanics	3	1	0	4	4
	PC	17CV204P	Fluid Mechanics - Lab	0	0	2	2	1
	PC	17CV202T	Strength of Materials	3	1	0	4	4
	PC	18CV206P	Material Testing - Lab	0	0	2	2	1
	HSC	16CV206T	Engineering Geology	2	0	0	2	2
				17	**3**	**6**	**26**	**23**
Semester 4	**PC**	18CV216T	Hydraulic Engineering	3	1	0	4	4
	PC	18CVL46P	Hydraulic Engineering - Lab	0	0	2	2	1
	PC	18CV215T	Structural Analysis	3	1	0	4	4
	PC	17CV205T	Basic Surveying	4	0	0	4	4
	PC	19CV201P	Surveying Practice - Lab	0	0	2	2	1
	PC	16CV218T	Building Planning and Drawing	4	0	0	4	4
	PC		Communication Lab - II	0	0	2	2	1
	OE	18CV318T	Open Elective	3	0	0	3	3
	BSC	16MA202T	Numerical Techniques (Numerical and Statistical methods	3	1	0	4	4
	Project	TP310	Industrial Orientation (3 weeks)	0	0	0	0	1
				20	**3**	**6**	**29**	**27**

Course structure of B.Tech (Civil Engineering) for batch 2018-22

Semester 5	**PC**	18CE301T	Structural Analysis – II	3	1	0	4	4
	PC	18CE304T	Geotechnical Engineering – I	3	1	0	4	4
	PC	18CE303T	Environmental Engineering – I	3	1	0	4	4
	PC	18CE302T	Hydrology and Water Resources Engineering	4	0	0	4	4
	OE	18CE305T	Advance Surveying and Geomatics	3	0	0	3	3
	PC	18CE305P	Advance Surveying and Geomatics Practice	0	0	2	2	1
	PC	18CE304P	Soil Mechanics Lab	0	0	2	2	1
	PC	18CE303P	Environmental Engineering - I Lab	0	0	2	2	1
				16	**3**	**6**	**25**	**22**
Semester 6	**PC**	19CV403T	Design of RCC structure	3	1	0	4	4
	PC	18CV315T	Environmental Engineering – II	3	1	0	4	4
	PC	20CE403T	Geotechnical Engineering – II	3	1	0	4	4
	PC	18CV312 T	Irrigation Engineering and Hydraulic Structure	4	0	0	4	4
	OE	18CE402T	Estimating and cost analysis	3	1	0	4	4
	PC	20CE403P	Geotechnical Engg. Lab	0	0	2	2	1
	PC	18CE213P	Environmental Engineering – II Lab	0	0	2	2	1
	PC	20CV402P	Civil CAD Lab	0	0	2	2	1
	HSC		Communication Lab – III					0/P/NP
	Project	20TP309T	Industrial Training	0	0	0	0	2
				16	**4**	**6**	**26**	**25**

Course structure of B.Tech (Civil Engineering) for batch 2018-22

Semester 7	**PC**	19CV401T	Construction Technology and Equipment	3	1	0	4	4
	PC	20CV403T	Highway Engineering	3	1	0	4	4
	PC	19CV403T	Design of Steel Structure	3	1	0	4	4
	PC	20CV401T	Earthquake Engineering	3	1	0	4	4
	PC	20CV401P	Earthquake Engineering Lab	0	0	2	2	1
	PC	20CV402P	Civil Computational Lab	0	0	2	2	1
	PC	20CV403P	Highway Engineering lab	0	0	2	2	1
	Project	20TP310T	Seminar	0	0	0	0	3
				12	**4**	**6**	**22**	**22**
Semester 8	**PC**	19CV402T	Railway, Airport, Docks and Harbour Engineering	3	1	0	4	4
	PC	UCV406	Construction Project Management	3	1	0	4	4
	OE	19CV413T	Only for Project Students Dept. Elective - I	3	1	0	4	4
	Project	19CV409P/19CPCL01	Major Project/Comprehensive Project	0	0	0	0	8
				9	**3**	**0**	**12**	**20**

Component wise Distribution:

Code	Component	Lec	Tutorial	Practical	Hrs	Credits
HSC	Humanities & Social Science Including Management Courses	6	0	4	10	9
BSC	Basic Science Courses	18	4	4	26	24
ESC	Engineering Science Courses including Workshop, drawing, Basic of Electrical, Basic of Mechanical, Computer etc…	14	0	6	20	17
Ind	Industry 4.0 Course					
PC	Professional Core Courses	66	16	30	112	97
CE	Professional Elective Courses related to chosen specialization					
OE	Open Elective Subjects from Other technical / emerging subjects	16	2	0	18	18
Project	Project work, Seminar or Internship in Industry or elsewhere	0	0	0	0	14
Overall		120	22	44	186	179

SEMESTER – I

COURSE CODE	COURSE NAME	L – T – P	CREDITS
16MA101T	MATHEMATICS – I	3 – 1 – 0	4
16CE106T	ELEMENTS OF CIVIL ENGINEERING & MECHANICS	4 – 0 – 0	4
16EE102T	BASIC ELECTRONICS	3 – 0 – 0	3
16SC102T	PHYSICS (Theory)	3 – 0 - 2	3
16SC102P	PHYSICS (Practical)		1
16HS108T	ENVIRONMENTAL STUDIES	3 – 0 – 0	3
16MA106P	COMPUTER PROGRAMMING	0 – 0 – 2	1
16ME101T	ENGINEERING GRAPHICS (Theory)	1 – 0 – 2	1
16ME101P	ENGINEERING GRAPHICS (Practical)		1
16SP101/2/3P	NCC / NSS / SPORTS	0 – 0 – 2	1

MATHEMATICS – I

16MA101T					Course: Mathematics - I					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	--	4	4	25	50	25	--	--	100

Prerequisite Subject:

Course Outcomes:

- To get in-depth knowledge of application of single variable Calculus with curve tracing as a base
- To gain anability for solving and analyzing problems of multivariable Calculus
- To solve improper integrals and understand different types of series and their convergence
- To get an idea of the role of vectors in Calculus and their relation to physical system

UNIT I:	**8 hrs**
Calculus for single variable: Successive differentiation, Leibnitz theorem (without proof), Taylor's and Maclaurin's expansion of functions of single variable. Fundamental theorem of Integral calculus, Application of integrals to length, area, volume and surface area of revolution. **Curve Tracing:** Asymptotes, Cartesian, polar and parametric forms.	
UNIT II:	**11 hrs**
Calculus for of Several variable: Partial derivatives, Euler's theorem, directional derivative and gradient, Taylor's and Maclaurin's expansion of functions of several variables, Mamixa and minima of functions of several variables, Lagrange's method of undetermined multipliers, Multiple Integrals – double and triple**,** Jacobian, Change of order of integration, change of coordinates, evaluation of area, volumes of solids, Mass, center of gravity and moment of inertia.	
UNIT III:	**11 hrs**
Infinite Series & Improper Integrals: Convergence and divergence of Infinite series. Comparison test, D' Alembert's ratio test, Raabe's test, logarithmic test, Cauchy's root test. Alternating series; Leibnitz test, power series. Convergence of improper integrals, Beta and Gamma functions and its properties.	
UNIT IV:	**9 hrs**
Vector Calculus: Scalar and vector fields, Line and surface Integrals, Gradient divergent	

curl, Green's Theorem and Stoke's theorem (without proof) with application and physical significance.	
Total Hours:	**39 hours**

References:

1. Meriam & Craige, Engineering Mechanics, John Wiley & Sons.
2. N.H Dubey, Engineering Mechanics-Statics and Dynamics, Tata McGraw Hill Private limited
3. R. S. Khurmi, Engineering Mechanics, S. Chand Publication
4. Elements of Civil Engineering by Jagadeesh T.R. and Jayaram, Sapna Book House, Bangalore
5. Elements of Civil Engineering (IV Edition) by S.S. Bhavikatti, Vikas Publishing House Pvt. Ltd., New Delhi.
6. Ferdinand P Beer and E Russel Johnson , Mechanics for Engineers (Statics & Dynamics) McGraw Hill book company, New York

ELEMENTS OF CIVIL ENGINEERING & MECHANICS

16CE106T					Course: Elements of Civil Engineering and Mechanics					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
4	0	--	4	4	25	50	25	--	--	100

Prerequisite Subject:

Course Outcomes:

- To Demonstrate understanding the facts and ideas about Civil Engineering Structures and their scopes
- Solve problems by applying acquired knowledge about concurrent and non-concurrent system of forces and to compute the resultant & equilibrium forces for given problem
- Analyze the support reactions of simply supported beam and different types of truss
- Solve problems by applying acquired knowledge about centroid, center of gravity & moment of inertia in different shapes and lamina and to analyze the co-efficient of friction for different shapes

UNIT I:	**12 hrs**
Basics and scope of Civil Engineering: Introduction to Civil Engineering, Role of Civil Engineer, Scope of Civil Engineering**.** Brief introduction to sub branches of Civil Engineering: Transportation Engineering, Environmental Engineering, Water resources Engineering, Geotechnical Engineering, Structural Engineering, Engineering Surveying. Construction Materials: Basic ingredients of Concrete. Smart materials/alternate materials. Brief details of residential, commercial buildings, Green buildings, smart cities	
UNIT II:	**13 hrs**
Concurrent system of forces: Definition of a force, system of forces and their classifications, principle of transmissibility, resolution of a force and its rectangular components, triangular, parallelogram and polygon law of forces. Determination of resultant of concurrent coplanar system of forces. **Non-concurrent system of forces:** Moment of a force, Varignon's theorem of moments, couples and their characteristics. Determination of magnitude, direction and position of resultant of non-concurrent coplanar system of forces. Example problems. **Equilibrium of concurrent system of forces:** Conditions of equilibrium for concurrent coplanar system of forces, Lami's theorem. Example problems	
UNIT III:	**12 hrs**

Equilibrium of non-concurrent system of forces. Types of supports, loads and beams. Conditions of equilibrium for non-concurrent coplanar system of forces, Determination of support reactions for statically determinate beams i.e simply supported beam, cantilever beam. Overhanging beams.

Trusses: Definition: Plane truss, determinate truss and indeterminate truss. Analysis of plane determinate trusses for member forces and reactions, using method of joints and method of sections with numerical examples.

UNIT IV:	**13 hrs**

Friction: Introduction, angle of friction, coefficient of friction, cone friction, limiting friction, types of friction, laws of static friction, Example problems related to impending motion on horizontal and inclined planes, wedge friction and ladder friction.

Centroid and Centre of Gravity: Definition, derivation of expressions for centroidal distances of simple planar laminas like rectangle, triangle, quarter and semi circles. Determination of centroidal distances of compound laminas.

Moment of Inertia: Definition, derivations of expressions for moment of inertia of simple planar laminas like rectangle, triangle, quarter, semi-circle and circle. Theorems of perpendicular and parallel axis. Concept of axis of symmetry, Definitions of polar moment of inertia, radius of gyration, Determination of moment of inertia, polar moment of inertia, radius of gyration of compound laminas about centroidal axes and about any specified reference line.

Total Hours	**50 hrs**

References:

1. Meriam & Craige, Engineering Mechanics, John Wiley & Sons.
2. N.H Dubey, Engineering Mechanics-Statics and Dynamics, Tata McGraw Hill Private limited
3. R. S. Khurmi, Engineering Mechanics, S. Chand Publication
4. Elements of Civil Engineering by Jagadeesh T.R. and Jayaram, Sapna Book House, Bangalore
5. Elements of Civil Engineering (IV Edition) by S.S. Bhavikatti, Vikas Publishing House Pvt. Ltd., New Delhi.
6. Ferdinand P Beer and E Russel Johnson , Mechanics for Engineers (Statics & Dynamics) McGraw Hill book company, New York

BASIC ELECTRONICS

16EE102T					Course: Basic Electronics					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	--	3	3	25	50	25	--	--	100

Prerequisite Subject:

Course Outcomes:

- To understand working and application of BJT
- To understand basic concepts and applications of OPAMP
- To understand the number systems and logic circuits
- To understand communication basics

UNIT I:	**11 hrs**
Semiconductor diodes and applications: Introduction Of Semiconductors, Electrons And Holes In An Intrinsic Semiconductors, Donor And Acceptor Impurities, P-Type And N-Type Semiconductors, Formation Of A P-N Junction Diode, Biasing Of P-N Junction Diode, V/I Characteristics Of Diode, Diode Rectifier Circuits (Half Wave And Full Wave), Diode Rectifiers With Capacitor Filter, Zener Diode, V/I Characteristic Of Zener Diode, Voltage Regulators, Zener Diode As Voltage Regulator, 78xx And 79xx Ics For Voltage Regulation, Photo Diodes.	
UNIT II:	**08 hrs**
Bipolar Junction Transistor Characteristics: Junction Transistor, Transistor Current Components, Working of a BJT, Operating Regions, Transistor as a Switch, Transistor as an Amplifier, CB, CE and CC Configurations, Input and Output Characteristics, Transistor Biasing.	
UNIT III:	**08 hrs**
Introduction To Operational Amplifiers: Block Diagram and Characteristics of Ideal Op-Amp, Parameters of an Op-Amp, Concept of Feedback, Inverting and Non- Inverting Amplifier, Differential Amplifier, Virtual Ground, Adder, Subtractor, Comparator, Integrator and Differentiator, Zero Crossing Detector, Voltage Follower.	
UNIT IV:	**12 hrs**
Digital Electronics: Number systems (Decimal, Binary, Octal and Hexadecimal), One's and two's complements, Binary codes (weighted and non-weighted codes), Boolean algebraic theorems and simplification of Boolean expressions, Logic gates, Implementation of Boolean expressions using logic gates, Standard and canonical forms of Boolean expression, POS and SOP forms,	

Simplification of Boolean expressions using K-map, Basics of Flip-flops and its applications. **Introduction To Communication Systems:** Elements of Communication Systems, Concept of Modulation and Demodulation, Basics of Analog and Digital Communication	
Total Hours	**39 hrs**

References:

1. Boylestad and Nashlesky, “Electronic Devices and Circuit Theory”, PHI
2. R. A. Gaikwad, “Operational Amplfier and Linear Integrated Circuits”, PHI
3. Albert Malvino and David J. Bates, “Electronic Principles”, Tata McGraw Hill
4. Morris Mano, “Digital Design”, PHI

PHYSICS (THEORY)

16SC102T					Course: Physics (Theory)					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	--	4	4	25	50	25	--	--	100

Prerequisite Subject:

Course Outcomes:

- It requires to shape the engineering perspective in the student mind
- This aims to provide an understanding of the physical phenomena
- This aims to develop an analytical perspective in the student
- This aims to enable the students the importance of application of already studied topics

UNIT I:	**13 hrs**
Vector concepts & applications in Physics: Introduction to vector algebra, Physical concepts in vector fields and Scalar fields with examples, Physical and mathematical concepts of gradient, divergence and curl, Green's theorem, Gauss theorem, applications in gravitation and electrostatics. Stokes' theorem and its applications. **Electrostatics and Electrodynamics**: Gauss's law in dielectric medium, Equation of continuity, Biot Savart law – Ampere's law – magnetization and magnetic intensity, Faraday's law of induction – generalization of Ampere's law, displacement current, Maxwell's equations, wave equation for Poynting vector. Electromagnetic radiation, electromagnetic wave propagation in free space and isotropic dielectric medium, Poynting theorem.	
UNIT II:	**07 hrs**
Waves and oscillations: Types of waves, Simple harmonic motion, Damped simple harmonic motion, types of damping, Forced oscillation, resonance, , Energy Transport in Wave motion. **Acoustics & Ultrasonic:** Introduction to Sound, Sabine's reverberation theory, Acoustical defects and their remedies, Doppler Effect. Ultrasonic waves, methods of their generation and detection, properties and application of ultrasonic waves.	
UNIT III:	**08 hrs**
Interference: Types of interferences, Thin film interference, Anti-reflecting films; wedge shape films; Newton's rings and its applications, Diffraction: Diffraction of light waves, Fraunhofer	

diffraction at a single slit, Two slit Fraunhofer **Diffraction:** Pattern, N- Slit Fraunhofer Diffraction Pattern, diffraction grating, resolving power, Rayleigh Criterion, Fresnel diffraction (Introduction). Polarization: Polarization of light, production of polarized light, types of polarization and their representation, Malus's law, polarizer and analyser, Double refraction, Interference of Polarized light: Quarter wave plates and Half wave plates	
UNIT IV:	**12 hrs**
Laser & Fiber Optics: Concepts of maser and laser, Interaction of radiation of matter-quantum mechanical view, Einstein coefficients spontaneous and stimulated emission, principles involves in laser, Meta stable state, Population inversion, three and four level laser system, and optical amplification and optical resonator, characteristics of laser, Ruby, He-Ne and semiconductor lasers, Application of lasers, Optical Fiber, physical structure and basic theory, modes in optical fibers, step index and graded index fibers, losses in optical fibers, applications of optical fibers in communication. **Modern Physics:** Failure of Classical Mechanics, Ultraviolet catastrophe, Photoelectric effect, Compton Effect. Plank's Hypothesis, De Broglie's Dual Nature Principle, Introduction to Quantum Mechanics, Eigen value function, Time dependent and time independent Schrodinger Equation, Tunneling effect.	
Total Hours	**40 hrs**

Texts Books and References:

1. Resnick, Halliday and Krane, Physics part I and II, 5th Edition John Wiely (2002).
2. Ghatak, Optics, 3rd edition, Tata McGraw Hill (2005).
3. Kittel C., Knight W.O. and Ruderman M.A., Mechanics - Berkeley Physics Course, Vol. 1, Tata McGraw-Hill.
4. Purcell E.M. Electricity and Magnetism - Berkeley Physics Course, Vol.2, TataMcGraw-Hill.
5. Crawford F.S. - Waves and Oscillations, Berkeley Physics Course, Vol. 3,McGraw-Hill.
6. Feyman R.P., Leighton R.B. and Sands M. The Feyman Lectures on Physics, Vol. 1., Narosa Publication
7. Feyman R.P., Leighton R.B. and Sands M. The Feyman Lectures on Physics, Vol. 2. Narosa Publication
8. Griffith D.J.H., Introduction to Electrodynamics - Prentice Hall, India.
9. M. N. Avadhanulu, A text book of engineering Physics, S. Chand & Company, Ltd.
10. Brij Lal, N. Subrahmanyam, Heat and Thermodynamics, S. Chand & Company, Ltd.

PHYSICS (PRACTICAL)

16SC102P					Course: Physics (Practical)					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
--	--	2	1	2	--	--	--	25	25	50

Prerequisite Subject:

Course Outcomes: At the end of semester students should able to

List of Experiments:

1. Study of Interference using Michelson's Interferometer.
2. Introduction to Oscilloscope.
3. Study of Interference using Newton's Ring experiment.
4. Experiment to determine volumetric coefficient of expansion of liquids.
5. Experiment to determine thermal conductivity of different solid bodies.
6. Experiment with solar collector.
7. Measurement of vapour pressure.
8. Experimental to determine linear thermal expansion coefficient of solid bodies.
9. Experiment on reflection of Ultrasonic waves.
10. Experiment to determine heat capacities.
11. Experiment to determine critical temperature.
12. Study of effect of electric force.
13. Experiments with hot air engine.

14. Experiments with heat pump.

15. Study of conducting electricity by means of electrolysis.

16. Measurement of viscosity.

17. Determining Plank's constant and Inverse square law.

18. Experiments on diffraction with He-Ne Laser Kit.

19. Study of Hall Effect.

20. Determining semiconductor energy band gap using four probe method.

21. Experiment to study forced oscillations.

22. Study of charging and discharging of capacitive plates.

23. Study of Bio-Savant's Law

24. Study of Kerr Effect.

25. Experiments on spectroscopy.

26. Experiments on Fiber Optics.

27. Study of Photoconductivity.

28. Study of Interference using ultrasonic Interferometer.

29. Determining e/m by Thomson's method.

30. Study of Polarization of light using LASER.

31. Millikan's oil drop experiment.

32. Study of Holography.

ENVIRONMENTAL STUDIES

16HS108T					Course: Environmental Studies					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	--	3	3	25	50	25	--	--	100

Prerequisite Subject:

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

- To understand the concept behind ecosystem and natural resources conservation
- To understand the basics of multi-scale environmental pollution
- To study the environmental pollution control strategies in detail
- To study the concept of sustainability in day to day life

UNIT I:	**06 hrs**
Bird's Eye view to Environment: Environmental Studies – Its importance and Multidisciplinary nature; Ecosystem and its various types, factors affecting the functioning of an ecosystem; Biodiversity – its importance, threats and conservation; Natural Resources – Forest, Water, Mineral, Energy, Minerals, Food; Review of State of India's Environment.	
UNIT II:	**06 hrs**
Multi-scale Environmental Pollution (Global, Regional and Local): Concept of Clean Environment, Introduction to various environmental standards – air, water, soil, noise, heat. Causes and Effects of Air Pollution, Water Pollution, Soil Pollution, Solid Waste (organic and Inorganic) Pollution, Hazardous Waste Pollution, Marine Pollution, Noise Pollution, Thermal Pollution, Radioactive Pollution; Pollution across Indian cities – case studies; Introduction to man-made disasters like floods, heat waves, landslides, etc.	
UNIT III:	**06 hrs**
Environmental Pollution Control Strategies: Multi-approaches (role of research, technology, policy, planning & implementation, legislation & judiciary, incentives & business) for reducing various types of pollution; Case studies of Pollution control strategies; Review of the Central and State Government's policies and mechanisms for managing various natural resources and controlling the various types of pollutions (including Swacch Bharat Abhiyan), Global Initiatives for environmental management; Indian Culture and Traditional Wisdom for managing environment	

UNIT IV:	06 hrs
Social Issues and the Environment: Concept of sustainability and Sustainable Development, Environmental Sustainability Index, Environmental Ethics, Public awareness and people's participation (bottlenecks and solutions), Consumerism and Waste products, Introduction to Carbon Footprint & Water Footprint, Green Buildings, Green Business (profitability in managing environment)	
Total Hours	**24 hrs**

Text-book and Reference Books:

1. Bharucha Erach, Textbook for Environmental Studies, UGC New Delhi
2. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd, Ahmedabad 380013, India
3. Clark, R. S., Marine Pollution, Clanderson Press Oxford
4. Daniel B. Botkin & Edwards A. Keller, Environmental Science, Wiley INDIA edition.
5. Hawkins R. E., Encyclopedia of Indian Natural History, Bombay Natural History Society, Bombay
6. Miller T. G. Jr., 2006. Environmental Science, Clengage Learning, India
7. Odum E. P. 1971. Fundamentals of Ecology, W. B. Saunders Co, USA
8. Survey of the Environment, The Hindu
9. Down to Earth, Centre for Science and Environment
10. Wagner K. D., 1998. Environmental Management, W. B. Saunders Co, USA
11. Gilbert Masters and Wendell P. Ela, 2012. Introduction to Environmental Engineering and Science, PHI Learning Pvt Ltd, New Delhi
12. Annual State of India's Environment 2016 and 2015, Down to Earth, Centre for Science and Environment, New Delhi
13. Climate Actions – Increase Your Handprint and Decrease Your Footprint, Centre for Environment Education, Ahmedabad, 2015
14. Alexandare Rojey, 2009. Energy and Climate, Wiley Publications, Great Bratain
15. Trivedi R.K., Handbook of Environmental Laws, Rules and Guidelines, Compliances and Standards, Vol I & II
16. Environmental Studies by R. Rajagopalan, Oxford University Press
17. John Barrows and Lisa Iannucci, 2009. The complete idiot's guide to Green Building and Remodelling, Alpha Publishing, Penguin Group, USA
18. Water Harvesting Manual, Centre for Science and Environment, New Delhi
19. Making Water Everybody's Business, Centre for Science and Environment, New Delhi

COMPUTER PROGRAMMING

16MA106P					Course: Computer Programming					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
--	--	2	1	2	--	--	--	25	25	50

Prerequisite Subject:

Course Outcomes:

- To understand the basics of input output operations, datatypes
- To understand the use of conditional operators
- To understand the use of Looping Structures
- To understand the basics and application of Array
- To understand pointers
- To understand structures

List of Experiments:

Write Algorithm/Draw Flowchart/ Write C++ Programs For The Following. (Simple Programs)

Write Algorithm/Draw Flowchart/ Write C++ Programs For The Following. (Using If Condition)

Write Algorithm/Draw Flowchart/ Write C++ Programs For The Following. (Using Loop)

Write Algorithm/Draw Flowchart/ Write C++ Programs For The Following (Using Array)

ENGINEERING GRAPHICS

16ME101T					Course: Engineering Graphics					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
1	--	--	1	1	25	50	25	--	--	100

Prerequisite Subject:

Course Outcomes:

- Understand the basic fundamentals of engineering graphics and representation of various ideas through concept of drawings.
- Comprehend the theory of projection and develop the skills of visualization for solid geometries
- Understand the basic principles of orthographic projection and use it to represent the views on reference planes.
- To apply their technical communication skill for 3-dimensional geometries in the form of communicative drawings using isometric projection.

UNIT I:	**03 hrs**
Introduction to Engineering Graphics, Drawing instruments and accessories, lettering, lines and dimensioning. BIS - SP46. Use of plane scales and Representative Fraction, Free hand sketching. **Engineering Curves:** Classification of Engineering Curves, Construction of Conics, Cycloidal Curves, Involutes and Spirals. **Projections of Points & Lines:** Introduction to principal planes of projections, Projections of the points located in same quadrant and different quadrants, Projections of line with its inclination to one reference plane and with two reference planes. True length of the line and its inclination with the reference planes.	
UNIT II:	**03 hrs**
Projections of Solids & Section of Solids: Classification of solids. Projections of solids like Cylinder, Cone, Pyramid and Prism with its inclination to one reference plane and with two reference planes. **Development of Lateral Surfaces:** Concept of development of the different surfaces. Parallel Line Development and Radial Line Development.	
UNIT III:	**03 hrs**
Orthographic Projections: Principle of projection, Principal planes of projection, Projections from	

the pictorial view of the object on the principal planes for View from Front, View from Top and View from Side using first angle projection method and third angle projection method, Full Sectional View.	
UNIT IV:	**04 hrs**
Isometric Projections and Isometric View or Drawing: Isometric Scale, Conversion of orthographic views into isometric projection, isometric view or drawing	
Total Hours	**14 hrs**

Text and References:

1. N. D. Bhatt and V. M. Panchal "Engineering Drawing", Charotar Publishing house, Anand
2. K. Venugopal "Engineering Drawings and Graphics", New Age International (P) Ltd.

ENGINEERING GRAPHICS (PRACTICAL)

16ME101P					Course: Engineering Graphics (Practical)					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
4	0	--	4	4	25	50	25	--	--	100

Prerequisite Subject:

Course Outcomes: The students will learn

- The role of engineering graphics in a product design process. Use of drawing tools and software
- Technical communication skill in the form of communicative drawings

List of Drawing Sheets:

1. Engineering curves
2. Projection of Lines
3. Projections of Solids
4. Development of surfaces of solids
5. Orthographic projections
6. Isometric projections
7. Practice with various CAD tools (2D and 3D drawing)

SEMESTER - II

COURSE CODE	COURSE NAME	L – T – P	CREDITS
16MA103T	MATHEMATICS – II	3 – 1 – 0	4
16SC101T	CHEMISTRY (Theory)	3 – 0 – 2	3
16SC101P	CHEMISTRY (Practical)		1
16ME106T	ELEMENTS OF MECHANICAL ENGINEERING	3 – 0 – 0	3
16EE106T	ELEMENTS OF ELECTRICAL ENGINEERING	3 – 0 – 0	3
16HS109T	PROFESSIONAL ETHICS AND HUMAN VALUES	1 – 0 – 0	1
16ME103P	WORKSHOP PRACTICE	0 – 0 – 2	1
16HS103P	COMMUNICATION SKILLS (Practical)	0 – 0 - 2	1
16TP110	civil Services and Social Internship	0 – 0 – 0	1

MATHEMATICS – II

16MA103T					Course: Mathematics – II					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	--	4	4	25	50	25	--	--	100

Prerequisite Subject:

Course Outcomes:

- Identify the use of various special functions in engineering aspects
- Illustrate the ability to handle mathematical models, to describe physical phenomena, using suitable techniques.
- Develop the ability to apply appropriate tool/method to extract the solutions of engineering problems.
- Analyze the obtained solution in context with theory
- Appraise mathematical problems from real to complex domain
- Create a mathematical model of engineering interest.

UNIT I:	**10 hrs**
Complex Analysis: Complex numbers, Function of a Complex variable, Analytic function, Cauchy-Riemann equations, Conformal mapping and its type, Some standard & special conformal mappings, Definition of a Complex line integral, Cauchy's integral theorem, Cauchy's Integral formula, Residue theorem, Calculation of residues, Evaluation of real definite integrals.	
UNIT II:	**10 hrs**
Ordinary differential equation: Differential equations of first order and higher degree, Linear. Independence and dependence of functions. Higher order differential equations with constant, coefficient, Rules for finding C.F. and P.I., Method of variation of parameter, and method of undermined coefficients, Cauchy and Legendre's linear equations, Linear differential equations of second order with variable coefficients; Simultaneous linear equations with constant coefficients. Various applications of higher order differential equations in solution of engineering problems, Orthogonal trajectories.	
UNIT III:	**10 hrs**
Partial Differential Equations: Formation of P.D.E, Equations solvable by direct integration, Linear and non-linear equations of first order, Lagrange's equations. Homogeneous and non-homogeneous linear P.D.E. with constant coefficients. Rules for finding C.F. & P.I.	
UNIT IV:	**09 hrs**

Laplace transforms: Piecewise continuous functions and exponential order functions, Definition, Existence and Properties of Laplace transform, unit step function and Heavyside function, Inverse laplace transform, laplace transform of derivative, Convolution theorem, Applications for solving differential equations	
Total Hours	**39 hrs**

Texts and References:

1. Complex variables and applications (7thEdition), R.V.Churchill and J.W.Brown, McGraw-Hill (2003)
2. Complex analysis, J.M.Howie, Springer-Verlag (2004)
3. Higher Engineering Mathematics, R. K. Jain & S. R. K. Iyernagar.
4. E.Kreyszig, Advanced engineering mathematics (8th Ed.), John Wiley (1999)
5. W.E.Boyce and R. DiPrima, Elementary Differential Equations (8th Ed.) John Wiley (2005)
6. Ordinary and Partial Differential Equations by M.D. Raisinghania, 8^{th} edition, S. Chand Publication (2010)
7. Introduction to partial differential Equations, K Sankara Rao,PHI Learning pvt ltd.

CHEMISTRY (THEORY)

16SC101T					Course: Chemistry (Theory)					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	--	--	3	3	25	50	25	--	--	100

Prerequisite Subject:

Course Outcomes:

- Understand the hardness of water, different types of hardness and their removal techniques
- Understand types of fuel, types of fuel, calorific values and new age energy devices
- Understand the concept of corrosion, their types and control
- Understand the concept of lubrication and choice of lubricants for various industrial application
- Understand the properties and applications of advanced materials such as polymers, nanomaterials
- Understanding the working principles and applications of various analytical techniques

UNIT I:	**12 hrs**
Water and its Treatment: Introduction, sources of water Impurities in water, hard and soft water, Degree of hardness, Types of hardness, Scale and sludge formation in boiler, Effect of hardness in oil industry, Caustic embrittlement, Priming and Foaming, Softening of water by Lime-Soda process, Zeolite process, Ion-exchange process and RO process. Biological treatment of water, Potable water, COD & BOD. **Corrosion and its Control:** Introduction, Theories of corrosion, Electrode potential, Types of corrosion, Factors of corrosion, Protection of metals from corrosion – Isolation method, Cathodic protection, Sacrificial method, Cathodic protection, ICCP.	
UNIT II:	**13 hrs**
Chemistry of Fuels and Lubricants: **Fuels:** Origin, Classification and properties of Solid, Liquid, Gaseous Fules, Characteristics of good fuel, Merits & demerits of solid, liquid and gaseous fuels, Proximate and Ultimate analysis, Octane number (RON, MON) and Cetane number, Petrol and Diesel Engine, Fuel Cell and Fuel Cell technology **Lubricants -** General characteristics of lubricants, mechanism of lubrication, Classification of lubricants, chemistry of lube oil and greases, Cutting fluids, Selection of lubricants, Properties of lubricants, Biolubricant	

UNIT III:	12 hrs
Chemistry of Advanced Materials : A. Nanomaterials: Basics of Synthesis Properties and Application B. Polymers & Resins C. Modern-age Catalysts (Emission-control catalyst) D. Cement and cementing materials	
UNIT IV:	**13 hrs**
Instrumental Methods of Chemical Analysis Principle, Instrumentation and Applications of FT-IR, UV-Vis, Chromatographic Techniques (GC, etc), Thermal Analysis (TG-DTA-DSC); Electroanalytical techniques (pH-metry, conductometry, potentiometry), Polarimeter	
Total Hours	**50 hrs**

Texts and References:

1. Jain and Jain, Engineering Chemistry, Dhanpat Rai Publication
2. Wiley Engineering Chemistry 2nd Edition
3. Engineering Chemistry 2e, Prasanta Rath, Cengage Learning
4. Textbook of Engineering Chemistry, 4th Edition, R Gopalan, D Venkappayya, S Nagarajan, Vikas Publishing House
5. James G. Speight, The Chemistry and Technology of Petroleum, CRC Press, New York

CHEMISTRY (PRACTICAL)

16SC101P					Course: Chemistry (Practical)					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
--	--	2	1	2	--	--	--	50	50	100

Prerequisite Subject:

Course Outcomes:

- Perform experiments to determine constituents such as Ca, Mg, Fe, Cl, Cu, in samples\ Learning and handling of electroanalytical instruments such as pH meter, Conductivity meter
- Preparation of industrially important organic polymeric compounds and understanding of reaction

List of Experiments [2 hrs Each, maximum 10 experiments]

1. **External Indicator** – To determine the strength of given solution of ferrous ammonium sulphate by titrating against standard N/40 $K_2Cr_2O_7$ using potassium ferricyanide as an external indicator
2. **Iodometry** – To determine the strength of given copper sulphate solution by titrating against N/20 sodium thiosulphate (hypo) solution
3. **Iodimetry** – To determine the strength of given ascorbic acid by titrating against standard N/10 iodine solution
4. **Complexometric Titration** – To determine the total, permanent and temporary hardness of given water by complexometric titration using standard 0.01M EDTA solution
5. **PH metric titration** – To determine the strength of given HCl solution using a standard NaOH solution by performing a pH-metric titration
6. **Conductometric titration** – To determine the strength of given HCl solution using a standard NaOH solution by performing a conductometric titration
7. **Potentiometric titration** – To determine the strength of given HCl solution potentiometrically
8. **Chemical Kinetics** – To study the kinetics of decomposition of sodium thiosulphate by a mineral acid
9. **Chloride in Water** – Determination of Chloride in the given water sample by Mohr Method
10. **Polymerization** – To prepare a polymer (Nylon 6, 10) and identify the functional groups by FT-IR
11. **Melting point** – To determine meting point and purity of an organic compound by digital Melting Range apparatus

12. **Polarimetery** – To measure the optical rotation of various dilutions of sucrose by polarimetry, and calculate the specific rotation of sucrose from the data obtained
13. **Spectrophotometry** – To determine the λmax and concentration of given unknown potassium permanganate using UV-Visible Spectroscopy technique
14. **Gas Chromatography** – To separate different isomers of alcohol and determine the percentage of each by gas chromatography
15. **Thermal Analysis** – To observe fusion, crystallization, glass transition temperatures (Tg) and analyse amount and rate of change in the mass of a sample as a function of temperature/time using thermal analysis technique (DSC-TG)
16. **Chromatography** – To separate mixture of organic compounds by chromatrotron
17. **Fractional Distillation** - To distill mixture of organic solvents by rota-evaporator
18. **Organic preparation** - To prepare Aspirin by Conventional /Microwave/Sonochemistry method
19. **Organic preparation** - To prepare Grignard reagent (methyl magnesium iodide) and its transformation by using chiller

ELEMENTS OF MECHANICAL ENGINEERING

16ME106T					Course: Elements Of Mechanical Engineering					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	--	--	3	3	25	50	25	--	--	100

Prerequisite Subject:

Course Outcomes:

- Understand the basic fundamentals and terminologies applied in thermodynamics
- Analyze and solve closed system and control volume related energy conservation problems with ideal gas and pure substances
- Understand and analyze internal combustion engine cycles, pumps and compressors
- Understand the classification, construction and working and applications of power transmission systems and boilers.

UNIT I:	**10 hrs**
Introduction to Thermodynamics: Definition and its applications. Systems and control volumes, thermodynamic properties, state and equilibrium processes and cycles, temperature and Zeroth law of thermodynamics. Forms of Energy, energy transfer by work and heat, law of conservation of energy (First law of thermodynamics) **Properties of Pure substances:** Definition, examples and phases; Phase change processes, Property diagrams and tables, ideal gas equation of state	
UNIT II:	**10 hrs**
Closed system analysis: Concept of moving boundary work, energy balance. Specific heats, internal energy and Enthalpy-expressions for ideal gas, liquids and gases **Control volume analysis:** Conservation of mass, flow work, energy analysis of steady flow systems and applications **Introduction to 2nd law of Thermodynamics**: Limitations of First Law, Thermal Energy reservoirs, heat engines, Refrigerators and Heat pumps, Kelvin Plank and Clausius statement and their equivalence.	
UNIT III:	**10 hrs**
Internal Combustion Engines: Introduction, classification and brief description of I.C. engines mechanism, 4-Stroke and 2-Stroke petrol, gas and diesel engines, Otto, Diesel and dual cycles and	

their air standard efficiencies and mean effective pressures. **Pump and compressors:** Classification of pumps and compressors, working principle, Theory of single stage reciprocating air compressor, effect of clearance, volumetric efficiency, concept of multistage compression	
UNIT IV:	**10 hrs**
Power transmission systems: Belts, gears, rope, couplings, clutches, brakes, and bearings **Boilers**: Classification, study of various types of boilers.	
Total Hours	**40 hrs**

Texts and References

1. Yunus A. Cengel & Bole, Thermodynamics- An Engineering Approach by Tata Mcgraw Hill, New Delhi
2. P. K. Nag, Engineering Thermodynamics, Tata Mcgraw Hill, New Delhi
3. R.K.Rajput , Engineering Thermodynamics, EVSS Thermo Laxmi Publications
4. Rayner Joel, Engineering Thermodynamics, ELBS Longman.
5. R.Yadav , Fundamentals of Engineering Thermodynamics by, Central Publishing House, Allahabad
6. B L Singhal and R. Singhal, Elements of Mechanical Engineering, Tech-Max Publications, Pune.

ELEMENTS OF ELECTRICAL ENGINEERING

16EE106T					Course: Elements Of Electrical Engineering					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	--	--	3	3	25	50	25	--	--	100

Prerequisite Subject:

Course Outcomes:

- To understand the basics of direct current and it's sources
- To learn new methods to simplify the circuit
- To study fundamentals of alternsting current and it's effect on different circuits.
- To understand the concepts of electromagnetism and electrostatics
- To study three phase circuits and transformer
- To gain knowledge about electric wiring, safety and protection

UNIT I:	**10 hrs**
GENERAL: Concepts of E.M.F., potential difference and current, resistance, effect of temperature on resistance, resistance temperature coefficient, and insulation resistance. S.I. units of work, power and energy. Conversion of energy from one form to another in electrical, mechanical and thermal systems, batteries and cells, their types, primary cells and secondary cells, Lead Acid, Ni-Cd and Ni-MH batteries, current capacity and cell ratings, charging methods and maintenance procedure. **D.C. CIRCUITS:** Classification of electrical networks, Ohm's law, Kirchhoff's law and their applications for network solutions. Simplifications of networks using series and parallel combinations and star-delta conversions	
UNIT II:	**10 hrs**
ELECTROMAGNETISM: Magnetic effect of an electric current, cross and dot conventions, right hand thumb rule and cork screw rule, nature of magnetic field of long straight conductor and toroid. Concept of M.M.F., flux, flux density, reluctance, permeability and field strength, their units and relationships. Simple series and parallel magnetic circuits, analogy of electrical and magnetic circuit, force on current carrying conductors placed in magnetic field, Fleming's left hand rule. Faradays laws of electromagnetic induction, statically and dynamically induced E.M.F., self and mutual inductance, coefficient of couplings. Energy stored in magnetic field. Charging and discharging of inductor and time constant.	

ELECTROSTATICS: Electrostatics field, electric flux density, electric field strength, absolute permittivity, relative permittivity, capacitance and capacitor, composite dielectric capacitors, capacitors in series and parallel, energy stored in capacitors, charging and discharging of capacitors and time constant.

AC FUNDAMENTALS: Sinusoidal voltages and currents, their mathematical and graphical representation, concept of instantaneous, peak (maximum), average and R.M.S. values, frequency, cycle, period, peak factor and form factor, phase difference, lagging, leading and in phase quantities and phasor representation. Rectangular and polar representation of phasors.

UNIT III:	**10 hrs**

SINGLE PHASE A.C. CIRCUITS: Study of A.C. circuits consisting of pure resistance, pure inductance, pure capacitance and corresponding voltage-current phasor diagrams and waveforms. Development of concept of reactance, study of series R-L, R-C, R-L-C circuit and resonance, study of parallel R-L, R-C and R-L-C circuit, concept of impedance , admittance, conductance and suceptance in case of above combinations and relevant voltage-current phasor diagrams, concept of active, reactive and apparent power and power factor.

POLYPHASE A.C. CIRCUITS: Concept of three-phase supply and phase sequence. Voltages, currents and power relations in three phase balanced star-connected loads and delta-connected loads along with phasor diagrams.

SINGLE PHASE TRANSFORMERS: Construction, principle of working, E.M.F. equation, voltage and current ratios. Losses, definition of regulation and efficiency, determination of these by direct loading method. Auto transformers and dimmer stats.

UNIT IV:	**10 hrs**

Electrical Wiring: Connectors and switches, systems of wiring, domestic wiring installation, sub circuits in domestic wiring, simple control circuit in domestic installation, industrial electrification.

ILLUMINATION: Types of lamps, fixtures and reflectors, illumination schemes for domestic, industrial and commercial premises, Lumen requirements for different categories.

SAFETY and PROTECTION: Safety, electric shock, first aid for electric shock and other hazards, safety rules, use of multi-meters, grounding, importance of grounding, equipment grounding for safety, circuit protection devices, fuses, MCB, ELCB and relays.

Total Hours	**40 hrs**

Text and References:

1. B. L. Theraja, "***Electrical Technology***", Vol.1, S. Chand Publication, New Delhi
2. V. N. Mittal, "***Basic Electrical Engineering***", TMH Publication, New Delhi
3. Surjitsingh, "***Electrical Estimating and Costing***", DhanpatRaiand Co.
4. V. K. Mehta, "***Basic Electrical Engineering***", S.Chandand Company Ltd., New Delhi
5. Edward Hughes, "***Electrical Technology***", Seventh Edition, Pearson Education
6. H. Cotton, "***Elements of Electrical Technology***", C.B.S. Publications
7. John Omalley Shawn, "***Basic Circuits Analysis***", McGraw Hill
8. Del. Toro, "***Principles of Electrical Engineering***", Prentice Hall of India

PROFESSIONAL ETHICS AND HUMAN VALUES

16HS109T					Course: Professional Ethics And Human Values					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
1	--	--	1	1	25	50	25	--	--	100

Prerequisite Subject:

Course Outcomes:

- Identify the core values that shape the ethical behaviour of an Engineer
- Awareness on professional ethics and human values
- To know their role in technological development
- To appreciate the rights of others
- Improved soft skills and learn to work in group
- Learn to understand and discuss on issues of social interest

UNIT I:	**03 hrs**
Human Values : Morals, Values and Ethics – Integrity – Work Ethics – Service Learning – Civic Virtue – Respect for others – Living Peacefully – Caring – Sharing – Honesty –Courage – Value time – Co-operation – Commitment – Empathy – Self-confidence – Spirituality- Character. **Engineering Ethi**cs: The History of Ethics-Purposes for Engineering Ethics-Engineering Ethics-Consensus and Controversy –Professional and Professionalism –Professional Roles to be played by an Engineer –Self Interest, Customs and Religion-Uses of Ethical Theories-Professional Ethics-Types of Inquiry – Engineering and Ethics-Kohlberg's Theory – Gilligan's Argument –Heinz's Dilemma	
UNIT II:	**03 hrs**
Engineering as Social Experimentation: Comparison with Standard Experiments – Knowledge gained – Conscientiousness – Relevant Information – Learning from the Past – Engineers as Managers, Consultants, and Leaders – Accountability – Role of Codes – Codes and Experimental Nature of Engineering. **Engineers' Responsibility for Safety and Risk:** Safety and Risk, Concept of Safety – Types of Risks – Voluntary v/s Involuntary Risk- Short term v/s Long term Consequences- Expected Probability- Reversible Effects- Threshold Levels for Risk- Delayed v/s Immediate Risk- Safety and the Engineer – Designing for Safety – Risk- Benefit Analysis-Accidents.	

UNIT III:	04 hrs
Engineers' Responsibilities and Rights : Collegiality-Techniques for Achieving Collegiality –Two Senses of Loyalty- obligations of Loyalty-misguided Loyalty – professionalism and Loyalty-Professional Rights –Professional Responsibilities – confidential and proprietary information-Conflict of Interest-solving conflict problems – Self- interest, Customs and Religion- Ethical egoism-Collective bargaining- Confidentiality-Acceptance of Bribes/Gifts-when is a Gift and a Bribe- examples of Gifts v/s Bribes-problem solving-interests in other companies- Occupational Crimes-industrial espionage-price fixing-endangering lives- Whistle Blowing-types of whistle blowing-when should it be attempted- preventing whistle blowing.	
UNIT IV:	**03 hrs**
Global Issues: Globalization- Cross-culture Issues-Environmental Ethics-Computer Ethics-computers as the instrument of Unethical behaviour-computers as the object of Unethical Acts-autonomous computers-computer codes of Ethics- Weapons Development-Ethics and Research-Analysing Ethical Problems in Research-Intellectual Property Rights.	
Total Hours	**13 hrs**

Books for Reference:

1. "Engineering Ethics & Human Values" by M.Govindarajan, S.Natarajan and V.S.SenthilKumar-PHI Learning Pvt. Ltd-2009.
2. "Professional Ethics and Morals" by Prof.A.R.Aryasri, Dharanikota Suyodhana-Maruthi Publications.
3. "Professional Ethics and Human Values" by A.Alavudeen, R.Kalil Rahman and M. Jayakumaran-Laxmi Publications
4. "Professional Ethics and Human Values" by Prof. D.R. Kiran.
5. "Indian Culture, Values and Professional Ethics" by PSR Murthy- BS Publication.
6. "Ethics in Engineering" by Mike W. Martin and Roland Schinzinger – Tata McGraw-Hill – 2003.
7. "Engineering Ethics" by Harris, Pritchard and Rabins, CENGAGE Learning, India Edition, 2009.

Course Outcome to Programme Outcome Mapping

CO	1	2	3	4	5	6	7	8	9	10	11	12
CO1	W	M	S		M		M		M	M	W	
CO2	W	W	M	M		W		M	M	W		**W**
CO3	W	W	S		W	M	W		W	M		**W**

S: Strong; M : Medium; W : Weak

WORKSHOP PRACTICE

16ME103P					Course: Workshop Practice					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
--	--	2	1	2	--	--	--	50	50	100

Prerequisite Subject:

Course Outcomes:

- Introduction to Carpentry shop and hands on experience.
- Introduction to welding processes in the Welding shop
- Introduction to Fitting shop and measuring instruments
- To study about the Lathe Machine with demonstration
- To study about CNC machines with demonstration

List of Experiments:

1. Introduction to workshop safety and visit and overview of the workshop
2. Introduction to Fitting shop and measuring instruments.
3. Introduction to Carpentry shop and hands on experience.
4. Introduction to welding processes in the Welding shop.
5. Introduction to Arc welding with Demonstration.
6. Introduction to Gas welding and Resistant welding with Demonstration
7. Introduction to Machine shop.
8. To study about the Shaping Machine with demonstration.
9. To study about the Lathe Machine with demonstration
10. To study about the Milling Machine with demonstration.
11. To study about the Metal cutting, Grinding and Drilling Machine with demonstration.
12. To study about sheet metal work with hands on experience.
13. To study about CNC machines with demonstration
14. Hands on experience on Mini lath machine (aluminum block).
15. Hands on experience on Mini milling machine (aluminum block).

COMMUNICATION SKILLS (PRACTICAL)

16HS103P					Course: Communication Skills (Practical)					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
--	--	2	1	2	--	--	--	25	25	50

Prerequisite Subject:

Course Outcomes:

- Reading
- Wrighting Reviews
- Drafting Praposals
- Introducing Product/Service/Company
- Reading Comprehension
- Academic Use of Social Networking Site

Practical:

- Reading
- Writing Reviews (Books/Articles)
- Drafting Proposals
- Note Taking and Note Making
- Manual Writing
- Content Writing (Designing Websites, Creating Online Layout/Blogs)
- Introducing Product/Service/Company
- Reading Comprehension
- Academic Use of Social Networking Sites
- Listening Comprehension – MCQ
- Dictation
- Self-Introduction
- Mock Interviews

Books for References:

1. Bovee, Courtland, John Thill and Mukesh Chaturvedi. Business Communication Today. Delhi: Dorling kindersley, 2009.

2. Kaul, Asha. Business Communication. Delhi: Prentice-Hall of India, 2006.
3. Monippally, Matthukutty M. Business Communication Strategies. New Delhi : Tata McGraw-Hill Publishing Company Ltd., 2005.
4. Sharma, Sangeeta and Binod Mishra. Communication Skills for Engineers and Scientists. New Delhi: PHI Learning Pvt. Ltd., 2009

Semester 3					
Course Code	**Course Name**	**Theory**	**Tutorial**	**Practical**	**Credits**
16MA201T	Maths-III	3	1	0	4
17CV202T	Strength of Materials	3	1	0	4
16CV204T	Fluid Mechanics	3	1	0	4
16CV203T	Building Material and Construction	4	0	0	4
16CV214T	Concrete Technology	2	0	0	2
16CV206T	Engineering Geology	2	0	0	2
17CV202P	Material Testing - Lab	0	0	2	1
17CV204P	Fluid Mechanics - Lab	0	0	2	1
16CV214P	Concrete Technology Lab	0	0	2	1

STRENGTH OF MATERIAL

17CV202T					Course: Strength Of Materials					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

Prerequisite Subject:

Course Outcomes: At the end of semester students should able to

- Calculate simple stresses and strains and elastic constants, normal and tangential stresses, principle stresses using both analytical and graphical methods.
- Students should be able to draw SFD and BMD for simple beams and to calculate bending and shear stresses at various levels across the cross-section of the beam and to sketch the above stresses.
- Derive simple Torque equation and to sketch the variation of the shear stress across the shaft cross-section. Students should also be able to calculate the deflections and slopes of simple beams.
- Distinguish short column from the long column and need to calculate buckling load for long columns. Student should also be able to calculate the stresses in thin and thick cylinders.

UNIT I:	**14 hrs**
Simple Stresses and Strains: Introduction, Properties of Materials, Stress, Strain, Hook's law, Poisson's Ratio, Stress – Strain Diagram for structural steel, Principles of superposition, Total elongation of tapering bars of circular and rectangular cross sections. Composite section, Volumetric strain, expression for volumetric strain, Elastic constants, relationship among elastic constants, Thermal stress and strains. **Compound stresses:** Introduction, Stress components on inclined planes, General two-dimensional stress system, Principal planes and stresses, maximum shear stresses and their planes (shear planes).Graphical solutions for the compound stress using Mohr's circle method.	
UNIT II:	**14 hrs**
Bending moment and shear force diagrams in beams: Introduction, Types of beams loadings and supports, Shearing force in beam, Bending moment, Sign convention, Relationship between loading, shear force and bending moment, Shear force and bending moment equations, SFD and BMD with	

salient values for cantilever beams, simply supported beams and overhanging beams considering point loads, UDL, UVL and Couple.

Bending stress in beams: Introduction: Bending stress in beam, Pure bending, Assumptions in simple bending theory, derivation of Simple bending equation (Bernoulli's equation), modulus of rupture, section modulus, Flexural rigidity, problems on bending stress calculations for various sections of beams. Sketching of the bending stress variation across the sections of beams.

Shear stress in beams: Derivation of Shear stress intensity equations, Derivation of Expressions of the shear stress intensity for rectangular, triangular and circular cross sections of the beams. Problems on calculation of the shear stress intensities at various critical levels of T, I and Hollow rectangular cross sections of the beam. Sketching of the shear stress variation across the sections of beams.

UNIT III:	**12 hrs**

Torsion: Shaft, twisting moment, simple torque theory, derivation of simple torque equation, torsional rigidly, polar modulus, shear stress variation across solid circular and hollow circular sections and related problems

Deflection of beams: Introduction – Definitions of slope, deflection, Elastic curve derivation of differential equation of flexure, Sign convention ,Slope and deflection for standard loading classes using Macaulay's method for prismatic beams and overhanging beams subjected to point loads, UDL and Couple.

UNIT IV:	**12 hrs**

Elastic stability of columns: Introduction – Short and long columns, Euler's theory on columns, Effective length, slenderness ratio, radii of gyration, buckling load, Assumptions, derivations of Euler's Buckling load for different boundary conditions, Limitations of Euler's theory, Rankine's formula and related problems.

Thin and thick cylinders: Introduction: Longitudinal, circumferential (hoop) stress in thin cylinders. Derivations of the expressions for longitudinal and circumferential stresses. Efficiency of longitudinal and circumferential joints. Derivations of the expressions for change in length, diameter and volume when the thin cylinder subjected to internal fluid pressure.

Thick cylinders: Derivations of Lame's equations applicable to thick cylinders, calculation of longitudinal, circumferential and radial stresses. Sketching the variation of radial stress (pressure) and circumferential stress across the wall of thick cylinder.

Total Hours	**52 hrs**

References:

1. B.C Punmia Ashok Jain, Arun Jain, Mechanics of Materials, Lakshmi Publications, New Delhi.
2. Singer, Strength of Materials, Harper and Row Publications.
3. Timoshenko and Young, Elements of Strength of Materials, Affiliated East-West Press.
4. James M. Gere ,Mechanics of Materials, (5th Edition), Thomson Learning.
5. E.P. Popov, Mechanics of Materials Prentice Hall India
6. S Ramamrutham, 'Strength of Materials

FLUID MECHANICS

16CV204T					Course: FLUID MECHANICS					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

Prerequisite Subject:

Course Outcomes:

- Understand the different concepts of fluid mechanics along with their properties
- Analyze the study of fluid kinematics and dynamics
- Design and evaluate the flow characteristics and pipeline networks
- Application of boundary layer and knowledge of forces on fluid

UNIT I:	**13 hrs**
Properties of Fluids: Introduction, Properties of fluid and their explanation, Cohesion-adhesion-surface tension-capillarity-real, ideal and newtonian fluid. **Fluid Statics:**Pressure and Its Measurement – Pressure, pascal's law, pressure gauge and manometers. **Hydrostatic Forces on the Surface :**Total pressure and center of pressure, pressure force on vertical and inclined lamina, curved surface, masonry dams, Minimum bottom width and sections of dams. **Buoyancy and Floatation:** Buoyancy, archimedes' principle, center of buoyancy, meta-center and meta-centric height, types of equilibrium and determination of meta-centric height.	
UNIT II:	**13 hrs**
Fluid Kinematics: Introduction, Methods of fluid motions, Lagrangian and Eulerian methods, Path-stream-streak-potential lines, Types of flow, Continuity equation, Velocity potential-stream function, concept of flow net. **Fluid Dynamics:** Introduction, Energy possessed by fluid body, Energy Equations (Bernoulli's and Euler's), Inter conversion and correction factors, Momentum equation and rate of change of momentum, Barlow's curve.	
UNIT III:	**13 hrs**

Viscous Flow: Introduction, Reynolds experiment, Critical velocity, Laminar flow in circular pipe, Loss head, Two dimensional laminar flow between parallel plates. **Turbulent Flow:** Introduction, Darcy-weisbach equation, Coefficient of friction, Prandtl mixing length theory, Eddy viscosity, Boussineq's equation. **Pipe Flow Analysis:** Introduction, Laws of fluid friction, Darcy-weisbach formula, Hydraulic and total energy line, Pipes in series-parallel, Dupuit's equation, Loss head in tapering pipe, Flow from one tank to another through a pipe, Pressure wave and its velocity, Surge tank.	
UNIT IV:	**13 hrs**
Boundary Layer Flow: Introduction, Boundary layer and separation, Flow in boundary layer, Thickness of boundary layer, Momentum and energy thickness, Drag force, Laminar and turbulent boundary layer, Velocity distribution. **Forces on Submerged Bodies:** Introduction, Drag and lift force, Drag and lift coefficient, Karman-vortex trail, General equations for the force exerted on body. **Impact of Jet:** Introduction, Direct and oblique impact on stationary flat plate, moving plate.	
Total Hours	**52 hrs**

Student centering learning: (The student centering learning contents should be declared at the commencement of semester. It should be maximum 10%; however exact contents is left to faculty)

Texts and References

1. R K Bansal, "A textbook of fluid mechanics and hydraulic machines", Laxmi Publishers, New Delhi, 2015.
2. A K Jain, "Fluid Mechanics including Hydraulic Machines", Khanna Publishers, New Delhi, 2015.
3. R K Rajput, "A textbook of fluid mechanics", S. Chand Publishers, 2013.
4. S Ramamrutham, "Hydraulics fluid mechanics and fluid machines", DhanpatRai Publishers, New Delhi, 2015.
5. P N Modi and S M Seth, "Hydraulics and fluid mechanics", Standard Book House Publishers, New Delhi, 2015.
6. R J Garde and A G Mirajgaoker, "Engineering fluid mechanics", Scitech Publishers, New Delhi, 2012.

Course Outcome to Programme Outcome Mapping:

CO	1	2	3	4	5	6	7	8	9	10	11	12
CO1	S	W	S	S	M	M	S	M	S	S	S	M
CO2	S	M	S	S	M	M	S	S	S	S	M	M
CO3	S	M	S	S	M	M	S	S	S	S	M	M
CO4	S	S	S	S	S	M	S	S	S	S	S	S

BUILDING MATERIALS AND CONSTRUCTION

16CV203T					Course: BUILDING MATERIALS AND CONSTRUCTION					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
4	0	-	4	4	25	50	25	--	--	100

Prerequisite Subject:

Course Outcomes:

- Identify utilization of different materials according to its field requirement and have certain idea about different green building materials
- Develop knowledge of different building components and different types of foundation, masonry and dpc
- Identify methods used for shoring and underpinning and best suitable temporary structure used for the construction with basic knowledge of utilization of best suitable methods and materials for flooring and roofing
- Define different types of doors, windows and staircase and develop the understanding of their suitable locations and dimensions

UNIT I:	**12 hrs**
Building Materials: Different chemical, physical and mechanical properties of materials, Properties-Requirements-Advantages-Disadvantages of different materials i.e; Stone, Brick, Steel, Cement, Lime, Concrete, Wood, Mortar, Paint and Varnish, etc. **Green Building Materials:** Properties and requirements of green building materials, Different types of green building materials used for green building construction	
UNIT II:	**14 hrs**
Building Components: Sub-structure and super-structure with their function in the building. **Foundation:** Requirement of foundation, Type of Shallow foundation i.e; Wall footing,Column footing, Grillage foundation, Combined footing, Mat or Raft footing, etc., Deep Foundationi.e; Pile Foundation, Coffer Dams, Caisson or Well Foundation etc., Design of shallow foundation.	

Masonary: Technical terminology used for masonary, Bonds and connection of brick masonary, Defects and comparison of brick and stone masonary, types of stone masonary, joints in stone masonary, Lifting and dressing tools for stone masonary. Damp Proof Course: Effect and causes of dampness, materials and methods used for DPC, Types of treatment used for DPC	
UNIT III:	**13 hrs**
Walls: Basics of types of wall (load bearing, cavity and partition wall), Detail of types of partition wall. Shoring and Under Pinning: Requirements and types. Scaffolding: Requirements and types. Floors and Roofs: Requirements, terminology used for roofs and types of roofs and flooring material.	
UNIT IV:	**13 hrs**
Doors &Windows: Location of doors and windows, technical terms used for doors and windows, types of doors and windows. **Staircase:** Technical terms used in stair, Requirements of good stairs, types of steps and classification of stairs, Design of stair.	
Total Hours	**52 hrs**

References:

CONCRETE TECHNOLOGY

16CV214T					Course: CONCRETE TECHNOLOGY					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
2	0	0	2	2	25	50	25	--	--	100

Pre-requisite: Building Materials & Construction

Course Outcomes:

- To define and understand the physical properties of cement, sand and aggregates.
- To demonstrate the properties of various types of mineral and chemical additives and their utility
- To explain the important properties of fresh, hardened cement concrete and explain methods to prevent and repair different types of crack
- To solve design concrete mix as per is standards

UNIT I:	**08 hrs**
Introduction to concrete, its component and use. **Hydraulic Cement**: Manufacturing, emission, types and hydration. **Aggregates:** properties, types of aggregates, classifications, grading of aggregates, packing and void contents, alkali-aggregate reactions, testing of aggregates	
UNIT II:	**04 hrs**
Mineral Additives: properties of Fly ash, slag, silica fume, metakaolin, rice husk ash, lime powder. Chemical Additives: plasticizers, superplasticizers, retarders, water reducers, air entraining admixture.	
UNIT III:	**10 hrs**
Fresh Concrete: Workability, rheology, shrinkage, bleeding, segregation, test methods Hardened Concrete: Strengths of hardened concrete (Tensile & Compressive strength, Flexural& Bond strength), standard test methods as per IS standards. Durability and Permeability of Concrete: Mass transport in concrete, carbonation, chloride ingress, sulphate attack, salt attack, frost, salt scaling, alkali silica reaction, repair, Cracking: Chemical shrinkage, autogenous shrinkage, drying shrinkage, plastic shrinkage, thermal cracking.	
UNIT IV:	**04 hrs**

Mix design of concrete: roles of water to cement ratio, water content, chemical admixtures, mineral additives, aggregates Non-Destructive testing and repair of concrete.	
Total Hours	**26 hrs**

Text and References:

1. R. Santhakumar, Concrete Technology oxford university press, 2011.
2. M.S. Shetty, Concrete Technology- Theory and Practice, S.Chand Publication.
3. M.L.Gambhir, Concrete Technology, TaTaMacgrawhill publication
4. A.M.Neville, Concrete Technology, Pearson education India ltd.

ENGINEERING GEOLOGY

16CV206T					Course: Engineering Geology					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
2	0	0	2	2	25	50	25	--	--	100

Pre-requisite: Building materials &Costruction

Course Outcomes:

- Students will develop the basic observational skills needed to function as geoscientists.
- Students will make quantitative measurements of various physical, chemical and biological properties of the earth system
- Students will develop mapping skills and use such as topographic and geologic maps to estimate distances, visualize landforms, and locate / identify geographic and geologic features
- Students will identify the common forms of igneous, metamorphic, and sedimentary rock in hand samples and in field exposures using observations of mineral composition and texture.

UNIT I:	**06 hrs**
Definition and scope of geology, branches of geology, origin, age and interior of earth movements and importance in engineering, plate tectonics, earthquake belts in India, Geological agencies/ earth processes: weathering, erosion by running waters, glaciers, wind and ocean and their engineering importance.	
UNIT II:	**06 hrs**
Mineralogy: study of the rock forming minerals, properties , behaviour and engineering significance of clay minerals	
UNIT III:	**07 hrs**
Petrology: classification of rocks, description, occurrence, engineering properties and distribution various types of rocks/construction materials	
UNIT IV:	**07 hrs**
Structural geology: Dip, strike, folds, faults and joints-their engineering aspects, geological maps and geotechnical investigations for dam, tunnels, buildings, road cuttings, landslides-causes and prevention, sea erosion and coastal protection.	
Total Hours	**26 hrs**

Text and References:

1. Kesavulu , Textbook of Engineering Geology, Macmillan India Limited, 2nd Ed, 2009
2. K M Bangar , Principals of Engineering Geology : Standard Publishers Distributors, 2ndEdition, 2009
3. D V Reddy, Engineering Geology, Vikas Publishing House, 1st Edition, 2010
4. Waltham Tony, Tony Waltham, Foundations of Engineering Geology, Spons Architecture Price Book, 3rd Edition, 2009

MATERIAL TESTING LAB

17CV202P					Course: MATERIAL TESTING LABORATORY					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
-	-	2	1	2	-	-	-	25	25	50

Prerequisites: Basic Surveying Theory

Course outcomes:

- Conduct standard tests on metals under various static load like tension, compression shear and bending
- Conduct standard tests on metals under impact load.
- Conduct standard tests of flexure and compression test on clay roof tiles and brick respectively
- Conduct standard tests of crushing, impact and abrasion on course aggregate.

Course Outcome to Programme Outcome Mapping:

	1	2	3	4	5	6	7	8	9	10	11	12
CO-1	S	S	S	S				M	S	S	S	S
CO-2	S	S	S	S				M	S	S	S	S
CO-3	S	S	S	S				M	S	S	S	S
CO-4	S	S	S	S	S			M	S	S	S	S

S: Strong; M: Medium; W: Weak

FLUID MECHANICS

17CV204P					Course: Fluid Mechanics-I					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
-	-	2	1	2	-	-	-	25	25	50

Course outcomes:

- Understand the concepts of fluid mechanics
- Application of concepts for its practical field
- Analysis of data for fluid mechanics problem in field
- Evaluate the data and their importance in fluid mechanics problem

List of Experiments:

1. Determination of viscosity of oil
2. Establish relationship between pressure and height
3. Determination of metacentre of a floating body
4. Verification of conservation of energy in a duct based on Bernouli's theorem
5. Calibration of venturimeter, orifice meter, pitot tube and rotameter
6. Determination of coefficient of friction in close conduit as major losses
7. Determination of minor losses from bend, elbow, sudden contraction, enlargement

CONCRETE TECHNOLOGY LAB

16CV214P					Course: CONCRETE TECHNOLOGY LAB					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
-	-	2	-	2	-	-	-	25	25	50

Prerequisite: Concrete Technology Theory

Course outcomes:

- To exhibit the memory and effectively link theory with practice and demonstrate the properties of aggregates.
- To demonstrate understanding of basic concept of cement and experimental work on the properties of cement
- To demonstrate the workability and mechanical properties of concrete
- To demonstrate the workability and mechanical properties of concrete

List of Experiments:

Aggregates

(a) Fineness modulus of fine and coarse aggregate

(b)Flakiness & Elongation Index

(d) Bulk Density

(e) Bulking of sand

(h) Water Absorption

(i) Los Angeles Abrasion test

Cement

(a) Fineness of cement by sieve analysis

(b) Specific gravity of cement

(c) (i) Standard consistency of cement & (II)Initial and final setting time of cement

(d) Soundness of cement by Le-chatelier method

Concrete

(a) Compressive strength of cement mortar cube

(b) Workability of cement concrete by

(i) Slump test

(ii) Compaction factor test

(iii) Flow table test

(b) Workability test on Self compacting concrete [slump, L-Box, V-Funnel, U-Box]

(c) Compressive strength of cement concrete cube

(d) Non-destructive test of concrete

Lab Outcome to Programme Outcome Mapping

CO	1	2	3	4	5	6	7	8	9	10	11	12
CO1			S		M		M		M	S		
CO2			S	M	M	M	S			M		
CO3		S	S	S	M	S						
CO4		S	S	S	M	S			M			

S: Strong; M: Medium; W: Weak

Semester 4					
Course Code	**Course Name**	**Theory**	**Tutorial**	**Practical**	**Credits**
18CE314T	Structural Analysis	3	1	0	4
16CV212T	Hydraulic Engineering	3	1	0	4
17CV205T	Basic Surveying	4	0	0	4
16CV203T	Building Planning and Drawing	4	0	0	4
18CV43P	Hydraulic Engineering - Lab	0	0	2	1
18CV207P	Surveying Practice - Lab	0	0	2	1
	Communication Lab - II	0	0	2	1
18CV318T	Open Elective	3	0	0	3
MA202T	Numerical Techniques	3	1	0	4
	Industrial Orientation (3 weeks)	0	0	0	1

STRUCTURAL ANALYSIS – I

18CE314T					Course: STRUCTURAL ANALYSIS - I					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	-	4	4	25	50	25	-	-	100

Prerequisite: Strength of Material

Course Outcomes:

- After completion of this course the students will be able toanalyze simple beams for slopes & deflection using moment area and conjugate beam methods, and three-hinged arches for axial thrust, shear and bending moment
- Determine deflections using strain energy method, unit load method and castigiano's theorem
- Analyze two hinged arch and to draw ild for reaction, shear and bending moment in simple beams
- To analyze indeterminate beams using clapeyron's theorem of three moments.

UNIT I:	**14 hrs**
Structural systems: Forms of structures, Conditions of equilibrium, Degree of freedom, Linear and Non linear structures, One, two, three dimensional structural systems, Determinate and indeterminate structures. Deflections of Beams: Moment area method, Conjugate beam method. Three hinged circular and parabolic arches with supports at same levels and different levels, Determination of thrust, shear and bending moment,	
UNIT II:	**12 hrs**
Strain energy: Definitions of Strain energy due to axial load, bending and shear, theorem of minimum potential energy, law of conservation of energy, Principle of virtual work, The first and second theorems of Castigliano, problems on beams, frames and trusses, Betti's law, Clarke - Maxwell's theorem of reciprocal deflection. Deflection of beams and simple frames using strain energy method.	
UNIT III:	**14 hrs**
Deflection: Deflection of joints of trusses using unit load method Two Hinged Arches: Analysis of two hinged parabolic arches for various loading cases.	

Influence Diagrams reaction, shear force bending moments of statically determinate beams. Maximum bending moments and shear forces at specified sections due to static and moving loads	
UNIT IV:	**12 hrs**
Consistent Determination method: Analysis of single span beams with various loading and boundary conditions. Analysis of Continuous beams using Clapeyron's theorem of three moments	
Total Hours	**52 hrs**

Text and References:

1. Reddy C. S., Basic Structural Analysis,Tata McGraw Hill, New Delhi.
2. R.C.Hibbeler, 'Structural Analysis, sixth Edition, Pearson publications, NewDehli
3. S.B.Junnarkar & H J Shah, "Mechanics of Structures", Volume I, Charotar publishing house, Anand
4. T S Thandava Moorrthy , Structural Analysis, Oxford University Press
5. B.C. Pumia, Strength of Materials and Theory of Structures Vol I & II, Jain Laxmi Publication, New Delhi.

Course Outcome to Programme Outcome Mapping

CO	1	2	3	4	5	6	7	8	9	10	11	12
CO1	S		S									
CO2	S	M	S									
CO3	S	W	S								M	
CO4	S	M	S								M	

S : Strong M : Medium; W : Weak

HYDRAULIC ENGINEERING.

16CV212T					Course: HYDRAULIC ENGINEERING					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	-	4	4	25	50	25	-	-	100

Prerequisite:

1. Elements of Civil Engineering and Applied Mechanics
2. Strength of Materials
3. Fluid Mechanics - I

Course outcomes:

- Define the dimensional and model analysis
- Classify and analyze the uniform flow and it characteristic
- Classify and analyze the non-uniform flow and applications
- Classify the orifice and mouth pieces, notches and weir
- Justify and prove the uniform and non uniform flow by the expression
- Design and evaluting most economical section

UNIT I:	**12 hrs**
Dimensional and Model Analysis: Introduction, Physical quantity, Systems of units, Dimensions of quantities, Dimensional homogeneity of equation, Dimensional analysis, Rayleigh's and Buckingham's method, Models and analysis, Selection of scale and similarity of behavior, Similitude, Resistance to the motion of a partially submerged body, Fixed and movable bed models, Karman number, Distorted models.	
UNIT II:	**13 hrs**
Uniform flow: Classification of flow in channels, Geometry elements in channel section, Velocity distribution in a channel, Chezy's formula, Uniform flow, Chezy's, Kutter's and Manning's equation, Most economic sections of a channel, Rectangular, trapezoidal, Circular and triangular channel sections.	
UNIT III:	**13hrs**
Non-uniform flow: Critical flow in channel, Normal and critical slopes, Specific force, Computations for critical velocity and critical depth, Hydraulic jump, Expression for hydraulic jump, Length of	

hydraulic jump, Gradually varied flow, Characteristics of gradually varied flow, Computations of gradually varied flow in channels, Applications of critical flow concepts, water surface profiles.	
UNIT IV:	**12 hrs**
Orifices and Mouthpieces: Orifice, Classification of orifice, Coefficient of orifice and their relationship, Discharge through orifice, Time of emptying tank, Mouthpiece and its classification, External mouthpiece, Convergent-divergent mouthpiece, Borda's mouthpiece. **Notches and Weirs:** Introduction, Difference between notch and weir, Classification of notch and weir, Discharge through different types of weir, Velocity approach, Time of emptying reservoir by rectangular an triangular weir, Discharge through bridge openings, Sluice gate.	
Total Hours	**50 hrs**

Text and References:

1. Dr. R K Bansal, "A textbook of fluid mechanics and hydraulic machines", Laxmi Publishers, New Delhi, 2015.
2. Dr. A K Jain, "Fluid Mechanics including Hydraulic Machines", Khanna Publishers, New Delhi, 2015.
3. Er. R K Rajput, "A textbook of fluid mechanics", S. Chand Publishers, 2013.
4. Er. S Ramamrutham, "Hydraulics fluid mechanics and fluid machines", Dhanpat Rai Publishers, New Delhi, 2015.
5. P N Modi and S M Seth, "Hydraulics and fluid mechanics", Standard Book House Publishers, New Delhi, 2015.
6. R J Garde and A G Mirajgaoker, "Engineering fluid mechanics", Scitech Publishers, New Delhi, 2012.
7. K Subramanya, "Flow in open channels", McGraw Hill Publishers, New Delhi, 2015.
8. Ven Te Chow, "Open channel hydraulics", McGraw Hill Publishers, New Delhi, 2012.

Course Outcome to Programme Outcome Mapping:

CO	1	2	3	4	5	6	7	8	9	10	11	12
CO1	S	M	S	W	W	M	S	M	M	S	S	M
CO2	S	M	S	S	S	M	S	M	M	M	S	W
CO3	S	M	W	W	M	M	S	S	S	M	S	M
CO4	W	W	S	S	S	M	S	S	S	S	S	S

S: Strong; M: Medium; W: Weak

BASIC SURVEYING

16CV205T					Course: Basic Surveying					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
4	--	--	4	4	25	50	25	-	-	100

Prerequisite:

Course Objective:

- To understand the principles and procedure for linear and angular measurement
- To learn the importance and procedure for elevation calculation and contour plotting
- To be aware of various methods and significance of plate table surveying and Theodolite surveying
- To recognize the usefulness of calculating area and volume in construction work and also learn to use surveying in various construction projects.

Course Outcome:

- Understand the principles and procedures for linear and angular measurement
- Learn the basic methods of elevation measurement and create contour maps for elevation
- Analyze the method and principle of plane table surveying and theodolite traversing
- Examine and measure the area and volume of a given survey site

UNIT I:	**10hrs**
Linear measurements: Classification of surveys; Linear measurements using chains and tapes, chaining and ranging, principles of chain survey, reciprocal ranging, applications, errors and corrections in chaining, obstacles in chaining, Procedure of field work **Angle and direction measurements:** Introduction, Measurement of bearing, Designation of bearings, whole circle bearings & quadrant bearings, fore bearing and back bearing, Computation of angles from bearings, Principles of compass survey, local attraction and corrections, Numerical	
UNIT II:	**14 hrs**
Elevation measurements: Principle of levelling, levelling instruments- Dumpy and Automatic levels, booking and reducing levels, simple and differential levelling, profile and cross-section levelling,	

reciprocal levelling, methods of levelling, levelling difficulties, curvature and refraction corrections, examples, **Contouring:** definition, contour interval, characteristics of contours, direct and indirect methods of contouring, interpolation of contours, uses of contour maps.	
UNIT III:	**14hrs**
Plane table survey: Equipment's, working operations, different methods, advantages and disadvantages, Two point and Three point problems **Theodolite Traversing:** Theodolite, temporary and permanent adjustments, measurement of horizontal and vertical angles, elimination of errors, Traversing: Uses and method of traversing, traversing procedure, check in closed and open traverse, traverse computation, plotting of traverse survey, numerical, Total station, functioning and measurements, field project using total station	
UNIT IV:	**14 hrs**
Computation of Areas &Volumes: Introduction, Computation of area of regular & irregular boundary, Trapezoidal& Simpson's rule, computation of volume for earthwork in cutting & filling **Survey Projects:** Introduction, survey work in various construction projects such as railway projects, road projects, water supply projects, topographic survey, city survey etc.	
Total Hours	**52 hrs**

Books for Reference:

1. Charles D. Ghilani, "Elementary Surveying", 13th Edition, Prentice Hall, Delhi
2. A M Chandra, "Higher Surveying", 3rd Edition, New Age International Publications, New Delhi
3. B C Punmia, "Surveying Vol. I", 17th Edition, Laxmi Publishing House, New Delhi
4. S K Duggal, "Surveying Vol. I", 4th Edition, Tata McGraw Hill Publication, New Delhi
5. N NBasak, "Surveying and Levelling", 2nd Edition, Tata McGraw Hill Publication, New Delhi

Course Mapping:

	1	2	3	4	5	6	7	8	9	10	11	12
CO-1	S	S	S	S					M	M	M	M

CO-2	S	S	S	S					M	M	M	M
CO-3	S	S	S	S					M	M	M	M
CO-4	S	S	S	S	S				M	M	M	M

BUILDING PLANNING AND DRAWING

16CV203T					Course: Building Planning and Drawing					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
2	0	4	6	6	25	50	25	-	-	100

Prerequisite:

Course Objectives:

- To learn about different principles of planning and building bye laws and functions of governing bodies.
- To study the terminology used for building planning and different aspects of the building with fire protection.
- To learn about plan, elevation and section of the building for residential and commercial buildings.
- To study about perspective view of the building and terminology with methods used for perspective drawing.

Course Outcomes:

- By learning this students are able to know about principles of planning, bye-laws of buildings and they can have idea about the functions of different governing bodies.
- By this study students are ready to get certain idea about different term used in building planning and different building bye-laws used for residential building.
- After learning this, students are able to know about the Plan, Elevation and Section of the Building and they can deal with planning of different residential as well as commericial buildings.
- By learning this, students will learn about different methods of projection and its applications in practical engineering field.

UNIT I:	**06hrs**
Introduction: Building industries, Classification of Buildings, Components of Building, Orientation of Building, Principle of Planning, National Building Code of India – 2005, Objectives and Scope of Building Bye Laws, Function of Different Governing Authority. Signs and Symbols with Abbreviations used in Building Drawing, Different types of Doors and Windows.	
UNIT II:	**06 hrs**

Building Planning: Aspect and Prospect of Building, Types of area, Set-back, FSI, Building Bye Laws of Residential Building, Some of Important Terminology related with Building Planning, Fire Protection Kingpost Truss, Queen post Truss, Stairs Drawing of30 cm Wall Section from Foundation to Slab (GF + FF)	
UNIT III:	**06 hrs**
Building Drawings: Types and Site Selection for Residential Building, Minimum, Dimensions of the Rooms for Residential Building, Planning Process and Requirement of Different Rooms of Building, Line Diagram and Site Plan for residential Building Planning of Single Story Residential Building Planning of Double Story Residential Building	
UNIT IV:	**06 hrs**
Planning of Different Public Building. **Perspective Drawing:** Necessity, Principles and Characteristics of Perspective Drawing Terminology Related with Perspective Drawing, Classification of Perspective Drawing. 1. Planning of Public Building (School, Bank, Commercial Complex, etc.) 2. Two Point Perspective Drawing	
Total Hours	**24 hrs**

Text and References:

1. "Building Planning and Drawing" by N. Kumara Swamy, A. Kameswara Rao Charotar Publications,
2. "Civil Engineering Drawing and House Planning" by B. P. Verma Khanna Publishers,
3. "Building Planning Designing And Scheduling" by Gurcharan Singh
4. "Building Planning and Drawing" by S. S. Bhavikatti (Author), M. V. Chitawa
5. National Building Code
6. "Civil Engineering Drawing" by S.C.Rangwala,
7. "Building planningandDrawing" by Dr. H.J. Shah, charterpublishing house pvt. Limited 2007

HYDRAULIC ENGINEERING LAB

18CV46P					Course: Hydraulic Engineering Laboratory					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	6	3	6	25	50	25	-	-	100

Prerequisite:

Course Objectives:

- Identify and obtain values of fluid properties and relationship between them.
- Understand the principles of continuity, momentum, and energy as applied to fluid motions.
- Recognize these principles written in form of mathematical equations.
- Apply these equations to analyze problems by making good assumptions and learn systematic engineering method to solve practical fluid mechanics problems.
- To compare the results of analytical models introduced in lecture to the actual behavior of real fluid flows.

Course Outcomes:

- Understand the concepts of hydrulic engineering
- Application of concepts for its practical field
- Analysis of data for hydrulic engineering problem in field
- Evaluate the data and their importance in hydrulic engineering problem

List of Experiments:

1. Determination of hydraulic coefficient using orifice and mouthpiece.
2. Measurement of velocity distribution in open channel using pitot tube, current meter and Acoustic Doppler Velocimeter (ADV), plotting of isovels& computation of energy and momentum correction factor.
3. Measurement of Manning's & Chezy's roughness coefficients in laboratory hydraulic tilting bed flume.
4. Determination of coefficient of discharge of venture flume, rectangular streamlined weir ogee weir, V-notch weir and sluice gate.
5. Establishment of sub-critical, critical & super-critical flows in open channel and plotting of specific energy curve.
6. Measurement and computation of gradually varied profile in open channel.

7. Establishment of hydraulic jump and study the characteristics of hydraulic jump in open channel.
8. Measurement of discharge over hump.
9. Observation of flow over spillway.

Text and References:

1. R K Bansal, “A textbook of fluid mechanics and hydraulic machines”, Laxmi Publishers, New Delhi, 2015.
2. A K Jain, “Fluid Mechanics including Hydraulic Machines”, Khanna Publishers, New Delhi, 2015.
3. R K Rajput, “A textbook of fluid mechanics”, S. Chand Publishers, 2013.
4. S Ramamrutham, “Hydraulics fluid mechanics and fluid machines”, DhanpatRai Publishers, New Delhi, 2015.
5. P N Modi and S M Seth, “Hydraulics and fluid mechanics”, Standard Book House Publishers, New Delhi, 2015.
6. R J Garde and A G Mirajgaoker, “Engineering fluid mechanics”, Scitech Publishers, New Delhi, 2012.
7. K Subramanya, “Flow in open channels”, McGraw Hill Publishers, New Delhi, 2015.
8. VenTe Chow, “Open channel hydraulics”, McGraw Hill Publishers, New Delhi, 2012.

SURVEYING PRACTICE LAB

18CV207P				Course: Basic Surveying Practice					
Teaching Scheme				Examination Scheme					
L	T	P	C	Theory			Practical		Total Marks
				MS	ES	IA	LW	LE/Viva	
-	-	2	2	--	--	--	25	25	50

Prerequisite: Basic Surveying Practice

Course Objective:

- To learn the usefulness of traditional survey methods through chain, tape and compass survey
- To learn the principles and procedure for using dumpy level for elevation calculation and contour plotting
- To be able to use Theodolite for engineering survey in various situations
- To be able to handle Total station for various engineering purposes

Course Outcome: At the end of this course, students will be able to:

- Usefulness of traditional survey methods through chain, tape and compass survey
- Use dumpy level for elevation calculation and contour plotting
- Theodolite for engineering survey in various situations
- Planimeter for determination of irregular areas

List of Experiments

1. Introduction to Surveying. Measurement of distance by ranging and chaining.
2. Measurement of bearings of sides of traverse with prismatic compass and computation of correct included angle
3. Locating given building by chain and compass traversing. (One full size drawing sheet)
4. Determination of elevation of various points with dumpy level by collimation plane method and rise & fall method. (One full size drawing sheet)
5. Measurement of horizontal and vertical angles from Theodolite.
6. Plotting a closed traverse using Theodolite. (One full size drawing sheet)
7. Plotting a open traverse using Theodolite (One full size drawing sheet)
8. Contour plan of given area.
9. Contour drawing of given area. (One full size drawing sheet)

10. Study of Total Station. Horizontal and vertical distance using Total Station
11. Traversing and area calculation using Total Station
12. Data import and processing from Total Station in software
13. Study of planimeter. Determination of area of irregular figure by using planimeter

Course Mapping:

	1	2	3	4	5	6	7	8	9	10	11	12
CO-1	S	S	S	S				M	S	S	S	S
CO-2	S	S	S	S				M	S	S	S	S
CO-3	S	S	S	S				M	S	S	S	S
CO-4	S	S	S	S	S			M	S	S	S	S

COURSE STRUCTURE OF 5TH SEMESTER CIVIL ENGINEERING OF BATCH 2018-22

Semester	Sr.No	Course Code	Course Name	Theory	Tutorial	Practical	Hrs	Credits
Semester 5	**1**	18CE301T	Structural Analysis – II	3	1	0	4	4
	2	18CE304T	Geotechnical Engineering – I	3	1	0	4	4
	3	18CE303T	Environmental Engineering – I	3	1	0	4	4
	4	18CE302T	Hydrology and Water Resources Engineering	4	0	0	4	4
	5	18CE305T	Advance Surveying and Geomatics	3	0	0	3	3
	6	18CE305P	Advance Surveying and Geomatics Practice	0	0	2	2	1
	7	18CE304P	Soil Mechanics Lab	0	0	2	2	1
	8	18CE303P	Environmental Engineering - I Lab	0	0	2	2	1

18CE301T					STRUCTURAL ANALYSIS – II					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	-	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To analyze the indeterminate beam and rigid joint frames for sway and non sway analysis.
- To understand elasto-plastic deformation of structures and collapse analysis of beam and rigid joint frame.
- To analyse indeterminate beam and rigid joint frame by matrix method.

UNIT 1 Slope Deflection Method **13 Hrs.**

Slope deflection method: Introduction, Sign convention, Development of slope-deflection equations and Analysis of beams and orthogonal rigid jointed plane frames (non-sway and sway analysis)

UNIT 2 Moment Distribution Method and Kani's Method **13 Hrs.**

Moment distribution method: Introduction, Definition of terms- Distribution factor, Carry over factor, Development of method and Analysis of beams and orthogonal rigid jointed plane frames (non-sway and sway analysis)

UNIT 3 Plastic Analysis **13 Hrs.**

Plastic Analysis: Introduction to plastic theory. plastic hinge, plastic moment, load factor, shape factors of various standard sections like rectangular, circular, triangular, T and I sections, collapse load, beam mechanism, column mechanism, sway mechanism, combined mechanisms. Plastic analysis of simple, continuous and portal frame for collapse load and plastic moments.

UNIT 4 Matrix methods of analysis **13 Hrs.**

Matrix methods of analysis: flexibility method, Stiffness matrix method, Introduction, Development of stiffness matrix for plane truss element and axially rigid plane framed structural elements and analysis of plane truss and axially rigid plane frames by stiffness method and Flexibility method

Max. 52 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO.1:- Analyze the indeterminate beams and rigid joint frame by slope and deflection method.
CO.2:- **Analyze** the indeterminate beams and rigid joint frame by moment distribution method.
CO.3:- **Analyze** the indeterminate beams and rigid joint frame by Kani's method
CO.4:- Understand the various concepts in plastic analysis.
CO.5:- Analyze collapse load for beam and frame by static and kinematic method.
CO.6:- Analyze indeterminate beam and frame by matrix method.

TEXT/REFERENCE BOOKS

1. Basic Structural Analysis: C.S.Reddy
2. Indeterminate Structural Analysis: C.K.Wang
3. Elementary structural analysis: J.B.Willbur, C.H. Norris and Utku
4. Plastic methods of Structural analysis: B.G. Neal

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END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A/Question: <Details> <> Marks

Part B/Question: <Details> <> Marks

18CE304T					Geotechnical Engineering I					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	-	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To describe origin of soil, phase diagram and relevant fundamental geotechnical parameters.
- To explain Index properties of soil.
- To explain compaction theory and compaction effort monitoring.
- To explain flow through permeable soil media, seepage effect and capillary phenomena.
- To explain concept of shear strength and consolidation of soils

UNIT 1 **13 Hrs.**

Fundamental definitions, origin and formation of soil. Phase Diagram, Voids ratio, Porosity, Percentage Air Voids, Air content, Degree of saturation, Water content, Specific Gravity of soil solids and soil mass, Densities and Unit weights - Bulk, Dry, Saturated & submerged and their inter relationships

UNIT 2 **13 Hrs.**

Index Properties of soil- Water content, Specific Gravity, Particle size distribution, Relative Density, Consistency limits and indices, in-situ density, Activity of Clay, Laboratory methods of determination of index properties of soils.Compaction, Standard and Modified proctor's compaction tests, factors affecting compaction, effect of compaction on soil properties, Field compaction control – compactive effort & method, lift thickness and number of passes, Proctor's needle, Compacting equipment

UNIT 3 **13 Hrs.**

Permeability, Darcy's law- assumption and validity, coefficient of permeability and its determination, factors affecting permeability, permeability of stratified soils, Seepage velocity, Superficial velocity and coefficient of percolation, quick sand phenomena, Capillary Phenomena. Concept of shear strength, Mohr-coulomb theory, conventional and modified failure envelops, Effective stress concept total stress, effective stress and Neutral stress, Concept of pore pressure, Total and effective shear strength parameters, factors affecting shear strength of soils

UNIT 4 **13 Hrs.**

Consolidation: Definition, Terzaghi's one dimensional consolidation theory-assumption and limitations, Normally consolidated, under consolidated and over consolidated soils, pre-consolidation pressure and its determination, Consolidation characteristics of soil

Max. 52 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Explain the origin soil and fundamental parameters of geotechnical engineering
CO2 – Classify the type of soil based on index properties.
CO3 – Quantify the compaction and consolidation characteristics of soil for field monitoring.
CO4 - Estimate the stress increment in soil domain due to foundation load.
CO5 – Quantify the change in soil stress characteristics due to flow of water through it.
CO6 – **Compute** the shear strength parameters for different soil and field condition

TEXT/REFERENCE BOOKS

1. Punmia B.C., "Soil Mechanics and Foundation Engineering." 16th Edition Laxmi Publications Co., New Delhi.
2. Murthy V.N.S., "Principles of Soil Mechanics and Foundation Engineering", 4th Edition, UBS Publishers and Distributors, New Delhi, 1996
3. Braja, M. Das, "Geotechnical Engineering", Fifth Edition, Thomson Business Information India (P) Ltd., India, 2002
4. Bowles J.E., "Foundation Analysis and Design", 5th Edition, McGraw Hill Pub. Co. New York, 1996
5. Alam Singh and Chowdhary G.R., "Soil Engineering in Theory and Practice", CBS Publishers and Distributors Ltd., New Delhi, 1994
6. Gopal Ranjan and Rao A.S.R., "Basic and Applied Soil Mechanics", New Age International (P) Ltd., New Delhi, 2000

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A/Question: <Unit I and Unit II> <25> Marks

Part B/Question: <Unit III and Unit IV> <75> Marks

18CE303T					Environmental Engineering I					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

1. Understanding the various aspects of water - sources, quality, demands
2. Design of Water Treatment Plant
3. Design of Water Distribution Network
4. Understanding the Water Management Concepts

UNIT 1 DRINKING WATER 13 Hrs.

Water cycle, Sources of water, Water quality standards, Impact of water quality on - human health, agriculture, materials etc., Water Demands types and estimation, Water Budget, Population Forecasting Methods.

UNIT 2 WATER TREATMENT 13 Hrs.

Design of Screens, Types of settling and settling tests, Design of Sedimentation Tank, Coagulation: mechanisms of coagulation, Mixing and Flocculation, Design of clariflocculator, Filtration: Slows sand filters, rapid sand filters, Water Softening, Water Disinfectioning, Action plan for efficient plant operation

UNIT 3 WATER DISTRIBUTION NETWORK 13 Hrs.

Pumps for lifting the water, Storage Reservoir, Water Distribution Network: analysis and design, Appurtenances in the distribution network

UNIT 4 WATER HARVESTING AND MANAGEMENT 13 Hrs.

Rain water Harvesting, Ground Water Recharge and Development, Water Conservation, Water Footprint, Planning and preparing Water Supply Projects

TOTAL 52 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Estimate the present and future needs of water of a city
CO2 – Design a Water Treatment Plant
CO3 – Propose measures for efficient functioning of a water treatment plant
CO4 – Design a Water Distribution Network
CO5 – Design of Water Harvesting units
CO6 – Devise a Water Supply project for a community / city

TEXT/REFERENCE BOOKS

1. Water Supply Engineering (Environmental Engineering), S. K. Garg, Khanna Publishers, 2016
2. Water Supply and Sanitation Engineering, GS Birdie, JS Birdie, Galgotia Publishing Ltd
3. Environmental Engineering, HS Paevy, DR Rowe, G Tchobanoglous, McGraw Hill
4. Water and Wastewater Engineering, Metcalf and Eddy, McGraw Hill
5. Chemistry for Environmental Engineers, Sawyer, C.N. and McCarty, P.L., and Parkin, G.F. 4th Edn. McGraw Hill, New Delhi, 1994.
6. Process Chemistry for Water and Wastewater Treatment, Benefield, Judkins and Weand, Prentice Hall

END SEMESTER EXAM PAPER SCHEME (Max Marks : 100)

Part A	8 Questions of 5 Marks each. 2 Questions from every unit.	40
Part B	6 Questions of 10 Marks each. 1 Question from unit 1 & 2 and 2 Questions from Unit 3 & 4	60

18CE302T					Hydrology and Water Resources Engineering					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	04	04	25	50	25	--	--	100

COURSE OBJECTIVES

- To understand the basic component of hydrology.
- To provide fundamentals of Ground water hydrology.
- To understand flood control measure and reservoir operation in hydrology
- To understand the case application of modelling techniques in water resources engineering

UNIT 1 BASIC CONCEPT OF HYDROLOGY **15 Hrs.**

Introduction, Worlds Water Resources, Hydrologic Cycle, Precipitation: Types-Forms-Measurement, Rain Hyetograph and Mass Curve, DAD relationship, IDF curve, Run Off: Rainfall-Runoff Process, Surface runoff, Direct Runoff, Base flow Separation, Evaporation Losses, Infiltration: Process-Capacity-Rate-Capacity Curve-Indices. Computation of Runoff: Runoff Cycle, Factors Affecting Runoff, Unit Hydrograph Theory, S-Curve Hydrograph.

UNIT 2GROUND WATER HYDROLOGY **10 Hrs.**

Definition, Occurrence, Zone and Movement of GW, GW Yield, Aquifers and their Types, Thiem's and Dupuit's formulas, Efficiency of Well, Infiltration Galleries and Well, Introduction to Open and Tube Well.

UNIT 3FLOOD CONTROL MEASURES AND RESERVOIR PLANNING **12 Hrs.**

Flood Control Measures: Introduction, Flood Control Measures: Dikes and Flood Walls - Storage Tanks and Reservoir – River Capacity and Diversion Channel. Reservoir Planning: Definition and Types, Capacity-Elevation and Area-Elevation Curve, Storage Zones, Catchment and Reservoir Yield, Reservoir Capacity and Methods of Finding, Hydrologic Reservoir Routing and Methods, Reservoir Sedimentation, Reservoir Losses.

UNIT 4MODELING TECHNIQUES IN WATER RESOURCES ENGINEERING **15 Hrs.**

Introduction of Model, Types of Model, Model and prototype, Introduction of Hydrologic and Hydrodynamic model, Basic of hydrologic Model and its application in water resources engineering, Introduction of Hydrodynamic model, Basic of 1D, 2D and 1D/2D coupled hydrodynamic model, Application of Hydrodynamic modelling in water resources engineering, Different Case applications of modelling in water resources engineering

Max. <52> Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 –Understand the basic of hydrological compotes and its application in HWRE
CO2 –Analyse and estimate the rainfall and runoff using analytical methods
CO3 –Understand the basic of ground water hydrology
CO4 –Understand hydrological process and apply it for different decision making system
CO5 –Learn basic concept and application of flood control measures and reservoir operation.
CO6 - Learn basic concept of coastal engineering

TEXT/REFERENCE BOOKS

1. Santosh Kumar Garg "Hydrology and Water Resource Engineering", Khanna Publishers, New Delhi.
2. HM Raghunath, "Hydrology-Principle, analysis and design" New Age Publication

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A: 05 Questions from Unit I-IV, each carrying 10 marks	50 Marks
Part B : 02 Question from Unit I-II, each carrying 10 marks	20 Marks
Part C : 03 Question from Unit III, carrying 30 marks	30 Marks

18CE305T					Advance Surveying and Geomatics					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	-	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To understand the principles and procedure for tacheometric surveying and curve setting
- To learn the principles and procedure for photogrammetric surveying
- To be aware of various concepts, significance and applications of remote sensing and GIS
- To recognize the usefulness of various modern surveying equipment in digital land surveying and mapping

UNIT 1 TACHEOMETRIC SURVEYING AND CURVE SETTING **10 Hrs.**

Tacheometric Surveying: Introduction, basic definitions, methods, fundamental principles, stadia system – fundamentals, field work in tacheometry, errors and precisions.
Curve setting: Designation of curves, setting out simple circular curve, methods of curve setting, compound and reverse curve, Setting out compound curve, transition curves, vertical curves, applications of site distance in transport planning

UNIT 2 PHOTOGRAMMETRIC SURVEYING **10 Hrs.**

Photogrammetric surveying: Basic principles, types of photographs, elevation of a point by photogrammetric measurement, scale of a vertical photographs, determination of flying height, tilt and relief, stereoscopic vision, parallax in aerial stereoscope, effects of change of elevation and parallax, parallax bar and numerical

UNIT 3 INTRODUCTION TO REMOTE SENSING AND GIS **10 Hrs.**

Remote sensing: Principles to Remote Sensing, Electromagnetic Spectrum (EMR), Atmospheric Windows, Sensors and Platforms, Concept of signature and resolution, Data products, Visual and digital image interpretation, ApplicationsGeographical Information System: Introduction of Geographical Information System (GIS), Components of GIS, Spatial and Attribute Data, GIS data structure: Vector data and Raster data, GIS data sources, Cartography, GIS applications.

UNIT 4 MORDEN SURVEYING EQUIPMENTS **09 Hrs.**

Modern Surveying Equipment and Land Surveying: Modern surveying electronic equipment: digital levels, digital theodolites, EDMs, total stations; principles, working and applications; lasers in surveying, Digital land surveying and mapping Global Positioning System: Introduction to Geodesy, Introduction to GPS, Types of GPS, GPS Survey Methods, GPS Software Post Processing, Applications of GPS in Civil Engineering

Max. 39 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to
CO1 – Understand the fundamentals of Surveying
CO2 – Understand the use of various instruments in advance surveying
CO3 – Understand the important of liner, angular and level measurement in various civil survey
CO4 – Implement the knowledge on RS and GIS techniques
CO5 – Understand the utility of GPS and GIS in mapping activities.
CO6 – Understand the various commands and keyboard shortcuts for faster the map or drawing Sheet making skills.

TEXT/REFERENCE BOOKS

1. Charles D. Ghilani, "Elementary Surveying", 13th Edition, Prentice Hall, Delhi
2. A M Chandra, "Higher Surveying", 3rd Edition, New Age International Publications, New Delhi
3. B C Punmia, "Surveying Vol. II", 17th Edition, Laxmi Publishing House, New Delhi
4. S K Duggal, "Surveying Vol. II", 4th Edition, Tata McGraw Hill Publication, New Delhi
5. Gottfried Konecny, "Geoinformation", 2nd Edition, CRC Press, USA.

.**END SEMESTER EXAMINATION QUESTION PAPER PATTERN**

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A/Question: <Details> <> Marks

Part B/Question: <Details> <> Marks

18CE305P					Advance Surveying and Geomatics - Lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	--	--	--	25	25	50

COURSE OBJECTIVES

- To gain the particle knowledge in advance surveying through experimental methods.
- To understand the function of Total station, Theodolite, GPS and GIS software through hand on experiment.

INTRODUCTION TO ADVANCE SURVEYING

Basic concept and use of advance surveying in civil engineering field.

EXPERIMENTS

Conduct the experiments onTachometers survey, setting out the curve using different curvey setting methods, Visual image interpretation and identification of objects in a satellite image, Working with Indian Remote Sensing Data Portal: BHUVAN, Working with Remote Sensing Data: ENVI Software , Introduction to ArcGIS: GIS data creation and mapping, Coordinate collection of point, line and polygon using Global Positioning System

SOFTWARE APPLICTION

Drawing sheet and map preparation using AUTOCAD and Q GIS software.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Understand the fundamentals of Surveying

CO2 – Understand the use of various instruments in advance surveying

CO3 – Understand the important of liner, angular and level measurement in various civil survey

CO4 – Implement the knowledge on RS and GIS techniques

CO5 – Understand the utility of GPS and GIS in mapping activities.

CO6 – Understand the various commands and keyboard shortcuts for faster the map or drawing Sheet making skills.

18CE304P					Environmental Engineering-I lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	0	0	0	25	25	50

COURSE OBJECTIVES

1. Understanding the sampling procedures for water collection
2. Understanding the reagents and apparatus required for a particular water quality test
3. Estimating the pollutants present in the Water through experimentation
4. Analyze the Water quality based on the respective standards

DETAILS OF LABORATORY PRACTICALS:

1. Determination of pH, Turbidity
2. Determination of Alkalinity and Acidity
3. Determination of Total Solids
4. Determination of Total Dissolved Solids, Total Suspended Solids
5. Determination of Total Hardness and Calcium Hardness
6. Determination of Chlorides
7. Determination of Coagulant Dosage by Jar Test
8. Determination of Residual Chlorine
9. Determination of Sulphates
10. Determination of Nitrates

OURSE OUTCOMES

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

CO1 – Understand the principle and procedure of analysis for water quality parameters
CO2 – Select and / or prepare the reagents and apparatus required for a water quality test
CO3 – Document the experimental results
CO4 – Estimate the concentration of a pollutant present in water
CO5 – Analyze the quality of water based on water quality standards
CO6 – Propose appropriate measures for improving the water quality

TEXT/REFERENCE BOOKS

1. Indian Standards (IS: 3025)
2. Indian Standards (IS: 10500-2012)
3. Standard Methods for The Examination of Water and Wastewater (American Water Works Association), ISBN-9780875532875

18CE302P					Soil Mechanics lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	0	0	0	25	25	50

COURSE OBJECTIVES

- To determine basic geotechnical parameters of soil.
- To determine Index properties of soil.
- To study the compaction characteristics of soil
- To determine engineering properties of soil

CONTENTS

1. Determination of moisture content and Field Density of Soils
2. Determination of specific gravity
3. Determination of Liquid Limit and Plastic Limit
4. Shrinkage Limit of Soils
5. Particle size analysis
6. Determination of Maximum Dry Density and Optimum Moisture Content Using Proctor Test
7. Unconfined Compression Strength of the Soils
8. Permeability Test : Constant Head
9. Permeability Test : Variable Head

COURSE OUTCOMES

At the end of this laboratory student will able

CO1 – **Identify** the soil type by physical observation
CO2 – **Determine** the index properties of the soil
CO3 – **Classify** the soil based on the index properties of the soil
CO4 – **Establish** the compaction characteristics of the soil
CO5 – **Determine** the compression strength of the soil
CO6 – **Measure** the permeability of the soil

TEXT/REFERENCE BOOKS

1. Laboratory manual
2. Punmia B.C., “Soil Mechanics and Foundation Engg.”, 16th Edition Laxmi Publications Co., New Delhi.
3. Murthy V.N.S.,“Principles of Soil Mechanics and Foundation Engineering”, 4th Edition, UBS Publishers and Distributors, New Delhi, 1996

COURSE STRUCTURE OF 6TH SEMESTER CIVIL ENGINEERING OF BATCH 2018-22

Semester	Sr.No	Course Code	Course Name	Theory	Tutorial	Practical	Hrs	Credits
Semester 6	1	19CV403T	Design of RCC structure	3	1	0	4	4
	2	18CV315T	Environmental Engineering – II	3	1	0	4	4
	3	20CE403T	Geotechnical Engineering – II	3	1	0	4	4
	4	18CV312 T	Irrigation Engineering and Hydraulic Structure	4	0	0	4	4
	5	18CE402T	Estimating and cost analysis	3	1	0	4	4
	6	20CE403P	Geotechnical Engg. Lab	0	0	2	2	1
	7	18CE213P	Environmental Engineering – II Lab	0	0	2	2	1
	8	20CV402P	Civil CAD Lab	0	0	2	2	1
	9		Communication Lab – III					0/P/NP
	10	20TP309T	Industrial Training	0	0	0	0	2

19CV403T					Course Name: DESIGN OF RCC STRUCTURES					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

Course objectives:

- To understand stress blocks, partial safety factors for materials and loads and specifications of the IS: 456-2000 code
- To design components of RCC structure like beams, slabs, columns, footings and staircases

UNIT 1: DESIGN OF BEAMS **14 Hrs.**

Introduction: Design: strength, stiffness, stability, serviceability, Design process: Analysis, design and detailing, Design philosophy: working stress method, Limit state method.

Design of Flexural Member (RCC Beam): (As per IS 456: 2000)

Concept of Flexural Member, Stress-Strain relationship of RC flexural member, Classification of Beam based on reinforcement, Classification based on Neutral axis. Moment resistance of RC-rectangle beam, Design of RC-beam for under reinforced section for singly and doubly type of beam (flexural reinforcement) Detail drawing. Design for shear, development length and deflection check, Details Drawing.

Design for flanged beam for: Flexure and shear for singly & doubly reinforced. Design for shear ,development length and deflection check, Details Drawing.

UNIT 2: DESIGN OF SLABS **9 Hrs.**

Design of Flexural Member (RCC Slab): (As per IS 456: 2000) **Design one-way slab:** for flexural, shear requirement. With application of development length, deflection check & detail drawing(Theory & Calculation)**Design Two-way slab:** for flexural, shear requirement. With application of development length, deflection check & detail drawing(Theory & Calculation)

UNIT 3: DESIGN COMPRESSION MEMBER AND FOOTING **21 Hrs.**

Design Compression Member: Using SP-16

Design of Axially Loaded complete with reinforcement detail drawing; Design of Axially loaded with Uniaxial Bending complete with reinforcement detail drawing; Design of Axially loaded with Bi-Axial Bending complete with reinforcement detail drawing.

Design RC Footing: Design of Rectangle Pad Footing for axially loaded. Consist of required size, depth, AST, check for shear, development length, detail drawing complete.

Design of Trapezoidal Footing for axially loaded. Consist of required size, depth, AST, check for shear, development length, detail drawing complete.Axially loaded with Bi-Axial Bending complete with reinforcement detail.

UNIT 4: Design RCC Staircase: **8 Hrs.**

Types of Staircase, components, loading, geometry, load calculations; Design of Dog legged staircase & Quarter turn staircase

COURSE OUTCOMES

At the end of semester students should able to

- **Explain** stress block, and to find flexural and shear strengths of beams
- **Design** under reinforced and balanced rectangular and flanged beams
- **Design** the one way, two way and cantilever slabs and checking them for shear and deflections
- **Understand** concept of short and long columns and to design the same
- **Design** flat or sloped isolated footings for coulums
- **Plan** and fix the staircase dimensions and to design staircases

TEXT BOOK/REFERENCES:

1. IS: 456-2000, "Indian Standard Plain and Reinforced Concrete Code of Practice", Bureau of Indian Standards, New Delhi
2. SP:16(6)-1980, "Design Aids for Reinforced Concrete to IS: 456-1978", Bureau of Indian Standards, New Delhi
3. P.C.Vergese, "Limit State Design of Reinforced Concrete", PHI Publications, New Delhi
4. N Krishna Raju, Design of Reinforced Concrete Structures, CBS Publishers New Delhi
5. Ramamrutham, Design of Reinforced Concrete Structure, Dhanpat& Roy Publishers, New Delhi.
6. Shah H.J, Reinforced Concrete Volume-I, Charotar Publication House Pvt .Ltd

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A/Question: <Details> <> Marks

Part B/Question: <Details> <> Marks

18CV315T					Environmental Engineering II					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

1. Introduction to quality and quantity of wastewater
2. Design of Sewerage System.
3. Design of Sewage Treatment Plant
4. Introduction to Waste to Energy concepts.

UNIT I: BASICS OF WASTEWATER **13 Hrs.**

Wastewater, classification of wastewater, composition of wastewater, characterization of wastewater (physical, chemical and biological), basics of sewage quality assessment, sources of wastewater, estimation of wastewater quantity.

UNIT II: WASTEWATER COLLECTION NETWORK **13 Hrs.**

Introduction to various sewerage systems, components of sewerage system, hydraulic designs of sewers, construction and maintenance of sewers, testing of a sewer line, cleaning of sewers, sewer appurtenances

UNIT III: TREATMENT & DISPOSAL OF SEWAGE **13 Hrs**

Significance of wastewater treatment, objectives of a sewage treatment plant, classification of treatment processes, design of a sewage treatment plant - Screening, Grit Removal Basin, Skimming Tank, Sedimentation Tank, Secondary Treatment of sewage through (i) Biological Filtration of Sewage (ii) Activated Sludge Process (iii) Rotating Biological Contractors, Digestion of Sludge, Disinfection of sewage and sludge, Various methods of disposal of treated Sewage along with their standards

UNIT IV: WASTE TO ENERGY **13 Hrs**

Principles of Waste to Energy, Sludge Digesters, Energy recovery from sludge (bio-waste)**,** introduction to Bio gas plants, Case studies.

Total [52 Hours]

COURSE OUTCOMES

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

CO-1 Estimate and forecast the Quantity of Sewage
CO-2 Characterize the sewage
CO-3 Design the sewerage system
CO-4 Design the wastewater treatment plant
CO-5 Take measures for the efficient functioning of a wastewater treatment plant.
CO-6 Estimate the sludge generation rate for a biogas plant

TEXT BOOK / REFERENCES:

1. Sewage Disposal and Air Pollution Engineering, S K Garg, Khanna Publishers
2. Water and wastewater engineering, Metcalf and Eddy, McGraw Hill
3. Environmental engineering, HS Paevy, DR Rowe, G Tchobanoglous, McGraw Hill
4. Water supply and sanitation engineering, GS Birdie, JS Birdie, Galgotia Publishing Ltd.

29CE403T					Geotechnical Engineering II					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	--	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To emphasize the importance of soil investigations and read a typical bore log data.
- To explain how earth pressure theory is important in geotechnical structures.
- To understand the stability of slopes and their analysis
- To explain the concept of bearing capacity and how to estimate the safe bearing capacity for various foundation system including settlement consideration
- To explain how do select a suitable shallow foundation system for various site conditions

UNIT 1 Subsurface Exploration: 13 Hrs.

Importance of exploration program, Methods of exploration: Boring, Seismic refraction method of geophysical exploration, Types of samples - undisturbed, disturbed and representative samples, Samplers, sample disturbance, area ratio, Recovery ratio, clearance, Stabilization of boreholes - Typical bore log. Number and depth of borings for various civil engineering structures, soil exploration report.

UNIT 2 Stresses In Soils and Lateral Earth Pressure 13 Hrs.

Boussinesq's and Westergaard's theory for concentrated, circular and rectangular loads, comparisons of Boussinesq's and Westergaard's analysis. Pressure distribution diagrams, contact pressure, Newmark's chart.

Active and Passive earth pressures, Earth pressure at rest. Rankine's and Coulomb's Earth pressure theories-–assumptions and limitations, Graphical solutions for active earth pressure (cohesionless soil only) – Culmann's and Rebhann's methods, Lateral earth pressure in cohesive and cohesionless soils, Earth pressure distribution.

UNIT 3 Stability Of Earth Slopes 13 Hrs.

Types of slopes, causes and type of failure of slopes. Definition of factor of safety, Stability of infinite slopes, Stability of finite slopes by Method of slices and Friction Circle method, Taylor's stability number, Fellineous method.

UNIT 4 Bearing Capacity 13 Hrs.

Definitions of ultimate, net and safe bearing capacities, Allowable bearing pressure. Terzaghi's and Brinch Hansen's bearing capacity equations - assumptions and limitations, bearing capacity of footing subjected to eccentric loading. Effect of ground water table on bearing capacity. Field methods of evaluation of bearing capacity - Plate load test, Standard penetration test and cone penetration test. Allowable Bearing Pressure, Factors influencing the selection of depth of foundation, Factors influencing Allowable Bearing Pressure, Factors influencing the choice of foundation, proportioning shallow Foundation.

Max. 52 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Plan the complete subsurface Investigation program and interpret a soil report.
CO2 - Calculate the stresses developed in the soil domain due to different surface loading.
CO3 - Quantify lateral earth pressure and apply for designing earth retaining structures.
CO4 - Analyse the stability of different types of slopes and apply the same for evaluating practical cases.
CO5 - Compute bearing capacity and justify the suitability of various foundations for different civil engineering structures.
CO6 - Write professional, clear, concise geotechnical reports and present the same.

TEXT/REFERENCE BOOKS

4. Punmia B.C., "Soil Mechanics and Foundation Engg.", 16th Edition Laxmi Publications Co., New Delhi.
5. Murthy V.N.S.,"Principles of Soil Mechanics and Foundation Engineering", 4th Edition, UBS Publishers and Distributors, New Delhi, 1996
6. Braja, M. Das, "Geotechnical Engineering", Fifth Edition, Thomson Business Information India (P) Ltd., India, 2002
7. Bowles J.E., "Foundation Analysis and Design", 5th Edition, McGraw Hill Pub. Co. New York, 1996
8. Alam Singh and Chowdhary G.R., "Soil Engineering in Theory and Practice", CBS Publishers and Distributors Ltd., New Delhi, 1994

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A/Question: <Unit I and Unit II> <25> Marks

Part B/Question: <Unit III and Unit IV> <75> Marks

18CV312T					Irrigation and Hydraulic Structures					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
4	0	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To get the basic knowledge of irrigation and their techniques.
- To get the concepts of designing lined and unlined canal.
- To get the knowledge of hydraulic structures used in canal system and their application in real life problems.
- To get the basic concepts of dams its requirement with forces and stability analysis.

UNIT 1 Introduction to Irrigation Fundamentals of Fluid Mechanics: **13 Hrs.**

Irrigation Techniques: Introduction to irrigation; Necessity, Advantages, Disadvantages, Problems, Types and Techniques. Water Requirement of Crops: Basics of crop and crop seasons, Duty-Delta, Irrigation Efficiency, Evapotranspiration, Soil-moisture-Irrigation Relationship

UNIT 2 Canal Design **13 Hrs.**

Canal Irrigation System: Types of canal, Basic terminology related to canal system.

Design of Irrigation Channels: Basics of sediment, Design of unlined canal.

Channel Lining and Water Logging: Basics of canal lining; Advantages, Disadvantages, Requirement of lining material, Types of canal lining, Design of Lined canal

UNIT 3 Canal Structures **13 Hrs.**

Diversion Head Works: Weir and Barrage, Layout and Components, Seepage Theories.

Canal Falls: Definitions and Locations, Types of falls.

Cross Drainage Works: Types and Suitability.

Canal Structure: Canal Regulation Works, Canal Escapes and Canal Modules.

UNIT 4 Dams **13 Hrs.**

Earthen Dams: Type and Method of Construction, Causes of Failure, Seepage Control, Design Criteria and Phreatic Line in Earth Dams, Introduction of Rock Dams.

Gravity Dams: Definitions, Cross Sections, Forces Acting on Dam, Modes of Failure, Elementary Profile, High and Low Gravity Dam, two Dimensional Analysis of Dam.

Max. 52 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Remembering basic concepts and fundamentals of the irrigation

CO2 – Understanding of the concepts to fulfil the need of irrigation

CO3 - Applying the knowledge of irrigation for its application in irrigation field

CO4 - Analysing the data for best of the knowledge for identifying irrigation requirement

CO5 - Evaluating the data in proper manner for best judgement making in irrigation

CO6 – Creating a marvel for social services and public utility in field of irrigation

1. Santosh Kumar Garg “Irrigation Engineering and Hydraulic Structures”, Khanna Publishers, New Delhi.
2. B. C. Punmia, Ashok Kumar Jain, Arun Kumar Jain, Dr. Pande Brij Basi Lal “Irrigation and Water Power Engineering”, Laxmi Publication.
3. S.R. Sahasrabudhe “Irrigation Engineering & Hydraulic Structures”, S.K. Kataria & Sons.
4. Birdie-Dass “Irrigation Engineering”, Dhanpat Rai Publishing Company (P) Ltd.
5. T K Sharma&R K Sharma “Irrigation Engineering”, S. Chand Publishing
6. GHOSH, KARUNA MOY “Analysis and Design Practice of Hydraulic Concrete Structures”, PHI Learning
7. P. N. Modi “Irrigation Water Resources and Water Power Engineering”, Standard Book House, Delhi.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A/Question: 10 questions of 1 mark each no choice	10 Marks
Part B/Question: 1 question of 10 marks each internal choice from respective unit	40 Marks
Part C/Question: Examples related to main units of end semester no choice	50 Marks

18CE402T					Estimating and Cost Analysis					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To be able to prepare an estimate for a building by taking off quantities from drawings.
- To be able to write detailed specifications for different types of work required for estimating, tenders and supervision.
- To be able to compute rates of different items of work from the first principles.

UNIT 1 SPECIFICATION AND RATE ANALYSIS **13 Hrs.**

SPECIFICATIONS- Definition- objective of writing specifications- essentials in specifications- general and detail specifications of common item of works in buildings- **RATE ANALYSIS-** Definition and purpose- Working out quantities and rates for the following standard items of works – earth work in different types of soils- cement concrete of different mixes- bricks masonry- flooring-plastering- RCC works- form work for different RCC items-wood and steel works for doors, windows and ventilators

QUANTITY ESTIMATION- Study of various drawings- important terms- units of measurement- abstract Methods of taking out quantities- centre line method- long-short wall method.

UNIT 2 ESTIMATE **13 Hrs.**

Preparation of detailed and abstract estimates for the following Civil Engineering works – Buildings – RCC framed structures with flat, sloped RCC roofs with all Building components- Different type of estimates- approximate methods of estimating buildings- cost of materials- Estimation of doors, windows & ventilators- Steel truss (Fink and Howe truss)- manhole and septic tanks- RCC Culverts. Methods for computation of earthwork – cross sections – mid section formula or average end area or mean sectional area-trapezoidal & prismoidal formula with and without cross slopes

UNIT 3 CONTRACTS **13 Hrs.**

Contract Management- Legal Aspects- Different Types of Contracts- their Relative Advantages and Disadvantages- Elements of Tender Operation- Evaluation of Tenders and Award of Work- Laws Related to Land Acquisition- Labour Safety and Welfare Disputes and Arbitration

UNIT 4 VALUATION **13 Hrs.**

Definitions of various terms- method of valuation- Freehold & Leasehold properties- Sinking fund- depreciation and method of estimating depreciation- Outgoings. **Max. 52 Hrs.**

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Identify various types of estimate.
CO2 - Understand rate analysis of civil construction works.
CO3 - Apply the rates of various items of civil construction works.
CO4 - Estimate cost of civil construction projects based on the rates.
CO5 - Understand a contracts, tenders and other legal requirements in construction.
CO6 – Propose a civil engineering project based on the its overall estimate and valuation.

TEXT/REFERENCE BOOKS

1. B. N. Dutta, Estimating and Costing in Civil Engineering, 27th Revised Edition, New Delhi: UBS Publishers & Distributors Ltd.
2. M. Chakraborti, Estimating, Costing, Specification & Valuation in Civil Engineering, Kolkata.
3. D. D. Kohli, and R. C. Kohli, A Text Book of Estimating and Costing (Civil), S Chand Publishers.
4. S.C. Rangwala, Estimating, Costing and Valuation, 15th Edition, Charotar Publishing House Pvt. Ltd.
5. Peurifoy, R.L., Ledbetter, W.B. and Schexnayder, C., Construction Planning, Equipment and Methods, 6th Edition, Tata McGraw-Hill, New Delhi, 2003
6. C.P.W.D. Hand Books
7. IS: 1200 (Part 1 to 28), Methods of Measurement of Building and Civil Engineering Works, Bureau of Indian Standards

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 All units have equal weightage of 25 marks each. **Exam Duration: 3 Hrs**

Part A/Question: Very short answer type questions, fill in the blanks	30 Marks
Part B/Question: Short answer type questions (80-100 words)	30 Marks
Part C/Question: Long answer type questions. Students would be required to solve the problem.	40 Marks

20CE403P					Geotechnical Engineering Lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	--	--	--	25	25	50

COURSE OBJECTIVES

- To determine engineering properties of soils in the context of foundation design
- To understand the soil exploration techniques
- To determine in-situ parameters of soils by field test

LIST OF EXPERIMENTS

1. Determination of free swell index and swelling pressure of soil
2. Determination of CBR value of soils
3. Determination of coefficient of consolidation and compression index using consolidation test
4. Determination of shear strength parameters using direct shear test
5. Determination of shear strength parameters using triaxial compression test (undrained)
6. Determination of shear strength of soft soils using vane shear test
7. Determination of bearing capacity of foundation using plate load test
8. Demonstration of soil exploration and SPT, CPT test
9. Electrical resistivity of soils
10. Dynamic cone penetration test

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - **Demonstrate** the theoretical concept, significance and experimental procedure to measure soil properties

CO2 - **Determine** free swell index, swelling pressure and CBR value of soils

CO3 – **Determine** shear strength of the soil considering soil type and field conditions

CO4 - **Explain** subsoil explorations and sounding tests

CO5 – **Determine** subsoil conditions and bearing capacity by electrical resistivity and plate load test

CO6 - **Interpret** soil properties in the context of soil behaviour and applications

TEXT/REFERENCE BOOKS

1 Laboratory Manual
2 B.C.Punmia, Ashok Kumar Jain, Arun Jain, Soil Mechanics and Foundations, Laxmi Publication, 16th Edition, 2015
3 K.R. Arora, Soil Mechanics and Foundation Engineering, Standard Publisher Dist., 2009.
4 Parbin Singh, Engineering and General Geology, S.K. Kataria & Sons, 2014.
5 Shashi Gulathi, Manoj Dutta, Geotechnical Engineering, Tata Mcgraw Hill Publisher, 2009.

18CE213P					Environmental Engineering II lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	0	0	0	50	50	100

COURSE OBJECTIVES

- Introduction to sampling procedures for wastewater collection
- Estimating the pollutants present in the Wastewater through experimentation
- Ascertaining the Wastewater quality based on the respective standards
- Documenting the experimental results and deriving inferences.

DETAILS OF LABORATORY PRACTICALS:

1. Determination of Dissolved Oxygen in water
2. Determination of the Optimal Dilution Ratio for performing the BOD Test
3. Determination of BOD of Domestic Sewage
4. Determination of BOD of Industrial Wastewater
5. Determination of COD of Domestic Sewage
6. Determination of COD of Industrial Wastewater
7. Determination of Oil and Grease in Domestic Sewage
8. Determination of Oil and Grease in Industrial Wastewater
9. Determination of Sulphates in Domestic Sewage
10. Determination of Ammonical Nitrogen in Domestic Sewage

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 –Collect and store the wastewater sample as per the guidelines

CO2 – Prepare the chemical reagents needed for a particular experimentation

CO3 – Calculate the concentration of a pollutant present in the wastewater

CO2 – Ascertain the quality of wastewater based on wastewater quality standards

CO3 – Recommend appropriate measures for improving the wastewater quality

CO6 –Document the full proceedings as a scientific report

TEXT/REFERENCE BOOKS

4. Indian Standards (IS: 3025)
5. Indian Standards (IS: 10500-2012)
6. Standard Methods for The Examination of Water and Wastewater (American Water Works Association), ISBN-9780875532875

20CV402P					CIVIL CAD lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	0	0	0	50	50	100

Details of Assignments:

Use of AUTOCAD in civil engineering

Following drawings are to be prepared using AUTOCAD or any other drafting software.

i) Cross section of foundation – masonry wall, RCC columns (isolated),) Staircase etc.
ii) RCC slabs beams and column reinforcement detailing.
iii) Drawing of plan, elevation and sectional elevation of single storied residential and buildings given the single line diagram and preparing excavation plan.
iv) Different civil engineering drawings related to geotechnical, transportation and resources engineering.

Structural analysis software

Use of commercial software like Staad pro and ETABS for analysis of following structures

i) 2D and 3D trusses, continuous beam, fixed beam, simply supported beam, cantilever beam with different types of loading.
ii) 2D and 3D portal frames-single storied and multi storied building.
iii) Analysis and design of multi storey (G+3) building (RCC) and industrial structures (steel).

Use of programming languages in civil engineering

Any programming language is used for the following civil engineering problems

i) Computation of SF and BM for cantilever and simply supported beam subjected to uniformly distribute and uniformly varying load acting throughout the span and with point load.
ii) Design of singly reinforced and doubly reinforced rectangular beams, slabs and column.
iii) Any other problems related to civil engineering.

Course Outcome:

1. Understanding of graphics and drafting appropriate for developing functional skill in computer aided drafting.
2. Knowledge and experience of preparing engineering drawings using AutoCAD.
3. Hands on training of commercially used software for analysis and design of structures.
4. Development of programming skills in students and understanding of its application in Civil Engineering.

References:-

1. Computer aided design- s. Rajiv, narosa publication
2. C.S.Krishna Murthy & Rajiv S. – Computer Aided Design, software & Analytical tools - Narasha publishing house India.
3. Computer Aided design in reinforced concrete- Dr. L. Shah-Structures Publishers Pune.
4. Krishnaraju,N. ‘’Structural Design & Drawing, Universities Press, 2009.

					Communication Skills – III (Semester V/VI) (Third Year)					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	0	2	--	--	--	25	25	50

COURSE OBJECTIVES

1. Understand of the fundamental elements of communication in English language.
2. Know and understand different practices of verbal and non-verbal communication with inputs to improve basic language skills.
3. Students are expected to be better equipped in the following areas:
   - **Listening:** Understanding basic content in lectures and common everyday situations
   - **Speaking:** Correct expression in the English language at a basic level
   - **Reading:** Understanding, retaining, and critically analyzing technical/non-technical content
   - **Writing:** Using appropriate vocabulary, grammar, effective paragraph construction, writing in day-to-day scenarios, including digital platforms

UNIT 1 **10 hrs**

- Writing research proposals
- Writing technical projects

UNIT 2 **15 hrs**

- The Art of Presentation
  - *Sapiens: A Brief History of Humankind* (2011), Yuval Noah Harari
  - *Thank You for Being Late: An Optimist's Guide to Thriving in the Age of Accelerations* (2016), Thomas L. Friedman
  - (Presentation in teams of 4 students each, not more than two from the same branch, with a view to promote cross-disciplinary research)

UNIT 3 **5 hrs**

- Uploading portfolios on SlideShare
  - ✓ Uploading Video modules

Total 30 Hours

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 **Confidence to listen, speak, read and write in English**
- CO2 **Being able to produce something new with the help of inputs**
- CO3 **Learning to critically analyze**
- CO4 **Preparing reports/critique with the help of collected data**
- CO 5 **Having a multi-dimensional/disciplinary perspective and approach**
- CO6 **Better improved and sharpened skills to present, convince and persuade to be an effective and successful professional**

TEXT/REFERENCE BOOKS

- Kaul, Asha. Business Communication. Delhi: Prentice-Hall of India, 2006.
- Maley, A. 'Literature in the Language Classroom', The Cambridge Guide to Teaching ESOL, Cambridge University Press, 2001.
- Richards, Jack C., and Willy A. Renandya, eds. Methodology in Language Teaching: An Anthology of Current Practice. Cambridge University Press, 2002.
- Sharma, Sangeeta and Binod Mishra. Communication Skills for Engineers and Scientists. New Delhi: PHI Learning Pvt. Ltd., 2009.

Assessment Tool	Marks	Assignments
Lab Work	25	• Business Proposal – 15 • Research Project Proposal – 15 • Reviews on the two books – 20

Semester	Sr.No	Course Code	Course Name	Theory	Tutorial	Practical	Hrs	Credits
Semester 7	1	19CV401T	Construction Technology and Equipment	3	1	0	4	4
	2	20CV403T	Highway Engineering	3	1	0	4	4
	3	19CV403T	Design of Steel Structure	3	1	0	4	4
	4	20CV401T	Earthquake Engineering	3	1	0	4	4
	5	20CV401P	Earthquake Engineering Lab	0	0	2	2	1
	6	20CV402P	Civil Computational Lab	0	0	2	2	1
	7	20CV403P	Highway Engineering lab	0	0	2	2	1
	8	20TP310T	Seminar	0	0	0	0	3

19CV401T					Construction Technology and Equipments					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To understand the factors affecting selection of construction equipments and develop ability to compute the owning and operating costs of construction equipments
- To develop ability and knowledge about various operating procedures of earth moving equipments and soil stabilization and compacting equipments
- To develop ability and knowledge about the concrete batching plant equipments and concrete placing equipments, wooden modular formwork, aluminium formwork
- To develop ability and knowledge about wheel mounted cranes, crawler mounted cranes, tower cranes, piling equipments and metro rail construction technology

UNIT 1 SELECTION OF CONSTRUCTION EQUIPMENTS **13 Hrs.**

Construction Equipment management – Identification, planning and selection of construction equipments - Maintenance management - Replacement - Depreciation analysis - Owning and operating cost computations of equipments- Safety management of equipments.

12 Hrs.

UNIT 2 EARTH MOVING, SOIL COMPACTING AND STABILIZING EQUIPMENTS

Equipment for earthwork- Earth moving operations - Types of earth work equipment – Tractors- Motor Graders- Scrapers - Front end Loaders - Hydraulic excavators- Earth movers- Soil compacting and stabilizing equipments.

UNIT 3 CONCRETE BATCHING, PLACING EQUIPMENTS AND FORMWORK TECHNOLOGY **14 Hrs.**

Equipment for production of aggregate and concreting : Crushers – Feeders – Screening Equipment Handling Equipment – Concrete batching and mixing equipment –Ready mixed concrete batching plant equipments - Concrete pouring and pumping equipment –Transitmixers

Formwork Technology: Wooden Modular Formwork- Aluminium Modular Formwork

UNIT 4 CRANES, MISCELLENOUS CONSTRUCTION EQUIPMENTS AND MASS RAPID TRANSIT CONSTRUCTION TECHNOLOGY **3 Hrs.**

Cranes: Wheel mounted, Crawler mounted, Tower cranes, Guyed derrick crane, Scotch derrick crane, Gantry cranes, Truck mounted cranes

Miscellenous Equipments: Trenching- Tunneling- Drilling- Blasting, Equipment for dewatering and grouting - Foundation and pile boring equipment - Forklifts and related equipment - Portable Material Bins – Conveyors - Hauling Equipment.

MRTS Construction Technology: Underground structures - Elevated segmental structure construction technology- Case studies of underground and elevated metro rail construction technologies

COURSE OUTCOMES

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

CO1 **Understand** the factors affecting the selection of construction equipments and develop ability to compute the owning and operating costs of construction equipments

CO2 **Analyze** and **learn** about various operating procedures of earth moving equipments and soil stabilization and compacting equipments

CO3 **Evaluate** the operating procedures and build knowledge about the concrete batching plant equipments and concrete placing equipments

CO4 **Create** knowledge about wooden modular formwork and aluminium modular formwork

CO5 **Create** knowledge about metro rail construction technology

CO6 **Analyze** and **evaluate** the operating about cranes and piling equipments

TEXT/REFERENCE BOOKS

1. Peurifoy, R.L., Ledbetter, W.B. and Schexnayder, C., Construction Planning, Equipment and Methods, 6th Edition, Tata McGraw-Hill, New Delhi, 2015
2. Sharma S.C. Construction Equipment and Management, Khanna Publishers, New Delhi.
3. Deodhar, S.V. Construction Equipment and Job Planning, Khanna Publishers, New Delhi.
4. Dr.Mahesh Varma, Construction Equipment and its planning and Application, Metropolitan Book Company, New Delhi.

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A/Question: 10 Questions of 2 marks each-No choice **20** Marks

Part B/Question: 2 Questions from each unit with internal choice, each carrying 16 marks **80** Marks

20CV403T					Highway Engineering					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To give an overview about the highway engineering with respect to planning and alignment.
- To know the importance of geometric design.
- To learn the procedure and method of pavement design as per IRC.
- To study the various traffic parameters and its estimation and design.

UNIT 1 : PRINCIPLES OF TRANSPORTATION ENGINEERING **12 Hrs.**

Importance of transportation, Different modes of transportation and comparison, Characteristics of road transport, Road types and classification, road patterns, various road development plans in India, factors involved in alignment of new road link, planning surveys, Indian Roads Congress Guidelines.

UNIT 2 : HIGHWAY GEOMETRIC DESIGN **13 Hrs.**

Importance of geometric design, Terrain classification, Design speed, Factors affecting geometric design, Cross sectional elements-Camber- width of pavement; Sight Distance design- Stopping sight distance- Overtaking sight distance-overtaking zones- Examples on SSD and OSD- Sight distance at intersections, Horizontal alignment-Radius of Curve-Super elevation – Extra widening- Transition curve and its length, Setback distance – Examples, Vertical alignment-Gradient-summit and valley curves.

UNIT 3 PAVEMENT MATERIALS AND PAVEMENT DESIGN **14 Hrs.**

Desirable properties and different test procedure of pavement materials (tests for soil, aggregate, bitumen etc). Road construction methods. PAVEMENT DESIGN: Pavement types, component parts of flexible and rigid pavements and their functions, design factors, ESWL and its determination, Flexible pavement- Design of flexible pavements as per IRC;37-2001-, Rigid pavement- Westergaard's equations for load and temperature stresses- Design of slab thickness only as per IRC:58-2002. Different types of Flexible and Rigid pavement failures and pavement management methods.

UNIT 4 PAVEMENT CONSTRUCTION **13 Hrs.**

Earthwork –Cutting-Filling, Preparation of sub grade, Specification and construction of i) Granular Sub base, ii) WBM Base, iii) WMM base, iv) Bituminous Macadam, v) Dense Bituminous Macadam vi) Bituminous Concrete, vii) Dry Lean Concrete sub base and PQC viii) concrete roads.

Max. 52 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Describe various factors considered for planning and alignment of Highway.
CO2 – Understand different geometric parameters and its importance in design.
CO3 – Compute geometric parameters and can design highway components as per requirement.
CO4 – Conduct different pavement materials tests and can analyze results to check suitability of material for construction.
CO5 – Design flexible and rigid pavement as IRC.
CO6 – Create modern safe and efficient traffic network system.

TEXT/REFERENCE BOOKS

1. L.R. Kadiyali, "Highway Engineering", Khanna Publishers, New Delhi.
2. S.K. Khanna and Dr. C.E. G. Justo, "Highway Engineering", Nem Chand & Bros., Roorkee.
3. S.K. Sharma, "Principles, Practice and Design of Highway Engineering", S. Chand & Co., New Delhi.
4. L.R. Kadiyali, "Traffic Engineering and Transport Planning," Khanna Publishers, New Delhi.
5. Transportation Engineering – K P Subramanium, Scitech Publications, Chennai
6. IRC – 37 "Guidelines for Design of flexible Pavements", IRC, New Delhi, 2001.
7. IRC – 67 "Code of Practice for Road Signs", IRC, New Delhi – 2001.
8. IRC: 58, 2002: "Guidelines for the Design of Plain Jointed Rigid Pavements for Highways", IRC, N. Delhi, December, 2002.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100	Exam Duration: 3 Hrs
Part A : 10 Questions of 2 marks each-No choice	20 Marks
Part B : 2 Questions from each unit with internal choice, each carrying 16 marks	80 Marks

19CV403T					Design of Steel Structure					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

Prerequisites:

1. Structural Analysis

COURSE OBJECTIVES

- To gain knowledge on different types of connections.
- To design the steel structural elements of different forms subjected to a different state of loading.

UNIT 1 DESIGN PHILOSOPHIES AND CONNECTIONS **13 Hrs.**

Working stress method/ Allowable stress design, ultimate load method, limit state method. Introduction to limit state, Concept of limit State Design, Different Limit States as per IS 800 – 2007, Concepts of plasticity, yield strength. Types Loads and combinations loading. Design Strengths, deflection limits, serviceability.

Introduction Bolted connections -Types of failure, Design specifications, High- strength bolts, Efficiency of joint - Prying action. Welded connections-Specifications for welding - Design Strength - Efficiency of joint. Design of eccentric connections with brackets.

13 Hrs.

UNIT 2 COMPRESSION MEMBERS

Introduction compression members, Euler's buckling theory, Behavior of real columns, Types of sections Design of compression members, Buckling class, slenderness ratio, strength design. Laced - battened columns, column splice, column bases - slab base, gusset base. Built-up compression members.

UNIT 3 TENSION MEMBERS AND BEAMS **13 Hrs.**

Introduction tension members. Types of tension member, types of failures, Design of Tension members - Design Strength of members

Introduction to beams, Plastic moment, Bending and shear strength. Design of laterally supported / unsupported beams. Web Buckling, Crippling and Deflection of Beams.

UNIT 4 ROOF TRUSSES **13 Hrs.**

Introduction, Components of a roof truss, and Types of trusses. Types of loads- Dead, Live and wind loads. Design of purlins.

Max. 52 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Classify the different design philosophies.
CO2 - Examine the different types connections.
CO3 - Design the compression.
CO4 - Predict the tension strength of members.
CO5 - Design laterally supported and unsupported beams.
CO6 - Design the purlins.

TEXT/REFERENCE BOOKS

1. S.K.Duggal , Limit State Design of steel structures, Tata McGraw- Hill,2014
2. K.S.Sai Ram, Design of steel structures, Person Education, 2015

CODE BOOKS AND TABLES:

1. IS 800-2007: General construction in steel-Code of practice (third revision), Bureau of Indian Standards, New Delhi.
2. Steel Table

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A/Question: 10 Questions of 2 marks each-No choice 20 Marks

Part B/Question: Questions from each unit with internal choice, each carrying 20 marks 80 Marks

20CV401T					Earthquake Engineering					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To understand fundamentals of earthquake and seismological aspects
- To understand free and forced vibration and their analysis
- To explain the principles of earthquake resistant structures
- To discuss code provisions and their application on different types of structures

UNIT 1 SEISMOLOGY AND EARTHQUAKE FUNDAMENTALS **08 Hrs.**

Seismology and earthquakes**:** Basic earthquake principles: Introduction - Internal structure of earth - Plate tectonics faults - seismic waves – Seismograph - Classification of earthquakes - Magnitude and intensity of earthquakes - Seismic zones in India - Earthquake ground motion: Amplitude parameters - frequency content parameters - duration parameters

Common Earthquake effects: Surface rupture - Regional subsidence – liquefaction – slope movement – Tsunami

UNIT 2 THEORY OF VIBRATION AND MACHINE FOUNDATION **12 Hrs.**

Free vibrations of single degree-of-freedom systems: Dynamic loads and dynamic analysis - degrees of freedom - Undamped free vibrations - multiple elastic forces - viscously damped vibrations, equations of motion and solution - logarithmic decrement.

Forced vibrations of single degree-of-freedom systems: Forced vibrations (harmonic loading) of single degree of freedom systems - Undamped and viscously damped vibrations - equations of motion and solution - Force transmitted to foundation – transmissibility - response to harmonic support excitations.

Introduction, Types of Machines and Foundations, General requirements, Permissible Amplitude - Design

UNIT 3 EARTHQUAKE RESISTANT FEATURES OF STRUCTURE **10 Hrs.**

Load Transfer Path - Strength Hierarchy - Reversal of Stresses - Importance of Beam Column Joints - Importance of Stiffness and Ductility (Capacity Design Concept) in Structures - Earthquake Design Philosophy Inertia forces - Behaviour of brick masonry - stone Masonry and RC structures - Base Isolation - Adoptive systems - Case studies.

Effect of Short Column - Soft Storey - Improper Detailing - Masonry Infill Walls – Eccentricity – Pounding - Floating Columns on seismic performance of building

UNIT 4 LATERAL LOADS ON BUILDINGS AND DUCTILE DETAILING **09 Hrs.**

Analysis for Earth Quake Loads: IS: 1893-2016 - Seismic Coefficient method- modal analysis - Applications to multi-storied building frames.

Ductile Detailing: Ductility of R.C structures- Confinement- detailing as per IS-13920-2016 – principles of design of beams, columns.

Max. 39 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - **Explain** the fundamental of seismology and earthquake effects

CO2 - **Analyse** free and forced vibration with applications

CO3 - **Design** machine foundations

CO4 - **Demonstrate** basic principle of earthquake resistant design

CO5 - **Explain** ductile detailing concept and associated effect on seismic structural response

CO6 -**Design** the structures subjected to earthquake in accordance with relevant Indian standards.

TEXT/REFERENCE BOOKS

1. A.K. Chopra, Dynamics of structures, Prentice Hall, 2000.
2. I.S. 1893 - 2016, Criteria for Earthquake Resistance design of Structures.
3. Pankaj Agarwal and Manish Shrikhande, Earthquake resistant design of structures, PHI 2006.
4. Kramer, S. L., Geotechnical Earthquake Engineering, Pearson Education, 2003.
5. Day, R. W., Geotechnical Earthquake Engineering handbook", McGraw Hill, 2003.
6. Kamlesh Kumar, Basic Geotechnical Earthquake Engineering", New Age, 2008.

20CV401P					Earthquake Engineering Lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	1	--	--	--	50	50	100

COURSE OBJECTIVES

- To understand Effect of bracing and shear wall on the seismic response
- To familiarise with earthquake engineering software
- To understand the effect of ground motion parameters on structure
- To understand the effect of earthquake time history and soil type on seismic response

LIST OF EXPERIMENTS

1. Study the effect of ground motion parameters on seismic performance of structure.
2. Study mode shapes of multi storey buildings.
3. Study effect of shear wall on seismic performance of building.
4. Study the effect of different bracing systems on seismic performance of the building
5. Observe behaviour of structure under pounding
6. Demonstrate effect of liquefaction of soil.
7. Compute the liquefaction potential
8. To observe phenomenon of vibration absorption
9. Introduction to open source earthquake engineering softwares
10. To determine the effect of near field earthquakes on the seismic response
11. To determine the effect of far field earthquakes on the seismic response
12. To determine the effect to soil parameters on seismic response

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - **Explain** the effect of ground motion parameters on the seismic performance of the structure
CO2 - **Demonstrate** the effect of shear wall, bracings on seismic performance of the structures
CO3 - **Understand** concept of natural frequency and mode shapes on vibrating systems
CO4 - **Compute** liquefaction potential and susceptibility soils
CO5 - **Predict** effect of shear wall and bracing system on structural vibrations
CO6 - **Explain** the effect of far field, near field earthquakes and soil parameters on seismic response.

TEXT/REFERENCE BOOKS

1. A.K. Chopra, Dynamics of structures, Prentice Hall, 2000.
2. I.S. 1893 - 2016, Criteria for Earthquake Resistance design of Structures.
3. Pankaj Agarwal and Manish Shrikhande, Earthquake resistant design of structures, PHI 2006.
4. Kramer, S. L., Geotechnical Earthquake Engineering, Pearson Education, 2003.
5. Day, R. W., Geotechnical Earthquake Engineering handbook", McGraw Hill, 2003.
6. Kamlesh Kumar, Basic Geotechnical Earthquake Engineering", New Age, 2008.

20CV403P					Highway Engineering Lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1		--	--	--	25	25	50

List of Experiments:

I. **Tests on aggregates**

1. Aggregate crushing value
2. Aggregate impact value
3. Los Angeles abrasion value
4. Shape tests-Flakiness index and Elongation index
5. Angularity of course aggregates and fine aggregates
6. Specific gravity and water absorption of course aggregate

II. Test on soil:

1. California Bearing Ratio test (Soaked and Un-soaked CBR)
2. Dynamic cone penetration test (ASTM D6951 (2015) procedure)

III. Tests on bitumen

1. Penetration value of bitumen
2. Softening point of bitumen
3. Ductility of bitumen
4. Flash and Fire point of bitumen
5. To determine viscosity & specific gravity of given bituminous material

IV. Test on bituminous mixes

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Identify engineering properties of aggregate by performing laboratory tests necessary for highway construction

CO2 – Demonstrate engineering properties of soil by performing laboratory tests necessary for highway design and construction

CO3 – Determine the grade & properties of bitumen by performing laboratory tests necessary for highway construction

CO4 – Design Bitumen Mixes

CO5 – Analyze the pavement material test results and evaluate the suitability for construction purpose

CO6 – Create smart materials which can be used for cost effective construction of road.

TEXT/REFERENCE BOOKS

1. L .R. Kadiyali, Principles and Practices of Highway Engineering, Khanna Publishers, 2009
2. MoRTH (2013) Specification for Road and bridge works (5th revision)
3. MS-2 manual (2015) Seventh edition, Asphalt Institute.
4. S. K. Khanna, C. E. G. Justo, A Veeraragavan, Highway Engineering, Khanna Publishers.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A : Lab Work – Continuous Assessment 25 Marks

Part B : Lab Exam and Viva 25 Marks

20CV402P					Civil Computational Lab					
Teaching Scheme					**Examination Scheme**					
L	**T**	**P**	**C**	**Hrs/Week**	**Theory**			**Practical**		**Total Marks**
					MS	**ES**	**IA**	**LW**	**LE/Viva**	
0	**0**	**2**	**0**	**2**	**--**	**--**	**--**	**25**	**25**	**50**

COURSE OBJECTIVES

- To orient students to basics of computational software packages used in project design, planning and execution.
- To provide basic computing skills in software programs; REVIT, MS^{TM} PROJECT and PRMAVERA
- To appraise students with technological expertise to showcase their design and planning skills for a civil engineering project.

Tutorials and small project assignments for select software packages

1. REVIT :- Using Menu, project browser, drawing area, introduction to basic tools, user interface, wall basics, quick toolbar, customizing ribbon, customizing user interface components, working with multiple views, navigational plan, section plan, elevation, printing and exporting to CAD, moving objects with dimensions, layers in walls- custom and stacked walls, floor and slab edges, creating and editing levels, 2D and 3D level ends, 2D and 3D grids, placing columns on grids, Ceilings, Roofs by extrusion, Roof variable thickness and conclusion of basic tools in REVIT Architecture.

2. MS PROJECT:- Operating philosophy, Screen elements, backstage view and project view, Table view, Gantt Chart view, Quick access toolbar, Creating a new project, assigning relationships between activities, creating a scheduling, creating events, creating and loading resources, using Work break down structure, computing costs, tracking project, printing reports.
3. PRIMAVERA:- Introduction to contract management, company directory, creating a project, tracking drawings, communicating project information, tracking submittals, documenting project issues, managing project costs, Using contracts, purchase orders and trends, change management, payment requisitions, customizing layouts, and safety module. Creating project, schedule, monitoring, and networks similar to MS PROJECT use and basic differences in the packages.

Max. 28 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Learn fundamentals of computational packages used in project design
CO2 – Understanding the concepts of project planning and monitoring
CO3 – Gain operational competence in REVIT architecture
CO4 – Gain operational competence in MS Project
CO5 – Gain operational competence in PRIMAVERA
CO6 – Get appraised with advances in computational technology in civil engineering practice

TEXT/REFERENCE BOOKS

1. Eric Wing, “REVIT 2020 for Architecture: No experience required”, John Wiley & Sons, 2019.
2. Carl S, Chatfield, Cindy Lewis and Timothy D. Johnson, “Microsoft Project 2019 Step by Step”, Microsoft Project, 2019.
3. Paul E. Harris “Planning and Control using Primavera P6”, Eastwood Harris Pty Limited, 2015.
4. Journal of Computing in Civil Engineering ASCE

20TP310T					Seminar					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
			3	-	--	--	--	--	--	--

COURSE OBJECTIVES

- To demonstrate a sound technical knowledge of their selected project topic.
- To study the problems of industry/society and apply engineering knowledge to solve the problem.
- Develop ability to solve complex problems and find engineering solution based on a systematic approach.
- To form a competent team with each member having a clearly defined job.
- Develop the ability to be updated with all the latest changes in technological world in the relevant field.

Details:

Students need to choose a topic related to the current practices in Civil Engineering and the project work can be carried out in a small group (not exceeding 3 students). The broad areas can be Structural design and analysis, Soil and Geotechnical engineering, Traffic engineering, pavement design and analysis, metro and mono rail construction, airport planning and design, Water resource management/GIS/Surveying, Construction techniques and management, Environmental engineering/energy conservation. The work can have novelty factor or it can be very complicated established problem , which need to solved with available established method.

The group need to choose a guide from the Department and the area / topic of research should be mutually convenient to the group and guide.

The hard bound copy of the thesis will be prepared as per PDPU format and submitted to Department through guide. One copy of the thesis signed by guide and Head of the Department will be submitted to Department library for originality and record. The project & dissertation work will be reviewed by a committee consisting of minimum 2-faculty members for the internal review component and the external review panel as per the norms of University.

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

1. CO1 Work in a team to select a problem for project work
2. CO2 Review and evaluate the available literature on the chosen problem
3. CO3 Formulate the methodology to solve the identified problem
4. CO4 Apply the principles, tools and techniques to solve the problem
5. CO5 Prepare a proper project report following all the guidelines set by the institute
6. CO6 Present project report through accepted tools like PPT,

Semester	Sr.No	Course Code	Course Name	Theory	Tutorial	Practical	Hrs	Credits
Semester 8	**1**	19CV402T	Railway, Airport, Docks and Harbour Engineering	3	1	0	4	4
	2	UCV406	Construction Project Management	3	1	0	4	4
	3	19CV413T	Only for Project Students Dept. Elective - I	3	1	0	4	4
	4	19CV409P/19CPCL01	Major Project/Comprehensive Project	0	0	0	0	8

19CV402T					Railway, Airport, Docks and Harbour Engineering					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To give an overview about different mode of transportation.
- To know the procedure and influencing factors for Planning of Railway line, Airport and Port.
- To learn geometric design of Railway, Runway and Taxiway
- To study the various components of ports and its construction methods.

UNIT 1 : RAILWAY ENGINEERING **12 Hrs.**

Introduction: Role of railways in transportation, Indian Railways, Selection of Routes, Permanent way and its requirements, Gauges and types, coning of wheels, **Rails-**Functions-requirements- defects-wear-creep-welding-joints, creep of rails. **Sleepers And Ballast:** Functions, requirements, Types, Track fitting and fasteners.

UNIT 2 : RAILWAY GEOMETRIC DESIGN **14 Hrs.**

Geometric Design: Necessity, Safe speed on curves, Cant-cant deficiency-negative cant-safe speed based on various criteria, (both for normal and high speed tracks) Transition curve, Gradient and types, grade compensation, Examples on above. **Points And Crossing:** Components of a turnout, Details of Points and Crossing, Design of turnouts with examples (No derivations) types of switches, crossings, track junctions Stations and Types, Types of yards, Signalling-Objects and types of signals.

UNIT 3 : AIRPORT ENGINEERING **13 Hrs.**

Introduction: Layout of an airport with component parts and functions, Site selection for airport, Aircraft characteristics affecting the design and planning of airport, Airport classification, Runway orientation using wind rose with examples.

Runway : Basic runway length-Corrections and examples, Runway geometrics, Taxiway-Factors affecting the layout - geometrics of taxiway-Design of exit taxiway with examples, Visual aids- Airport marking – lighting-Instrumental Landing System. Smart energy saving methods adopted in Airport.

UNIT 4 : PORT/HARBOUR ENGINEERING **13 Hrs.**

Harbours: Harbour classifications, Layout with components Natural phenomenon affecting the design of harbours - wind, wave and tide, currents, Breakwater-Types Wharf and Quays, Jetties and Piers, Dry dock and wet docks, Slipways, Navigational aids, warehouse and transit-shed.

Max. 52 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Describe various factors considered for planning of Railway line, Port and Airport.
CO2 – Understand different geometric parameters and its importance in design of Railway, Runway and Taxiway.
CO3 – Calculate the geometric parameters of Railway, Runway and Taxiway.
CO4 – Analyze wind duration, direction and intensity for orientation of runway
CO5 – Design of Runway and Taxiway as per code.
CO6 – Create energy efficient model of Airport, Harbour and port.

TEXT/REFERENCE BOOKS

9. Saxena and Arora, Railway Engineering - DhanpatRai& Sons, NewDelhi
10. M Agarwal, Indian Railway Track Jaico Publications, Bombay.
11. Dr. S. K. Khanna, M.G.Arora and S.S. Jain, Airport Planning & Design, Nem Chand & Bros.,Roorkee.
12. G.V. Rao Airport Engineering, Tata McGraw Hill Pub. Co., New Delhi.
13. R. Srinivasan and S. C. Rangwala, Harbour, Dock and Tunnel Engineering, 1995, Charotar Pub.House, Anand.
14. S. P. Bindra, A Course in Docks and Harbour Engineering, 1992, DhanpatRai& Sons, NewDelhi

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A : 10 Questions of 2 marks each-No choice 20 Marks

Part B : 2 Questions from each unit with internal choice, each carrying 16 marks 80 Marks

UCV406					Construction Project Management					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To develop ability and knowledge about the philosophy, concepts and scope of project management and the phases of project life cycle.
- To develop ability and knowledge about the different forms of project organization structures and work breakdown structures.
- To create problem solving ability and develop knowledge about the project planning & scheduling tools and also about the basic project controlling methods
- To develop ability and knowledge about the methods for project monitoring and methodology for project risk management.

UNIT 1 CONCEPT, SCOPE OF PROJECT MANAGEMENT AND PHASES OF PROJECT LIFE CYCLE 12 Hrs.

Introduction- Parameters affecting a project- Project planning & implementation cycle- Concept & scope of project management-Role of project manager- Enhancing the probability of success of a project **Phases of project life cycle:** Idea, Feasibility - Development, Implementation and Operation. **Work break down structure (WBS)-** Role of project manager in developing WBS- Typical hierarchy in the WBS of a project- Product oriented WBS; Functionally oriented WBS.

UNIT 2 PROJECT PLANNING AND SCHEDULING 16 Hrs.

Project organization structures - Factors responsible for organizational revolution- Formal & informal organization structures- Requirements of a project organization- Matrix organization structure- Selecting a project organization structure- Criteria to help determine a suitable organizational form in a given project environment **Project Planning & Scheduling**: Scheduling principles- Bar charts (Gantt charts)- Milestones Charts- S-curve- Network logic diagram- Critical path method- Arrow diagram- Time Estimates- Slack- Total float- Free float - Independent floats- Case studies.

UNIT 3 PROBABILISTIC TOOLS FOR PROJECT SCHEDULING AND PROJECT CONTROL 12 Hrs.

Probabilistic tools for Project Scheduling - PERT (Project evaluation & review techniques) - Three time estimates (optimistic, most likely, pessimistic)- Beta distribution- Expected time- Variance in project duration- Case Studies **Project Control:** Concept- Control cycle- Basic controlling parameters- Line of Balance- Role of project management on control cycle- Time control-Cost control-Potentiality of cost reduction during different phases of a project- Cost planning- Control curves- Cash flow- Time cost trade-off planning for minimum costs- Cost slope concept- Crash point- Normal Point- Total project cost- Controlling cost overrun & time overrun.

UNIT 4 PROJECT MONITORING AND RISK MANAGEMENT 12 Hrs.

Project Monitoring: Measurement of performance- Reporting of performance- Corrective measures for in favourable variations- Major functions of monitoring- Influence of decision-making authority in project monitoring **Project Risk Management:** Risk identification- Risk analysis- Risk response planning and mitigation measures- Case studies.

Sustainable development: Project management for sustainable development **Max. 52 Hrs**

COURSE OUTCOMES

On completion of the course, student will be able to

CO1- Understand the concepts and philosophy of project management and also about the different phases of the project life cycle.

CO2- Learn the methodology for formulation and application of work breakdown structure and organization structure

CO3- Create problem solving ability and knowledge about various project planning and scheduling tools and techniques and complex critical path network diagrams.

CO4- Analyze and solve the problems pertaining to project evaluation and review technique

CO5- Illustrate ability to apply the project monitoring methods

CO6- Learn and build concepts about project controlling methods, methodology for project risk management and methodology for project management for sustainable development

TEXT/REFERENCE BOOKS

1. Kumar Neeraj Jha, Construction Project Management, Pearson Publishers, New Delhi, 2018.
2. Nicholas John M, Project Management for Business and Technology: Principles and Practice, 2nd Edition, Pearson Prentice Hall New Delhi, 2007.
3. Iyer P Parameshwar, Engineering Project Management with case studies. Wheeler Publishing New Delhi, 2001.
4. Joy PK, Handbook of Construction Management, Macmillan Delhi, 1990

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 Exam Duration: 3 Hrs

Part A/Question: 10 Questions of 2 marks each-No choice 20 Marks

Part B/Question: 2 Questions from each unit with internal choice, each carrying 16 marks 80 Marks

19CV409P					Major Project					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	0	8	--	--	--	--	50	50	100

COURSE OBJECTIVES

- To demonstrate a sound technical knowledge of their selected project topic.
- To interpret the problems of industry/society and apply engineering knowledge to solve the problem.
- Develop ability to solve complex problems and find engineering solution based on a systematic approach.
- To communicate effectively with industry managers and the community at large in written and oral form.
- Become updated with all the latest changes in technological world and develop capability and enthusiasm for self-improvement through continuous professional development

Details:

Students need to choose a research topic related to the current practices in Civil Engineering and the project work can be carried out in a small group (not exceeding 3 students). The broad areas can be Structural design and analysis, Soil and Geotechnical engineering, Traffic engineering, pavement design and analysis, metro and mono rail construction, airport planning and design, Water resource management/GIS/Surveying, Construction techniques and management, Environmental engineering/energy conservation.

The group need to choose a guide from the Department and the area / topic of research should be mutually convenient to the group and guide. Students in minor project should give one page discussing the novelty of their work.

The hard-bound copy of the thesis will be prepared as per PDPU format and submitted to Department through guide. One copy of the thesis signed by guide and Head of the Department will be submitted to Department library for originality and record. The project & dissertation work will be reviewed by a committee consisting of minimum 2-faculty members for the internal review component and the external review panel would comprise of external examiner, head of department and guide.

COURSE OUTCOMES

On completion of the project, student will be able to

CO1 - **Define** the relevance of project topic selected for the study with the help of established techniques/principles.

CO2 - **Summarize** the problem statement with the help of literature survey, analytical and documentation skills.

CO3 - **Apply** the data/information gathered for problem to work out the project planning.

CO4 - **Solve** the problems using latest tools/techniques and experimental observations/theoretical modelling through critical investigation.

CO5 - **Prepare** a proper project report following all the guidelines set by the institute

CO6 - **Present** project report properly through accepted tools like PPT.

ASSESSMENT PATTERN

Max. Marks: 100	**Exam Duration: 3 Hrs**
Part A: Mid Semester Review	30 Marks
Part B: End semester Review and thesis submission	50 Marks
(Based on research article submitted in journals/ conference etc.)	
Part C: Continuous assessment by project guide.	20 Marks

19CPCL01					Comprehensive Project					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
			12	--	--	--	--	50	50	100

COURSE OBJECTIVES

- To know the roles and responsibility of a civil engineer in construction site.
- To know the process of contract, tender and selection of project also related government policy and norms.
- To learn the design and analysis of Residential building, high-rise building, bridges, Road, sewer and water pipe line, and other engineering components as per site requirement.
- To learn the scheduling of workers, material and equipment requirement for day to day work execution.
- To give exposure to handle different works execution at site and to maintain record.

Details:

Students/University need to choose a company related to Civil Engineering work. Comprehensive project will be carried out individually. The broad areas can be Structural design and analysis, Soil and Geotechnical engineering, Traffic engineering, pavement design and analysis, metro and mono rail construction, airport planning and design, Water resource management/GIS/Surveying, Construction techniques and management, Environmental engineering/energy conservation etc.

The student needs to choose a mentor from the Department and one supervisor from industry and the area of work should be mutually convenient to the student and mentor.

The hard-bound copy of the work/learning's will be prepared as per PDPU format and submitted to Department through supervisor and mentor with industry training certificate. One copy of the thesis signed by mentor and Head of the Department will be submitted to Department library for originality and record. The comprehensive project work will be reviewed by a committee consisting of minimum 2-faculty members for the internal review component and the external review panel would comprise of external examiner, head of department and mentor. The student will present his project work through suitable software means like power point.

COURSE OUTCOMES

On completion of the project, student will be able to

CO1 - **Define** the relevance of comprehensive project work area selected for the study.

CO2 - **Understand** the role and responsibility of a civil engineering at construction site.

CO3 - **Analyse** the various civil engineering components as per site requirement.

CO4 - **Apply** the knowledge in execution of work in a systematic manner

CO5 - **Prepare** schedule of workers, material and equipment requirement for day to day work execution.

CO6 - **Practice** the acquired knowledge, skills and attitudes for becoming a professional engineer

ASSESSMENT PATTERN

Max. Marks: 100	**Exam Duration: 3 Hrs**
Part A : Monthly Review	30 Marks
Part B : End semester Review and thesis submission (Based on research article submitted in journals/ conference etc.)	50 Marks
Part C: Continuous assessment by project mentor in consultation with industry supervisor.	20 Marks

COURSE STRUCTURE FOR B. TECH. IN CIVIL ENGINEERING														
List of Professional Core Electives			B. Tech. in Civil Engineering											
Sr. No.	Course/ Lab Code	Course/ Lab Name	Teaching Scheme					Examination Scheme						
								Theory			Practical		Total	
			L	T	P	C	Hrs/Wk	MS	ES	IA	LW	LE/Viva	Marks	
1	20CV310T	Advanced Structural Analysis	3	1	0	4	4	25	50	25	--	--	100	
2	20CV311T	Rock mechanics & underground structures	3	1	0	4	4	25	50	25	--	--	100	
3	20CV315T	Geospatial Technologies	3	1	0	4	4	25	50	25	--	--	100	
4	20CV313T	Value Engineering	3	1	0	4	3	25	50	25	--	--	100	
5	20CV406T	Intelligent Transportation Systems	3	1	0	4	4	25	50	25	--	--	100	
6	20CV413T	Design of Water and Sewerage Network	3	1	0	4	4	25	50	25	--	--	100	
7	20CV317T	Advanced Concrete Technology	3	1	0	4	4	25	50	25	--	--	100	
8	20CV324T	Computational Geomechanics	3	1	0	4	4	25	50	25	--	--	100	
9	20CV403T	Design of Hydraulic Structures	3	1	0	4	4	25	50	25	--	--	100	
10	20CV327T	Construction and Demolition Waste Management	3	1	0	4	4	25	50	25	--	--	100	
11	20CV319T	Railway Ports and Airport Engineering	3	1	0	4	4	25	50	25	--	--	100	
12	20CV321T	Air Pollution Engineering	3	1	0	4	4	25	50	25	--	--	100	
13	20CV401T	Finite element method	3	1	0	4	4	25	50	25	--	--	100	
14	20CV318T	Ground improvement technique	3	1	0	4	4	25	50	25	--	--	100	
15	20CV325T	Open Channel Flow	3	1	0	4	4	25	50	25	--	--	100	
16	20CV408T	Traffic Engineering	3	1	0	4	4	25	50	25	--	--	100	
17	20CV328T	Solid Waste Management	3	1	0	4	4	25	50	25	--	--	100	
18	20CV323T	Advance design of reinforced concrete structures	3	1	0	4	4	25	50	25	--	--	100	
19	20CV410T	Earthquake Engineering	3	0	0	3	3	25	50	25	--	--	100	
20	20CV410T	Earthquake Engineering Lab	0	0	2	1	1	--	--	--	25	25	50	
21	20CV322T	Advance Hydrology	3	1	0	4	4	25	50	25	--	--	100	
22	20CV326T	Transportation Planning	3	1	0	4	4	25	50	25	--	--	100	
23	20CV329T	Environmental impact assessment	3	1	0	4	4	25	50	25	--	--	100	
24	20CV407T	Structural dynamics and vibration	3	1	0	4	4	25	50	25	--	--	100	
25	20CV402T	Geo-environmental engineering	3	1	0	4	4	25	50	25	--	--	100	
26	20CV316T	RS and GIS in Water Resources Engineering	3	1	0	4	4	25	50	25	--	--	100	
27	20CV404T	Construction Technology and Equipments	3	1	0	4	4	25	50	25	--	--	100	
28	20CV312T	Pavement Engineering	3	1	0	4	4	25	50	25	--	--	100	

29	20CV405T	Industrial wastewater treatment	3	1	0	4	4	25	50	25	--	--	100
30	20CV409T	Prestressed Concrete Structures	3	1	0	4	4	25	50	25	--	--	100
31	20CV416T	Soil Structure Interaction	4	0	0	4	4	25	50	25	--	--	100
32	20CV411T	Hydrologic modelling And simulation	3	1	0	4	4	25	50	25	--	--	100
33	20CV320T	Primavera / Building Information Modelling	3	1	0	4	4	25	50	25	--	--	100
34	20CV414T	Pavement Management Systems	3	1	0	4	4	25	50	25	--	--	100
35	20CV415T	Environmental data analysis	3	1	0	4	4	25	50	25	--	--	100
36	20CV412T	Prefabricated Structures	3	1	0	4	4	25	50	25	--	--	100

20CV310T					Advanced Structural Analysis					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

Course Objectives:

- Determine deflections and forces in structures using the matrix method.
- Write and use computer programs which implement the matrix stiffness method.
- Understand the advanced nonlinear analysis and determine the collapse load of structure.

UNIT 1 **12 Hrs.**

Basic Concepts of Structural Analysis- Types of Framed Structures- Degrees of freedom- Deformations in Framed Structures- Actions and Displacements- Equilibrium- Compatibility- Static and Kinematic Indeterminacy- Structural Mobilizes- Principle of Superposition- Action and Displacement Equations- Energy and Virtual work Concepts.

Flexibility method- Element flexibility matrix- Principle of contragradience and Force Transformation Matrix- Member Flexibility matrix- Construction of structure flexibility matrix- Matrix determination of the displacement vector- Determination of member forces- Analysis of axially rigid continuous beams- rigid plane frames by flexibility method using Force Transformation Matrix.

UNIT 2 **08 Hrs.**

Stiffness method- equivalent joint loads- Displacement Transformation matrix- Member stiffness matrix- Total or System stiffness matrix- Truss analysis by stiffness method using Displacement Transformation Matrix- Continuous Beam and rigid frame analysis with axially rigid members by stiffness method using Displacement Transformation Matrix.

UNIT 3 **10 Hrs.**

Direct stiffness method- Local and global coordinate system- Transformation of variables- Transformation of the member displacement matrix- Transformation of the member Force matrix- Transformation of the member stiffness matrix- Transformation of the Stiffness Matrix of the member of a truss- Transformation of the stiffness matrix of the member of the Rigid frame- Overall stiffness matrix- Boundary conditions- Computation of internal forces- Analysis of trusses and continuous beams by direct stiffness method.

UNIT 4 **08 Hrs.**

Plastic Analysis- Introduction to plastic theory- Plastic hinge- plastic moment- load factor- shape Factors of various standard sections like rectangular- circular- triangular- T and I section- collapse load- beam mechanism- column mechanism-sway mechanism- combined mechanisms- Plastic analysis of simple- continuous and portal frame for collapse load and plastic moments.

Introduction non-linear analysis- Non-linearity in structure and non-linear analysis

Max. 52 Hrs.

COURSE OUTCOMES:

On completion of the course, student will be able to

CO1- Identify the fundamental concepts of engineering mechanics to development matrix methods for structural analysis.

CO2- Apply the matrix stiffness method to model the behaviour of planar trusses, beams, and frames.

CO3- Calculate deflections, reactions, and internal forces for planar trusses, beams, and frames using analytical and computer-based methods.

CO4- Develop computer programs for analysis of framed structure.

CO5- Determine the collapse load for beam and rigid joint frame by static and kinematics methods.

CO6- Understand the concept of non-linearity in structure and non-linear analysis.

TEXT/REFERENCE BOOKS:

1. Weaver W. and Gere J. M., Matrix Analysis of Framed Structure - CBS Publishers, Delhi.
2. Ghali & Nevelle , Structural Analysis - Spon Press, London.
3. Aslam Kassimali, Matrix Analysis of Structures - Cengage Learning, USA.
4. H. Kardestuncer ,Elementary Matrix Analysis of Structures, Mc-Graw Hill, USA.
5. Beaufait, Rowan, Computer Methods of Structural Analysis - Hadley and Heckett
6. Graves Smith , Linear Analysis of Frame works
7. Fleming J.F, Computer Analysis of Structural Systems

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A: 10 Questions of 2 marks each-No choice 20 Marks

Part B: 2 Questions from each unit with internal choice, each carrying 16 marks 80 Marks

20CV311T					ROCK MECHANICS & UNDERGROUND STRUCTURES					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To understand the scope of rock mechanics and exploration in real in-situ problems
- To learn the physical and engineering properties of different rock and rock masses
- To study different methods for determination of rock strength directly and indirectly
- To provide the usefulness of various rock improving techniques in fragile ground conditions
- To understand the concept of distribution of stresses around the tunnel.

UNIT 1: INTACT ROCK **15 Hrs.**

Scope of rock mechanics-Object of rock exploration-Rock quality designation - Problems related to rock mechanics- Rock materials- Physical properties- Strength behaviour in uniaxial compression- Tension and triaxial state- Stress-strain relationships- Anisotropy- Laboratory testing methods - Compressive strength test- Tensile strength test- Permeability- Direct shear test- Test for internal stress in rock- Indirect methods- Flexural strength of rock.

UNIT 2: ROCKMASS **13 Hrs.**

Properties of Rock Mass- Rock Mass Classification- Deere and Miller- Geological classification- ISRM-Terzaghi- RQD- RSR-RMR Rating and Q classifications- Weathered rocks- In-situ determination of elastic properties of rocks by dynamic method-Rock mass behaviour- Shear strength of jointed rocks- Strength criteria for rock mass.

UNIT 3: FAILURE CRITERION OF ROCK AND ROCK MASSES **12 Hrs.**

Brittle – ductile transition- Failure Criterion- Coulomb, Mohr's- Griffiths and Modified Griffiths criteria- Empirical criteria-Creep and its measurement.

UNIT 4: UNDERGROUND STRUCTURES **12 Hrs.**

Introduction- Types and classification of underground openings- Factors affecting tunnel design- Design methodology-Functional aspects- Size and shapes- Support systems- Analysis- Stresses and deformations around openings – Improvement-Necessity- Grouting- Rock bolting- Cable anchorage

Max. 52 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1-Identify the different types of rock and rock mass for its suitability and uses

CO2 -Analyse the strength and deformation behaviour of rock and rock mass

CO3-Apply the laboratory and field tests to determine properties of rock and rock mass

CO4-Inspect various failure criterions of rock and rock masses under different loading condition

CO5-Illustrate the application of rock mechanics in real field problem

CO6-Provide the engineering solutions for construction of underground structures

TEXT/REFERENCE BOOKS

1. Vutukuri, V.S., Lama, R.D. and Saluja, S.S. Handbook on Mechanical Properties of Rocks. Vol. 1, Trans Tech. Publications, 1974.
2. Goodman R. E., Introduction to Rock Mechanics – Jhon Wiley, London, 1989.
3. Bieniawski, Z. T. Engineering Rock Mass Classifications. John Wiley and Sooung syns, 1989.
4. John Jaeger and N. G. Cook. Fundamentals of Rock Mechanics. Wiley-Blackwell. 2007.
5. Zhang Lianyang. Engineering Properties of Rocks. Elsevier, 2005.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A: 02 Questions from Unit I-II, each carrying 15 marks	30 Marks
Part B : 03 Question from Unit I-II, each carrying 5 marks	15 Marks
Part C : 03 Question from Unit III-IV, each carrying 5 marks	15 Marks
Part D : 02 Question from Unit III-IV, each carrying 20 marks	40 Marks

20CV315T					Geospatial Technologies					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To understand the fundamental of RS and Image processing
- To understand the fundamentals of GIS and Processes.
- To understand the utilization of GPS and UAV for engineering mapping
- To learn the complex engineering application using Geospatial Techniques

UNIT 1 INTRODUCTION **07 Hrs.**

Introduction to remote sensing - Geographical information systems and global positioning systems - Benefits and applications of remote sensing – GIS, GPS, UAV techniques.

UNIT 2 REMOTE SENSING **15 Hrs.**

Fundamentals of remote sensing - Energy interactions - Ideal remote sensing systems, - Fundamentals of interpretation - Basic equipment used for interpretation - Elements of air photo interpretation - Interpretation keys - Different types of sensors - Platforms and remote sensing images; Digital Image processing: Characteristics of a digital image - Image enhancement - Contrast manipulation – Image registration – Digital image interpretation techniques

UNIT 3 GEOGRAPHICAL INFORMATION SYSTEM **15 Hrs.**

Introduction - Geo referenced data - Data input & output - Data quality and management - GIS analysis functions - Implementation of GIS - Airborne Laser Thematic Mapper (ALTM) LIDAR, Principles and methods of data collection – Digital Elevation Models; GPS and UAV: Earth Surface, datum – Co-ordinate systems - Segments of GPS System - GPS receivers and its components - Different methods of observation; Type of UAV, UAV components; Application of UAV

15 Hrs.

UNIT 4 ENGINEERING APPLICATIONS

Land use / Landcover mapping - resources mapping - Utility mapping - Urban and regional planning and environmental and other engineering applications

Max. 52 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Understand the basic concept of Remote Sensing and GIS techniques
CO2 – Classify the advance instrument techniques (GPS and UAV) in surveying
CO3 – Analyse a data using a spatial analysis technique
CO4 – Illustrate the application of RS and GIS in decision making activities
CO5 – Appraise the use of advance software techniques for map making activities.
CO6 – Create an art of map making activities.

TEXT/REFERENCE BOOKS

1. Remote sensing and image interpretation by Thomas M. Lillesand, Ralph W. Kiefer
2. Advances in land remote sensing system, Modelling, Inversion and application by Shunlin Liang
3. Haywood L, Cornelius S and S Carver (1988) An Introduction to Geographical Information Systems, Addison Wiley Longmont, New York.
4. Burgh PA (1986) Principles of geographical Information System for Land Resources Assessment, Clarendon Press, Oxford.
5. Burrough PA, McDonnell PA (2000) Principles of Geographical Information systems, London: Oxford University Press.
6. LoCP, Young KW Albert (2002) Concepts And Techniques of Geographic Information Systems, Prentice-Hall of India Pvt ltd, New Delhi

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A : 10 Questions of 2 marks each-No choice 20 Marks
Part B : 2 Questions from each unit with internal choice, each carrying 16 marks 80 Marks

20CV313T					Value Engineering					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To understand the concepts of value engineering
- To learn the methodology for value engineering job plan
- To learn the methods for value engineering in decision making
- To apply value engineering in construction projects

UNIT 1 INTRODUCTION TO VALUE ENGINERING **13 Hrs.**

Introduction to value engineering – Concepts- Value- Types of value-Function-types of function-Evaluation of function-Evaluation of costs-Evaluation of worth-Determination and evaluation of economic parameters of value.

UNIT 2 VALUE ENGINEERING JOB PLAN **13 Hrs.**

Concepts of job plan – Information phase- Function phase – Creation phase – Evaluation phase – Investigation phase – Implementation phase – Speculation phase – Analysis phase – Case studies

UNIT 3 VALUE ENGINEERING DECISION MAKING TOOLS **13 Hrs**

Engineering economics: Time value of money – Rate of Return (ROR) analysis – Breakeven analysis – Sensitivity analysis

Social Benefit Cost Analysis (SBCA)- Life Cycle Cost Analysis (LCCA) – Multi-Criteria Decision Making (MCDM), Case studies.

UNIT 4 FAST DIAGRAM AND COST MODELS **13 Hrs.**

FAST Diagram: FAST diagram techniques – Application of FAST diagramming method to infrastructure projects
Cost Models: Type of cost models – Cost matrix – Development of cost models for infrastructure projects, Case studies.

Max. 52 Hrs

COURSE OUTCOMES

On completion of the course, student will be able to:
CO1- Understand the concepts of value engineering
CO2- Apply the concepts of value engineering job plan
CO3- Analyze the concepts of ROR analysis, breakeven analysis and sensitivity analysis
CO4- Learn the methodology for computation of Social benefit cost analysis (SBCA)
CO5- Learn the methodology for computation of Life cycle cost analysis (LCCA)
CO6- Apply FAST diagramming methods and Cost models to infrastructure projects

TEXT/REFERENCE BOOKS

1. Miles, L. D. , Techniques of Value Analysis and Engineering, E. M Walker Publications, 1989
2. Dell'Isola, A., Value Engineering Practical Applications, RS Means Publishers, 1997.
3. Degarmo, E. Paul. Engineering Economy, Prentice Hall International Inc., New Jersey, 1997.
4. Chawla, Kishan. Social Cost – Benefit Analysis: An Introduction to Financial and Economic Appraisal of Projects. Mittal Publishers, 1987.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A/Question: 10 Questions of 2 marks each-No choice **20** Marks
Part B/Question: 2 Questions from each unit with internal choice, each carrying 16 marks **80** Marks

20CV406T					Intelligent Transportation Systems					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- Know the importance and role of ITS in-road transportation
- Study the various sensor and communication technologies used in ITS
- Learn the various functional areas of ITS
- Know the role of ITS in smart city development and sustainable transportation development.

UNIT 1 INTRODUCTION TO INTELLIGENT TRANSPORTATION SYSTEMS (ITS) **13 Hrs.**

Definition of ITS and Identification of ITS Objectives- Historical Background- Benefits of ITS - ITS Data collection techniques – Detectors- Automatic Vehicle Location (AVL)- Automatic Vehicle Identification (AVI)- Geographic Information Systems (GIS)- video data collection.

14 Hrs.

UNIT 2 TELECOMMUNICATIONS IN ITS

Telecommunications in ITS – Importance of telecommunications in the ITS system- Information Management- Traffic Management Centres (TMC)- Vehicle – Road side communication – Vehicle Positioning System

ITS functional areas – Advanced Traffic Management Systems (ATMS)- Advanced Traveller Information Systems (ATIS)- Commercial Vehicle Operations (CVO)- Advanced Vehicle Control Systems (AVCS)- Advanced Public Transportation Systems (APTS)- Advanced Rural Transportation Systems (ARTS).

13 Hrs.

UNIT 3 ITS USER NEEDS AND SERVICES

ITS User Needs and Services – Travel and Traffic management- Public Transportation Management- Electronic Payment- Commercial Vehicle Operations- Emergency Management- Advanced Vehicle safety systems- Information Management- ITS in risk management and safety improvement.

UNIT 4 AUTOMATED HIGHWAY SYSTEMS **12 Hrs.**

Automated Highway Systems - Vehicles in Platoons – Integration of Automated Highway Systems. ITS Programs in the World – Overview of ITS implementations in developed countries, ITS in developing countries. Application of ITS in Smart city development. Role of ITS in Sustainable road network development.

Max. 52 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Understand role of ITS in efficient road network operation.
CO2 - Apply the various sensor and communication technologies in ITS methodologies
CO3 – Design various ITS solution methodologies under Indian conditions.
CO4 – Analyze the traffic operation with and without ITS.
CO5 – Evaluate the best ITS solution with respect to field traffic issue.
CO6 – Create new ITS technology for sustainable transportation development.

TEXT/REFERENCE BOOKS

1. Intelligent Transportation Systems by Pradip kumar Sarkar and Amit Kumar Jain.
2. Permanent International Association of Road Congresses (**PIARC**) Intelligent Transportation System
3. ITS Hand Book 2000: Recommendations for World Road Association (PIARC) by Kan Paul Chen, John Miles.
4. Sussman, J. M., Perspective on ITS, Artech House Publishers, 2005.
5. National ITS Architecture Documentation, US Department of Transportation, 2007 (CD-ROM)

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A: 10 Questions of 2 marks each-No choice 20 Marks

Part B: 2 Questions from each unit with internal choice, each carrying 16 marks 80 Marks

20CV413T					Design of Water and Sewerage Network					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- Design of Water Distribution Network
- Understanding the Water Management Concepts
- Design of Sewerage System
- Understanding various software / tools for designing water and sewerage networks

UNIT 1 WATER DISTRIBUTION NETWORK **13 Hrs.**

Pumps for lifting the water- Storage Reservoir- Water Distribution Network: analysis and design- Appurtenances in the distribution network

UNIT 2 WATER HARVESTING AND MANAGEMENT **13 Hrs.**

Rain water Harvesting- Ground Water Recharge and Development- Water Conservation- Water Footprint- Planning and preparing Water Supply Projects

UNIT 3 WASTEWATER COLLECTION NETWORK **13 Hrs.**

Introduction to various sewerage systems- components of sewerage system- hydraulic designs of sewers- construction and maintenance of sewers- testing of a sewer line- cleaning of sewers- sewer appurtenances

UNIT 4 INTRODUCTION SOFTWARE TOOLS **13 Hrs.**

Introduction to Computed aided design of Water Distribution Network (for eg. Water Gems)- Introduction to computer aided design of Wastewater Distribution Network (for e.g. Sewer Gems).

TOTAL 52 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – **Design** a Water Distribution Network
CO2 – **Design** of Water Harvesting units
CO3 – **Devise** a Water Supply project for a community / city
CO4 – **Design** a Sewerage system
CO5 – **Propose** Maintenance activities for water and wastewater networks
CO6 – **Design** water and wastewater networks using softwares

TEXT/REFERENCE BOOKS

1. Water Supply Engineering (Environmental Engineering), S. K. Garg, Khanna Publishers, 2016
2. Water Supply and Sanitation Engineering, GS Birdie, JS Birdie, Galgotia Publishing Ltd Sewage Disposal and Air Pollution Engineering, S K Garg, Khanna Publishers, 2016
3. Environmental Engineering, HS Paevy, DR Rowe, G Tchobanoglous, McGraw Hill
4. Water and Wastewater Engineering, Metcalf and Eddy, McGraw Hill
5. Chemistry for Environmental Engineers, Sawyer, C.N. and McCarty, P.L., and Parkin, G.F. 4th Edn. McGraw Hill, New Delhi, 1994.
6. Process Chemistry for Water and Wastewater Treatment,Benefield, Judkins and Weand, Prentice Hall

END SEMESTER EXAM PAPER SCHEME (Max Marks: 100)

Part A	8 Questions of 5 Marks each. 2 Questions from every unit.	40
Part B	6 Questions of 10 Marks each. 1 Question from unit 1 & 2 and 2 Questions from Unit 3 & 4	60

20CV317T					Advanced Concrete Technology					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES:

- To introduce the various latest and modern construction materials, properties and their uses.
- To understand the various latest and modern construction materials, properties and their uses
- To create mix design of concrete as per latest IS codal provision.

Unit 1 CEMENTITIOUS MATRICES **13 Hrs.**

Basic introduction about past-present & future concrete-concrete mixture proportioning unitary/binary/ternary-Mix design with unitary- binary and ternary supplementary cementitious materials along with OPC.

High Strength Concrete- Classification of HSC- microstructure of HSC-composition of HSC/Ultra HSC- applications of HSC-design of HSC

Unit 2 SPECIAL CONCRETES **13 Hrs.**

Polymers in concrete- types of polymers- tests on polymer concrete- proportioning of polymer concrete- mix design with polymer in concrete. Properties and applications of geopolymer concrete-Fibre reinforced concrete-epoxy concrete, pervious concrete-hot weather & cold weather concrete.

Unit 3 SPECIAL MATERIALS IN CONSTRUCTION **13 Hrs.**

Self-compacting concrete-properties and application of self-compacting concrete-fresh properties of self-compacting concrete-mix design of self-compacting concrete containing supplementary cementitious materials along with OPC.

Unit 4 REPAIR AND REHABILITATION **13 Hrs.**

Distresses in concrete structures- deterioration of structures- causes & preventions- crack repair techniques.

Total 52 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Understand the functional role of ingredients of supplementary cementitious materials.
CO2 - Explain the terminology of binary, ternary, quaternary and how to replace with OPC.
CO3 - Classify the high, ultra-high- and high-performance concrete
CO4 - Design special concrete considering supplementary cementitious materials
CO5 - Determine the effect supplementary cementitious materials on self-compacting concrete.
CO6 - Explain the factors to be considered in construction of buildings and develop the construction practices and techniques.

References:

1. R. Santhakumar, Concrete Technology oxford university press, 2011.
2. M.S. Shetty, Concrete Technology- Theory and Practice, S.Chand Publication.
3. M.L.Gambhir, Concrete Technology, TaTaMacgrawhill publication
4. A.M.Neville, Concrete Technology, Pearson education India ltd.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100	**Exam Duration: 3 Hrs**
Part A: 10 Questions of 2 marks each-No choice	20 Marks
Part B: 8 Questions from each unit with internal choice, each carrying 10 marks	80 Marks

20CV324T					Computational Geomechanics					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To explain the fundamental principles of vectors and tensors., different types of tensors.
- To explain stress analysis, strain analysis and equilibrium equations.
- To explain stress development in soil domain due to external loading.
- To explain rheological properties of geomaterials.
- To explain the development of failure theories and application in different soil materials.

UNIT 1 FUNDAMENTALS OF VECTORS AND TENSORS **10 Hrs.**

Introduction, coordinate system, Vector algebra, scalar product, vector product, triple product, scalar and vector fields, indicial notation and summation Convention, kronecker delta, alternating delta, transformation of coordinates, definition of Cartesian tensor, isotropic tensor, quotient rule, surface-volume integral (divergence theorem)

UNIT 2 ANALYSIS OF STRESS AND STRAIN **16 Hrs.**

Analysis of stress. Analysis of strain. Equilibrium equations -Compatibility equations -stress strain relationship. Generalized Hooke's law. Octahedral shear, Stress function. Plane stress and plane strain -Simple two-dimensional problems in Cartesian and polar co- ordinates.

UNIT 3 STRESSES IN SOIL AND RHEOLOGICAL PROPERTIES **12 Hrs.**

Stresses in Soil: Description of state of stress and strain at a point, stress distribution problems in elastic half pace Boussnesque's analysis for concentrated force. Pressure bulb. Uniformly loaded circular and rectangular areas. Newmark influence diagram. Triangular and other loadings. Westergaard's analysis. Burmister's two-layer theory. Stress distribution around tunnels and vertical shafts. Rheological properties of material-equation of state, models, stress deformation behavior of soil subject to loading, solution of problems of linearly elastic solids. Deformation of Rheological constants. Pore pressure developed, settlement computations.

UNIT 4 FAILURE THEORIES IN SOIL **14 Hrs.**

Failure theories, Yield criteria, Tresca, Von Mises, Mohr-Coulomb failure conditions. Failure loci in deviatoric plane and principal stress space, influence of intermediate principal stress on failure. Constitutive Models in Soil Mechanics: Isotropic Elastic, Anisotropic Plasticity and Viscous Models. Representing Soil Behaviour using these Models, Advances in Constitutive models

Max. 52 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 Explain the basic concepts of vectors and tensors, and able to develop different tensors.
CO2 Demonstrate an ability to do the analysis of different practical stress strain condition.
CO3 Calculate stress developed in soil domain for different external surface loading condition.
CO4 Interpret properties of geomaterial like stress deformation, pore pressure development and settlement.
CO5 Evaluate different basic failure theories used for soil.
CO6 Evaluate advance constitutive models incorporating anisotropy, plasticity; and viscous models.

TEXT/REFERENCE BOOKS

1. Y. C. Fung, "Foundations of Solid Mechanics", Prentice - Hall Publishers.
2. S.P.Timoshenko and J.N. Goodier, "Theory of Elasticity", McGraw-Hill Book Company.,1988
3. C.T. Wang, "Applied Elasticity", McGraw-Hill Book Company
4. Wai-Fah Chang and Atef Saleeb, "Constitutive Equations for Engineering material: Volume 1: Elasticity and Modelling", Wiley-Interscience Publication
5. Slater R.A.C, "Engineering Plasticity", John Wiley and Son, New York, 1977.
6. Selvadurai A.P.S., "Plasticity & Geomechanics", Cambridge University Press, 2002

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A: 10 Questions of 2 marks each-No choice 20 Marks

Part B: 2 Questions from each unit with internal choice, each carrying 16 marks 80 Marks

Pandit Deendayal Petroleum University School of <Technology>

20CV403T					Design of Hydraulic Structures					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To understand concepts of hydraulic structures.
- To identify and compare suitability of a kind of hydraulic structures.
- To evaluate and analyse the hydrological data for decision making system.
- To learn the various design of hydraulic structure

UNIT 1 CANAL DESIGN **13 Hrs.**

Canal Irrigation System-Types of canal - Basic terminology related to canal system.
Design of Irrigation Channels - Basics of sediment - Design of unlined canal.
Channel Lining and Water Logging - Basics of canal lining – Advantages – Disadvantages- Requirement of lining material - Types of canal lining - Design of Lined canal.

UNIT 2 CANAL STRUCTURES **13 Hrs.**

Diversion Head Works - Weir and Barrage, Layout and Components - Seepage Theories.
Canal Falls - Definitions and Locations-Types of falls.
Cross Drainage Works - Types and Suitability.
Canal Structure - Canal Regulation Works - Canal Escapes and Canal Modules.
Include - Design of Weir and Falls (Any one type)

UNIT 3 GRAVITY DAMS **13 Hrs.**

Definitions, Cross Sections - Forces Acting on Dam, Modes of Failure - Elementary Profile - High and Low Gravity Dam - two-Dimensional Analysis of Dam - Design of Gravity dam - Construction of gravity dam.

Unit 4 SPILLWAY **13 Hrs.**

Location of spillways - Types of spillways - Energy dissipaters - Spillway crest gates.

Total 52 Hrs

COURSE OUTCOMES

On completion of the course, student will be able to
CO1 – Remember the basic concepts and fundamentals of design of hydraulic structures
CO2 – Understand the concepts of design of hydraulic structures and its need
CO3 – Illustrate the alternate design for different part of the structure
CO4 - Analyse the data for best suitability of hydraulic structure
CO5 – Judge the design for most economic structure
CO6 – Create a marvel for social services and public utility.

TEXT/REFERENCE BOOKS

1. Santosh Kumar Garg “Irrigation Engineering and Hydraulic Structures”, Khanna Publishers, New Delhi.
2. B. C. Punmia, Ashok Kumar Jain, Arun Kumar Jain, Dr. Pande Brij Basi Lal “Irrigation and Water Power Engineering”, Laxmi Publication.
3. S.R. Sahasrabudhe “Irrigation Engineering & Hydraulic Structures”, S.K. Kataria & Sons.
4. Birdie-Dass “Irrigation Engineering”, Dhanpat Rai Publishing Company (P) Ltd.
5. T K Sharma&R K Sharma “Irrigation Engineering”, S. Chand Publishing
6. GHOSH, KARUNA MOY “Analysis and Design Practice of Hydraulic Concrete Structures”, PHI Learning
7. P. N. Modi “Irrigation Water Resources and Water Power Engineering”, Standard Book House, Delhi.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A: 10 Questions of 2 marks each-No choice 20 Marks
Part B: 2 Questions from each unit with internal choice, each carrying 16 marks 80 Marks

Pandit Deendayal Petroleum University School of Technology

20CV327T					Construction and Demolition Waste Management					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

Pre-requisites: 1. Building construction materials

COURSE OBJECTIVES

- To explain the concept of municipal solid waste
- To understand the composition of construction and demolition waste
- To outline the significance of C&D waste recycling for sustainability
- To apply the knowledge of building materials in reuse and recycling

UNIT 1 FUNDAMENTAL OF SUSTAINABLE BUILDING MATERIALS **10 Hrs.**

importance of sustainable building materials- shortage of natural resources for construction -Introduction to Municipal solid waste- generation- source of waste-classification of type of solid waste- collection-segregation- physical, chemical and biological properties of waste- Structure and properties of main classification of materials- metals, polymers and ceramics

UNIT 2 CONSTRUCTION AND DEMOLITION (C&D) WASTE **18 Hrs.**

Construction materials classification- significance of demolition- building demolition process-construction and demolition debris collection- segregation and quantification of C & D debris from road work- building site work- demolition work- construction- renovation

UNIT 3 REUSE OF C & D WASTE **12 Hrs.**

Benefits of reuse of C & D waste- Conditions for reuse of waste – collection, storage of reusable materials- Concrete- brick- tiles, timber- metals, plastic- asphalt- asbestos- excavated material- disposal of debris- Guidelines to be Followed in Recycling- recycled concrete aggregates (RCA)- recycling plant

UNIT 4 APPLICATION OF RECYCLED WASTE MATERIAL **12 Hrs.**

Use of Recycled concrete, glass aggregate, reclaimed bitumen- asphalt pavement- Case studies on various applications

Max. 52 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Explain the significance of municipal solid waste management
CO2 - Assess the construction and demolition waste composition
CO3 - Understand the sources and generation of construction and demolition waste
CO4 - Prepare the suitable disposal system for waste material
CO5 – Propose reuse or recycle of waste material
CO6- Specify the application of recycled material in construction

TEXT/REFERENCE BOOKS

1. George Tchobanoglous, Frank Kreith et al “Hand book of solid waste management.” Mc Graw hill publications - Newyork.
2. William A Worrell, Aarne Vesilind, Solid waste Engineering, Cengage learning
3. Howard S Peavy, Donald R Rowe, George Tchobanoglous,“Environmental Engineering” McGrawhill
4. John Pichtel “ Waste management Practices” Taylor& Francis publishers

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A: 10 Questions of 2 marks each-No choice 20 Marks

Part B: 2 Questions from each unit with internal choice, each carrying 16 marks 80 Marks

20CV319T					Railway Ports and Airport Engineering					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To give an overview about different mode of transportation.
- To know the procedure and influencing factors for Planning of Railway line, Airport and Port.
- To learn geometric design of Railway, Runway and Taxiway
- To study the various components of ports and its construction methods.

UNIT 1 RAILWAY ENGINEERING **12 Hrs.**

Introduction - Role of railways in transportation - Indian Railways - Selection of Routes - Permanent way and its requirements - Gauges and types - coning of wheels - **Rails-**Functions-requirements- defects-wear-creep-welding-joints - creep of rails. **Sleepers and Ballast –** Functions – requirements – Types - Track fitting and fasteners.

UNIT 2 RAILWAY GEOMETRIC DESIGN **14 Hrs.**

Geometric Design – Necessity - Safe speed on curves - Cant-cant deficiency-negative cant-safe speed based on various criteria - (both for normal and high speed tracks) Transition curve - Gradient and types - grade compensation - Examples on above. **Points and Crossing -** Components of a turnout- Details of Points and Crossing - Design of turnouts with examples (No derivations) types of switches – crossings - track junctions Stations and Types - Types of yards - Signalling-Objects and types of signals.

UNIT 3 PORT/HARBOUR ENGINEERING **13 Hrs.**

Harbours - Harbour classifications - Layout with components Natural phenomenon affecting the design of harbours - wind, wave and tide – currents - Breakwater-Types Wharf and Quays - Jetties and Piers - Dry dock and wet docks – Slipways - Navigational aids - warehouse and transit-shed.

UNIT 4 AIRPORT ENGINEERING **13 Hrs.**

Introduction - Layout of an airport with component parts and functions - Site selection for airport - Aircraft characteristics affecting the design and planning of airport - Airport classification - Runway orientation using wind rose with examples. **Runway -** Basic runway length-Corrections and examples - Runway geometrics - Taxiway-Factors affecting the layout - geometrics of taxiway-Design of exit taxiway with examples, Visual aids- Airport marking – lighting-Instrumental Landing System. Smart energy saving methods adopted in Airport. **Max. 52 Hrs.**

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Describe various factors considered for planning of Railway line, Port and Airport.
CO2 –Understand different geometric parameters and its importance in design of Railway, Runway and Taxiway.
CO3 – Calculate geometric parameters and can.
CO4 – Analyse wind duration, direction and intensity for orientation of runway
CO5 – Design of Runway and Taxiway as per code.
CO6 – Create energy efficient model of Airport, Harbour and port.

TEXT/REFERENCE BOOKS

1. Saxena and Arora, Railway Engineering **-** DhanpatRai& Sons, NewDelhi
2. M Agarwal, Indian Railway Track Jaico Publications, Bombay.
3. Dr. S. K. Khanna, M.G.Arora and S.S. Jain, Airport Planning & Design, Nem Chand & Bros.,Roorkee.
4. G.V. Rao Airport Engineering, Tata McGraw Hill Pub. Co., New Delhi.
5. R. Srinivasan and S. C. Rangwala, Harbour, Dock and Tunnel Engineering, 1995, Charotar Pub.House, Anand.
6. S. P. Bindra, A Course in Docks and Harbour Engineering, 1992, DhanpatRai& Sons, NewDelhi

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A: 10 Questions of 2 marks each-No choice 20 Marks

Part B: 2 Questions from each unit with internal choice, each carrying 16 marks 80 Marks

20CV321T					Air Pollution Engineering					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- Understanding the various aspects of Air Pollutants
- Explain the impact of meteorology on air pollution
- Compute the concentration of various air pollutants
- Propose Mitigation of air pollution through various devices and modeling approach

UNIT I AIR POLLUTANTS **13 Hrs.**

Classification of air pollutants, properties of gaseous and particulate matter, effects of Air pollution on plants, animals, materials, human health, Sources of Air pollution and emission inventory, Air quality standards and Air Quality Index, Introduction to Air Pollution Legislation

UNIT II AIR POLLUTION METEOROLOGY **13 Hrs.**

Atmospheric energy balance, environmental lapse rates and atmospheric stability, winds, wind profiles, plume behaviour, turbulence, Dispersion of Air pollutants, Prediction of effective stack height - physics of plume rise, Holland's equation, Briggs equation, modifications of Gaussian dispersion models

UNIT III AIR POLLUTION MEASUREMENTS **13 Hrs.**

Instruments used in monitoring the air pollution, sampling and analysis of indoor air, ambient air and stack gas, design of sampling network design, application of satellite data for air pollution assessment, case studies for different cities of India

UNIT IV AIR POLLUTION MODELLING AND CONTROL **13 Hrs.**

Introduction to various air quality models (like Envi-MET, WRF-CHEM, Land GEMS, AERMOD, CALPUFF) for simulating air quality concentration, Introduction to Industrial air pollution control devices like settling chambers, cyclones, spray towers, electrostatic precipitators, etc., Indoor Air Quality enhancement

TOTAL 52 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to
CO1 – **Identify** the sources of air pollutants in a city
CO2 – **Estimate** the damage due to air pollutants
CO3 – **Associate** air pollution with meteorology
CO4 – **Calculate** the concentrations of various air pollutants
CO5 – **Predict** the concentrations of various air pollutants
CO6 – **Design** air pollution control framework

TEXT/REFERENCE BOOKS:

1. Air Pollution by M N Rao and H V N Rao, Tata McGraw Hill, 2017
2. Fundamentals of Air Pollution, A. C. Stern, Academic Press, 1994
3. Atmospheric Chemistry and Physics, John H. Seinfeld and Spyros N. Pandis, Wiley Interscience Publication, 2006
4. Sewage Disposal and Air Pollution Engineering, S K Garg, Khanna Publishers, 2016
5. Introduction to Atmospheric Chemistry, Daniel Jacob, Princeton University Press, 1999
6. Environmental Engineering, Arcadio P., Prentice Hall of India, 1999.
7. Environmental Pollution Control Engineering- CS Rao, Wiley Eastern Ltd., New Delhi, 1996.
8. Air Pollution Control Equipment H. Brauer and Y. B. G. Verma, Berlin Heidelberg, New York, latest edition

END SEMESTER EXAM PAPER SCHEME (Max Marks: 100)

Part A	8 Questions of 5 Marks each. 2 Questions from every unit.	40
Part B	6 Questions of 10 Marks each. 1 Question from unit 1 & 2 and 2 Questions from Unit 3 & 4	60

20CV401T					Course Name: FINITE ELEMENT METHOD					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

Course objectives:

- To understand finite element concepts, degrees of freedom, mesh size, numerical integration
- To analyse 1D, 2D problems using finite element technique
- Understand the 3D finite elements, material and geometric nonlinearity in FEM

UNIT 1 **13 Hrs.**

Introduction to theory of elasticity, Stress at a point. Rectangular stress components in 3D problems, Strain components in 3D Problems. Equilibrium Equations, Cauchy's stress formulae, Strain-Displacement Relations, stress-strain relations, stress / strain transformations, Plane stress/ Plane strain Problems

UNIT 2 **13 Hrs.**

Introduction to FEM, Brief history of the Development, Advantages and Disadvantages of finite element method, Finite element procedure, displacement model, convergence, compatibility, geometric invariance requirements, degrees of freedom, Shape functions, Types of finite elements in FEM Library. One dimensional element: FEM formulation for bar, beam elements in local and global coordinate system, stiffness matrices, and related problems

UNIT 3 **13 Hrs.**

FEM solutions for frame and truss problems, Two-dimensional FE formations for Constant strain triangular element (CST), Linear Strain Triangle (LST), rectangular plane elements.

Natural Coordinate system. Iso-parametric, sub-parametric and super-parametric concept FE formulation concept. Isoparametric formulations for triangular and quadrilateral elements, Jacobian matrix, related problems, Consistent and lumped load vector concept.

UNIT 4 **13 Hrs.**

Thin Plate Finite element formulation, Introduction to three-dimensional problem, types 3D finite elements, Introduction to Dynamic consideration in FEM, mass matrix, Introduction to material and geometrical nonlinearity

Max. 52 Hrs.

COURSE OUTCOMES:

At the end of the semester, students should able to

CO1- **Derive** Equilibrium Equations, stress-strain relations, stress / strain transformations
CO2- **Understand** FEM concept and to formulate 2-node bar element and to analyse the truss problems
CO3- **Formulate** beams finite element and to solve related problems
CO4- **Formulate** CST and quadrilateral elements and to solve related problems
CO5- **Understand** numerical integration, consistent load vector formation
CO6- **Understand** the 3D finite elements, material and geometric nonlinearity in FEM

Books for References:

1. R D Cook, D S. Malkus, M E Plesha and R J Witt, "Concept and applications of finite element analysis,", Forth Edition, Wiley Student Edition publication, Delhi
2. T.K. Chadrupatla and A D Belegundu, Introduction to Finite Elements in Engineering", Prentice Hall of India Publications New Delhi
3. J.N.Reddy, Än introduction to non linear finite element analysis", Oxford University Press, New Delhi
4. C S Krishnamoorthy, "Finite Element Analysis, Second Edition, Tata McGraw Hill Pubilcations New Delhi

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A: 10 Questions of 2 marks each-No choice 20 Marks

Part B: 2 Questions from each unit with internal choice, each carrying 16 marks 80 Marks

20CV318T					GROUND IMPROVEMENT TECHNIQUE					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To understand the behaviour of different problematic soil
- To learn the methods of treatment of different cohesive and cohesionless soil
- To learn ground reinforcement and grouting techniques for different insitu conditions
- To understand the basic concept of dewatering technique with its application

UNIT 1 PROBLEAMATIC SOIL **12 Hrs.**

Type of problematic soils, Hazards due to problematic soils, Role of ground improvement in foundation engineering, Methods of ground improvement – Geotechnical problems in alluvial, lateritic and black cotton soils, Selection of suitable ground improvement techniques based on soil conditions.

UNIT 2 DEWATERING **10 Hrs.**

Dewatering Techniques, Well points, Vacuum and Electroosmotic methods, Seepage analysis for two – dimensional flow for fully and partially penetrated slots in homogeneous deposits

UNIT 3 REINFORCEMENT AND GROUTING **15 Hrs.**

Concept of reinforcement, Types of reinforcement material, Reinforced earth wall, Mechanism, Simple design, Applications of reinforced earth. Role of Geotextiles in filtration, drainage, separation, road works and containment. Types of grouts, Grouting equipments and machinery, Injection methods, Grout monitoring stabilization with cement, Lime and chemicals: stabilization of expansive soil.

UNIT 4 INSITU TREATMENT OF COHESIVE AND COHESIONLESS SOIL **15 Hrs.**

In situ densification of cohesion-less soils and consolidation of cohesive soils: Dynamic compaction Vibroflotation, Sand compaction piles and deep compaction. Consolidation: Preloading with sand drains, and fabric drains, Stone columns: Installation techniques, Simple design, Relative merits of above methods and their limitations

Max. 52 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to
CO1 – **Identify** different types of problematic soils
CO2 - **Inspect** different in-situ treatment to the problematic soils
CO3 – **Provide** the solution of different type of reinforcement to the soil
CO4 – **Explain** various methods of grouting techniques
CO5 – **Illustrate** the process and application of dewatering in the real field problem
CO6 – **Understand** the engineering solutions for weak soil

TEXT/REFERENCE BOOKS

1. Moseley, M. P., and Kirsch, K., Ground Improvement, Second Edition, Spon Publication, CRC Press 2004.
2. Das, B. M., Advanced Soil Mechanics, Third Edition CRC Press 2004.
3. Koerner R M, Construction and Geotechnical Methods in Foundation Engineering, McGraw Hill Publishing Co. Ltd., 1984

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100	**Exam Duration: 3 Hrs**
Part A: 02 Questions from Unit I-II, each carrying 15 marks	30 Marks
Part B: 03 Question from Unit I-II, each carrying 5 marks	15 Marks
Part C: 03 Question from Unit III-IV, each carrying 5 marks	15 Marks
Part D: 02 Question from Unit III-IV, each carrying 20 marks	40 Marks

20CV325T					Open Channel Flow					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To learn basic concept of Open Channel Flow
- To provide the basic understanding of different types of flow and flow profile.
- To study the fundamental application of uniform and non-uniform flow in hydraulic and civil engineering

UNIT 1 FUNDAMENTALS OF OPEN CHANNEL AND UNIFORM FLOW **15 Hrs.**

Introduction, Types of channel, Classification of flows, Energy equations, Pressure distribution, Momentum equation, Energy-depth relationship, Chezy's – Darcy-weisbach and Manning's formula, Velocity and Shear stress distribution, Most economical section.

UNIT 2 GRADUALLY VARIED FLOW **15 Hrs.**

Differential equation, Classification of flow profiles, Control section, Analysis of flow profile, simple and advance numerical methods for GVF.

UNIT 3 RAPIDLY VARIED FLOW **12 Hrs.**

Momentum equation for hydraulic jump, Jump in horizontal rectangular and non-rectangular channels, Jumps on slopping floor, Energy dissipaters, Sharp and Broad crested weir, Ogee spillway and sluice gate flow.

UNIT 4 SPATIALLY VARIED – STEADY AND SUPERCRITICAL FLOW IN OPEN CHANNEL **10 Hrs.**

SPF with increasing and decreasing discharge, Response to disturbance for supercritical flow, Wave interaction and reflections, Numerical methods in gradually varied unsteady flow. **Max. 52 Hrs.**

COURSE OUTCOMES

On completion of the course, student will be able to
CO1 – **Understand** the basic of open channel flow
CO2 - **Classify** the Gradually Varied flow and it characteristic
CO3 - **Classify** the Rapidly Varied flow and it characteristic
CO4 – **Illustrate** the application of GVF and RVF in real world
CO5 – **Evaluate** the parameters for modelling
CO6 – **Design** the most control sections in hydraulic engineering

TEXT/REFERENCE BOOKS

1. K. Subramanya., Flow in Open Channels, Tata McGraw-Hill Education, 2009
2. Ven Te Chow., Open-Channel Hydraulics
3. Woodward, Sherman M., Hydraulics of steady flow in open channels, Chapman & Hall
4. Henderson, Open Channel Flow, MacMillan Series in Civil Engineering
5. Madan Mohan Das, Open Channel Flow, PHI Learning Pvt. Ltd.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A: 10 Questions of 2 marks each-No choice 20 Marks
Part B: 2 Questions from each unit with internal choice, each carrying 16 marks 80 Marks

20CV408T					Traffic Engineering					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To give an overview about the Traffic engineering and its controlling parameters.
- To know different methods available to conduct traffic survey for various purpose
- To learn design procedure for controlled and uncontrolled intersections.
- To study available methods of traffic control, operation and management.

UNIT 1 INTRODUCTION TO TRAFFIC ENGINEERING **13 Hrs.**

Elements of Traffic Engineering - road user, vehicle and road way and driver characteristics. - Design speed, volume. Passenger Car Units - Static and Dynamic- Highway capacity and level of service - capacity of urban and rural roads - Road user facilities - Parking facilities - Cycle tracks - Pedestrian facilities

UNIT 2 TRAFFIC STUDIES **14 Hrs.**

Traffic volume studies, origin destination studies, speed studies, travel time and delay studies, Parking studies, Accident studies. Elements of design - Alignment - Cross sectional elements - Stopping and passing sight distance. Horizontal curves - Vertical curves. Design problems. Traffic regulation and control - Signs and markings - Traffic System Management.

UNIT 3 TRAFFIC INTESECTION DESIGN **13 Hrs.**

Design of intersections – At-grade intersections- Principles of design – Channelization - Design of rotaries - Traffic signals - pre-timed and traffic actuated. Design of signal setting - phase diagrams, timing diagram – Signal co-ordination – Area traffic Control System. Grade separated interchanges - Geometric elements for divided and access controlled highways and expressways.

UNIT 4 TRAFFIC MANAGEMENT METHODS AND RSA **12 Hrs.**

Traffic Safety – Principles and Practices – Safety along links - Safety at intersections. Road Safety Audit – Countermeasures, evaluation of effectiveness of counter-measures– Road safety programmes. Introduction to ITS and its application in traffic control and management. **Max. 52 Hrs.**

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Understand the concept of Traffic flow parameters and capacity.
CO2 – Conduct different types of Traffic Surveys.
CO3 – Design at grade and grade separated intersections
CO4 – Analyze and identify the critical locations to improve safety of road network
CO5 – Evaluate the present traffic and future needs and development
CO6 – Create a method/Modal for efficient traffic operation and management.

TEXT/REFERENCE BOOKS

1. Traffic Engineering and Transport Planning by L.R. Kadiyali, Khanna Publishers, Delhi
2. Traffic Engineering by Matson, W. S. Smith & F.W. Hurd
3. G.J. Pingnataro, Principles of Traffic Engineering
4. D. R. Drew, Traffic Flaw Theory
5. W.R. Mchsne and R.P. Roess "Traffic Engineering"
6. Wohl & Martin, Traffic System
7. ITE Hand Book, Highway Engineering Hand Book, Mc Graw - Hill.
8. AASHTO A Policy on Geometric Design of Highway and Streets

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A : 10 Questions of 2 marks each-No choice 20 Marks

Part B : 2 Questions from each unit with internal choice, each carrying 16 marks 80 Marks

20CV328T					Solid Waste Management					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- Understanding various wastes - solid, hazardous and bio-medical waste
- Understanding waste segregation technologies
- Understanding waste treatment technologies and legislation for waste management
- Designing the optimal waste collection system and landfill sitting

UNIT 1 WASTE CHARACTERISTICS **13 Hrs.**

Types and sources of wastes: solid, hazardous and bio-medical waste; waste generation rates, waste projection models; TCLP tests, Waste sampling and testing, waste characterization

UNIT 2 SEGREGATION AND TRANSPORTATION **13 Hrs.**

Segregation Technologies: manual, eddy current, optical, magnetic, screw press, floatation, density sorting, cyclone, LIBS etc.; segregation at source, Storage and collection of municipal solid wastes, Transfer stations; Methods for Analysis and optimization of collection system; Disposal in landfills: site selection analysis for optimal sitting of landfill

UNIT 3 MANAGEMENT LEGISLATIONS **13 Hrs.**

Legislations on management and handling of solid wastes (municipal, e-waste, plastic waste etc.), hazardous wastes and biomedical wastes, hazardous wastes in municipal waste, reuse management, nuclear waste management, composting standards

UNIT 4 TREATMENT TECHNOLOGIES **13 Hrs.**

Reduce, re-use and recycling; energy conversion technologies: biochemical, thermo-chemical, thermal, thermal-mechanical, microwave, modelling composting process; Solidification and stabilization of hazardous wastes; Design of engineered landfill, Operation and maintenance issues of a landfill, waste to products

TOTAL 52 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to:
CO1 - **Understand** characterization of solid, hazardous and bio-medical waste
CO2 - **Apply** waste projection models for estimating waste generation of a city
CO3 - **Apply** waste segregation technologies for waste management
CO4 - **Utilize** methods for optimization of waste collection system and landfill sitting
CO5 - **Apply** waste treatment technologies for waste utilization
CO6 - **Apply** legislations for solid, hazardous and bio-medical waste management

TEXT/REFERENCE BOOKS:

1. George Techobanoglous et al., Integrated Solid Waste Management, McGraw, Hill Publication, 1993.
2. Charles A. Wentz, Hazardous Waste Management, McGraw Hill Publication, 1995.
3. Manual on Municipal solid Waste Management, CPHEEO, Govt. of India.
4. Guidelines for Hazardous and Other waste Rules MOEF (2016), Govt. of India.

END SEMESTER EXAM PAPER SCHEME (Max Marks: 100)

Part A	8 Questions of 5 Marks each. 2 Questions from every unit.	40
Part B	6 Questions of 10 Marks each. 1 Question from unit 1 & 2 and 2 Questions from Unit 3 & 4	60

20CV323T					ADVANCE DESIGN OF REINFORCED CONCRETE STRUCTURES					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES.

- To design components of RCC structures like ribbed beams, flat slab, Continuous beams, Corbel, Nibs, silos, bunkers and water tanks.

UNIT 1 YIELDLINE ANALYSIS **12 Hrs.**

Yield line analysis for slabs - Yield line criterion - Virtual work and equilibrium methods of analysis - for square and rectangular slabs with simple and continuous end conditions.

UNIT 2 DESIGN OF RIBBED SLABS AND FLAT SLABS **14 Hrs.**

Design of ribbed slabs: Analysis of the Slabs for moment and shears, Ultimate moment of Resistance, Design for shear, deflection, Arrangement of Reinforcements.

Flat slabs: Direct design method, Distribution of moments in column strip and middle strip, moment and shear transfer from slabs to columns, shear in Flat slabs, Check for one way and two way shears

UNIT 3 Shear Wall **12 Hrs.**

Analysis and design of shear wall framed buildings

UNIT 4 DESFING OF SILOS, BUNKERS AND WATER TANKS **14 Hrs.**

Design of silos and bunkers - Design of RCC OHT (Rectangular, Circular)

Max. 52 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to
CO1 - **Examine** slabs by using yield line theory.
CO2 - **Analyze** and design flat and ribbed slabs.
CO3 - **Design** the continuous beams, corbel and nibs.
CO4 - **Design** silos and bunkers
CO5 - **Apply** the principles of detailing of the reinforcements for RC structures
CO6 - **Design** water tanks.

TEXT/REFERENCE BOOKS

1. S. Unnikrishna Pillai and Menon, Reinforced Concrete Design, 2nd Edition Tata McGraw Hill, New Delhi, India, 2004.
2. P. C. Varghese, Advanced Reinforced Concrete Design, Prentice Hall of India, New Delhi, India, 2008.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A: 10 Questions of 2 marks each-No choice 20 Marks
Part B: 2 Questions from each unit with internal choice, each carrying 16 marks 80 Marks

20CV410T					Earthquake Engineering					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To understand fundamentals of earthquake, seismological aspects and free and forced vibration and their analysis
- To explain the principles of earthquake resistant structures
- To discuss code provisions and their application on different types of structures

UNIT 1 SEISMOLOGY AND EARTHQUAKE FUNDAMENTALS **08 Hrs.**

Basic earthquake principles: Introduction - Internal structure of earth - Plate tectonics faults - seismic waves – Seismograph - Classification of earthquakes - Magnitude and intensity - Seismic zones in India - Earthquake ground motion: Amplitude - frequency content - duration parameters - Common Earthquake effects: Surface rupture - Regional subsidence – liquefaction – slope movement – Tsunami

UNIT 2 THEORY OF VIBRATION AND MACHINE FOUNDATION **12 Hrs.**

Free vibration: Dynamic loads and dynamic analysis - degrees of freedom - Undamped free vibrations - viscously damped vibrations - logarithmic decrement - Forced vibrations of single degree-of-freedom systems: Forced vibrations - Undamped and viscously damped - Force transmitted to foundation – transmissibility - response to harmonic excitations - Introduction - Types of Machines and Foundations - General requirements - Permissible Amplitude – Design

UNIT 3 EARTHQUAKE RESISTANT FEATURES OF STRUCTURE **10 Hrs.**

Load Transfer Path - Strength Hierarchy - Reversal of Stresses - Beam Column Joints - Stiffness and Ductility (Capacity Design Concept) - Earthquake Design Philosophy - Behaviour of brick masonry - stone Masonry and RC structures - Base Isolation - Adoptive systems - Case studies - Effect of Short Column - Soft Storey - Improper Detailing - Masonry Infill Walls – Eccentricity – Pounding - Floating Columns

UNIT 4 LATERAL LOADS ON BUILDINGS AND DUCTILE DETAILING **09 Hrs.**

Analysis for Earth Quake Loads: IS: 1893-2016 - Seismic Coefficient method- modal analysis - Applications to multi-storied building frames. - Ductile Detailing: Ductility of R.C structures- Confinement- detailing as per IS-13920-2016 – principles of design of beams, columns. **Max. 39 Hrs.**

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - **Explain** the fundamental of seismology and earthquake effects
CO2 - **Analyse** free and forced vibration with applications
CO3 - **Design** machine foundations
CO4 - **Demonstrate** basic principle of earthquake resistant design
CO5 - **Explain** ductile detailing concept and associated effect on seismic structural response
CO6 -**Design** the structures subjected to earthquake in accordance with relevant Indian standards.

TEXT/REFERENCE BOOKS

1. A.K. Chopra, Dynamics of structures, Prentice Hall, 2000.
2. I.S. 1893 - 2016, Criteria for Earthquake Resistance design of Structures.
3. Pankaj Agarwal and Manish Shrikhande, Earthquake resistant design of structures, PHI 2006.
4. Kramer, S. L., Geotechnical Earthquake Engineering, Pearson Education, 2003.
5. Day, R. W., Geotechnical Earthquake Engineering handbook, McGraw Hill, 2003.
6. Kamlesh Kumar, Basic Geotechnical Earthquake Engineering, New Age, 2008.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A : 10 Questions of 2 marks each-No choice 20 Marks

Part B : 2 Questions from each unit with internal choice, each carrying 16 marks 80 Marks

20CV410T					Earthquake Engineering Lab					
Teaching Scheme					**Examination Scheme**					
L	**T**	**P**	**C**	**Hrs/Week**	**Theory**			**Practical**		**Total Marks**
					MS	**ES**	**IA**	**LW**	**LE/Viva**	
0	**0**	**2**	**1**	**1**	**--**	**--**	**--**	**25**	**25**	**50**

COURSE OBJECTIVES

- To understand Effect of bracing and shear wall on the seismic response
- To familiarise with earthquake engineering software
- To understand the effect of ground motion parameters on structure
- To understand the effect of earthquake time history and soil type on seismic response

LIST OF EXPERIMENTS

1. Study the effect of ground motion parameters on seismic performance of structure.
2. Study mode shapes of multi storey buildings.
3. Study effect of shear wall on seismic performance of building.
4. Study the effect of different bracing systems on seismic performance of the building
5. Observe behaviour of structure under pounding
6. Demonstrate effect of liquefaction of soil.
7. Compute the liquefaction potential
8. To observe phenomenon of vibration absorption
9. Introduction to open source earthquake engineering softwares
10. To determine the effect of near field earthquakes on the seismic response
11. To determine the effect of far field earthquakes on the seismic response
12. To determine the effect to soil parameters on seismic response

COURSE OUTCOMES

On completion of the course, student will be able to
CO1 - **Explain** the effect of ground motion parameters on the seismic performance of the structure
CO2 - **Demonstrate** the effect of shear wall, bracings on seismic performance of the structures
CO3 - **Understand** concept of natural frequency and mode shapes on vibrating systems
CO4 - **Compute** liquefaction potential and susceptibility soils
CO5 - **Predict** effect of shear wall and bracing system on structural vibrations
CO6 - **Explain** the effect of far field, near field earthquakes and soil parameters on seismic response.

TEXT/REFERENCE BOOKS

1. A.K. Chopra, Dynamics of structures, Prentice Hall, 2000.
2. I.S. 1893 - 2016, Criteria for Earthquake Resistance design of Structures.
3. Pankaj Agarwal and Manish Shrikhande, Earthquake resistant design of structures, PHI 2006.
4. Kramer, S. L., Geotechnical Earthquake Engineering, Pearson Education, 2003.
5. Day, R. W., Geotechnical Earthquake Engineering handbook", McGraw Hill, 2003.
6. Kamlesh Kumar, Basic Geotechnical Earthquake Engineering", New Age, 2008.

20CV322T					Advance Hydrology					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To understand the basic component of hydrology Processes.
- To provide fundamentals of flow through porous media.
- To understand the utilization of hydrograph theory
- To introduce the basic concept of statistic hydrology

UNIT 1 HYDROLOGICAL PROCESSES **13 Hrs.**

Hydrological processes-Reynolds's Transport Theorem - Continuity equation - momentum equation - energy equation - discrete time continuity mechanism - Computation and measurement of precipitation – evaporation – evapotranspiration - abstraction from precipitation - spatial and temporal distribution of rainfall.

UNIT 2 FLOW THROUGH POROUS MEDIA **13 Hrs.**

Unsaturated flow models - Horton's equation - Philips equation and Green-Ampt model computation of excess rainfall hyetograph from observed flood hydrograph - Green-Ampt infiltration equation and SCS-CN method.

UNIT 3 UNIT HYDROGRAPH **13 Hrs.**

Unit hydrograph theory - derivation of instantaneous unit hydrograph and synthetic unit hydrograph - lumped and distributed flow routing

UNIT 4 HYDROLOGY STATISTICS **13 Hrs.**

Basic Terms – Probability - Return Period - Probability relationships - Probability distributions, Statistical Flood Estimation - Empirical probability - General Procedure for flood estimation - Statistical Rainfall Estimation Software application of 1D river flow (FLDWAV, DWOPER/NETWORK, HEC-RAS, MIKE 11).

Max. 52 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Understand the basic of hydrological processes
CO2 – Analyse the rainfall and runoff relations through analytical methods
CO3 – Estimate the surface runoff using hydrograph theory
CO4 – Understand hydrological process and apply it for different decision-making system
CO5 – Apply basic concept and application of statistics hydrology.
CO6 – Create a model using software application in advance hydrology

TEXT/REFERENCE BOOKS

1. Chow VT, Maidment David R and Mays Larry W, Applied Hydrology, MacGraw Hill International editions, New Delhi, 1988
2. Mutreja K.N. Applied HydrologyTata McGraw-Hill publishing company Ltd., New Delhi, 1990
3. Subramanya K, Engineering Hydrology, Third Edition-Tata McGraw-Hill Publishing company Ltd., New Delhi, 2012.
4. Singh Vijay.P, Elementary Hydrology Prentice Hall, INDIA, 1992.
5. Ojha C S P, Bhunya P and Brendtsson P, Engineering Hydrology, Oxford University Press, Canada, 2008.
6. Han D., Concise Hydrology, Ventus publishing ApS, UK, 2010.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A: 10 Questions of 2 marks each-No choice 20 Marks

Part B: 2 Questions from each unit with internal choice, each carrying 16 marks 80 Marks

20CV326T					Transportation Planning					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To give an overview about importance of transportation planning for development.
- To learn the step model of transportation planning.
- To learn different trip generation and efficient distribution methods.
- To study trip scheduling method for transferring people and goods.
- To study land use transportation planning models.

UNIT 1 TRIP GENERATION AND DISTRIBUTION **13 Hrs.**

Trip generation models – Trip classification - productions and attractions – Trip rate analysis - Multiple regression models - Category analysis - Trip distribution models – Growth factor models, Gravity model and Opportunity modes.

UNIT 2 ROUTE CHOICE AND TRIP ASSIGNMENT MODEL **14 Hrs.**

Modal split models – Mode choice behavior – Trip end and trip interchange models - Probabilistic models - Utility functions - Logit models - Two stage model. Traffic assignment – Transportation networks – Minimum Path Algorithms - Assignment methods – All or Nothing assignment, Capacity restrained assignment and Multi path assignment - Route-choice behavior.

UNIT 3 TRIP SCHEDULING **12 Hrs.**

Statutory provision for road transport and connected organizations - Route scheduling - Freight transport - Vehicle scheduling - Optimum fleet size - Headway control strategies - Crew scheduling.

UNIT 4 LANDUSE PLANNING **13 Hrs.**

Land use transportation models - Urban forms and structures - Location models - Accessibility – Land use models - Lowry derivative models - Quick response techniques - Non-Transport solutions for transport problems. Preparation of alternative plans - Evaluation techniques - Plan implementation - Monitoring - Financing of Project – urban development planning policy - Case studies.

Max. 52 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – **Understand** the need and importance of proper transportation planning for development of nation.
CO2 – **Understand** base year and horizon year parameters which influencing planning
CO3 – **Apply** the knowledge in developing four step models.
CO4 – **Estimate** the present and future amount of trips to distribute.
CO5 – **Analyze** the transportation planning issues.
CO6 – **Create** method/Modal to distribute future people and freight transportation.

TEXT/REFERENCE BOOKS

1. Hutchinson, B.G., Principles of Urban Transport Systems Planning, Scripta, McGraw-Hill, NewYork, 1974.
2. Khisty C.J., Transportation Engineering - An Introduction, Prentice Hall, NJ, 2007.
3. Papacostas C.S. and Prevedouros, P.D., Transportation Engineering & Planning, PHI, New Delhi, 2002.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A : 10 Questions of 2 marks each-No choice 20 Marks
Part B : 2 Questions from each unit with internal choice, each carrying 16 marks 80 Marks

20CV329T					ENVIRONMENTAL IMPACT ASSESSMENT					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- Understanding environmental problems due to project activities.
- Understanding methods for environmental impact assessment
- Understanding models to assess impacts and life cycle assessment
- Writing report for environmental impact assessment

UNIT 1 EIA METHODOLOGY **13 Hrs.**

Evolution of EIA - screening, scoping - base line studies - term of reference - Methods for impact assessment - checklist method - leopold matrix - interaction matrix methodologies - network methodologies - principal component analysis - multivariate analysis - red listing process

UNIT 2 ASSESSMENT OF ENVIRONMENT **13 Hrs.**

Prediction and assessment of impact for air, water, soil and noise environment - type and quantity of pollutants - Basic information of quality standards - Models for air, water, soil, noise pollution assessment - AERMOD, MODFLOW, CADNA etc - Prediction and assessment of impact on cultural and socioeconomic environment - ecological model (MAXENT, Biomapper, BACI),

UNIT 3 LIFE CYCLE ANALYSIS **13 Hrs.**

Life Cycle Analysis (LCA): product and process - Models for LCA: GABI, USEEIO

UNIT 4 DOCUMENTATION **13 Hrs.**

EIA notification by Ministry of Environment and Forest (Govt. of India): Provisions in the EIA notification - Rapid and Comprehensive EIA - general structures of EIA document - Environmental management plan- post environmental monitoring - Environmental Clearance - Case studies in EIA

TOTAL 52 Hrs.

COURSE OUTCOMES

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

CO1- **Understand** impact of project activities on environment
CO2 - **Apply** methods for carrying out environmental impact assessment
CO3 - **Apply** models to assess environmental impacts
CO4 - **Understand** life cycle analysis of product and process
CO5 - **Apply** model for carrying out life cycle assessment
CO6 - **Write** report for environmental impact assessment

TEXT/REFERENCE BOOKS:

1. Canter R.L., Environmental Impact Assessment, Mc Graw Hill International Edition, 1997.
2. John G. Rau and David C. Wooten (Ed), Environmental Impact Analysis Handbook, McGraw Hill Book Company.
3. Gilpin A., Environmental Impact Assessment (EIA)- Cutting Edge for the 21st Century-1st Edition, Cambridge University Press 1994
4. Handbook of environmental management and technology: Gwendolyn Holmes, Ben Ramnarine Singh, Louis Theodore.
5. Michael Z., H., Ralph K. S., Life cycle assessment: theory and practice, Springer, 2018, ISBN-10: 3319564749

END SEMESTER EXAM PAPER SCHEME (Max Marks: 100)

Part A	8 Questions of 5 Marks each. 2 Questions from every unit.	40
Part B	6 Questions of 10 Marks each. 1 Question from unit 1 & 2 and 2 Questions from Unit 3 & 4	60

20CV407T					Course Name: STRUCTURAL DYNAMICS AND VIBRATION					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To familiarize the students with the fundamental concepts of structural dynamics and vibration.
- To generalize the concepts of structural dynamics and vibration for wider applications.

UNIT 1: DYNAMICS OF SINGLE DEGREE-OF-FREEDOM STRUCTURES **13 Hrs.**

Dynamic equation of equilibrium- Free vibration of single degree of freedom systems - Forced vibration - harmonic and periodic loading - Dynamic response functions - force transmission and vibration isolation - SDOF response to arbitrary functions - Numerical Evaluation of Dynamic Response of SDOF Systems - Time-domain analysis - finite difference methods - Frequency domain analysis - basic methodology

UNIT 2: TWO DEGREES OF FREEDOM SYSTEM **13 Hrs.**

Equation of motion and coordinate coupling - free vibration - forced harmonic vibration - vibration absorbers

UNIT 3: MULTI DEGREE FREEDOM SYSTEMS **13 Hrs.**

Concepts of normal mode vibrations - natural frequencies, mode shapes – nodes - Correct definition of natural frequency - Methods for finding natural frequencies by Rayleigh's quotient

UNIT 4: VIBRATIONS OF CONTINUOUS SYSTEMS **13 Hrs.**

Longitudinal vibrations of bar or rod - Equation of motion and solution, Lateral vibrations of beam - Equation of motion - initial and boundary conditions - solution

Max. 52 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - **Derive** the equation of motion of a single-degree-of-freedom system.
CO2 - **Compute** the natural frequency, damped frequency, logarithmic decrement, and time constant.
CO3 - **Find** the vibration response using the computer-based method.
CO4 - **Formulate** the equations of motion of two-degree-of-freedom systems
CO5 - **Express** the equation of motion in matrix form for multi-degree of freedom system
CO6 - **Find** the vibration solutions of Continuous Systems problems.

Books for References:

1. S S Rao, Mechanical vibration.
2. L. Meirovitch, Elements of vibration analysis
3. AK Chopra, Dynamics of structures
4. Mario Paz, Structural Dynamics: Theory and computation
5. R.W. Clough and J. Penzien, Dynamics of Structures

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A : 10 Questions of 2 marks each-No choice 20 Marks

Part B : 2 Questions from each unit with internal choice, each carrying 16 marks 80 Marks

20CV402T					Geo-environmental engineering					
Teaching Scheme					**Examination Scheme**					
L	**T**	**P**	**C**	**Hrs/Week**	**Theory**			**Practical**		**Total Marks**
					MS	**ES**	**IA**	**LW**	**LE/Viva**	
3	**1**	**0**	**4**	**4**	**25**	**50**	**25**	**--**	**--**	**100**

COURSE OBJECTIVES

- To explain the fundamentals and significance of geo-environmental engineering
- To understand the soil-water containment interaction
- To outline the types of waste containment systems and their site selection
- To apply the knowledge of geo-environmental engineering for contaminant site remediation.

UNIT 1 FUNDAMENTALS OF GEO-ENVIRONMENTAL ENGINEERING **14 Hrs.**

Introduction to Soil-water-environment interaction- multiphase behaviour of soil – role of soil in geo-environmental applications– sources and type of ground contamination – impact of ground contamination on geo-environment – Waste-source, classification and management of waste, Impact of waste dump and its remediation-MOEF guidelines for different types of waste

UNIT 2 SOIL-WATER-CONTAMINANT INTERACTION **12 Hrs.**

Soil mineralogy characterization and its significance in determining soil behaviour – soil-water interaction and concepts of double layer – forces of interaction between soil particles. Concepts of unsaturated soil – importance of unsaturated soil in geo-environmental problems - Factors effecting retention and transport of contaminants.

UNIT 3 WASTE CONTAINMENT SYSTEM **13 Hrs.**

Evolution of waste containment facilities and disposal practices – Site selection based on environmental impact assessment – Stability of landfills – Current practice of waste disposal – Monitoring facilities -Passive containment system - Leachate and Gas Management – Application of geosynthetics in solid waste management – Rigid or flexible liners- Testing and Design aspect- Landfill Components: Landfill layout and capacity - components of landfill and its functions - Types and functions of liner and cover systems, Compacted clay liner - selection of soil for liner - methodology of construction- Geotechnical use of different types of wastes such as Thermal power plant waste – MSW - mine waste - industrial waste

UNIT 4 CONTAMINANT SITE REMEDIATION **13 Hrs.**

Site characterization – risk assessment of contaminated site - remediation methods for soil and groundwater – some examples of in-situ remediation- bio remediation - thermal remediation - pump and treat method - phyto remediation and electro kinetic remediation - Leachate disposal and Post closure of landfill - Variation in engineering properties of soil due to contamination.

Max. 52 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Explain the significance of geo-environmental engineering
CO2 - Assess the contamination in the soil
CO3- Discuss the current practice of waste disposal
CO4 - Prepare the suitable disposal system for particular waste.
CO5 - Stabilize the waste and utilization of solid waste for soil improvement.
CO6 - Select suitable remediation methods based on contamination.

TEXT/REFERENCE BOOKS

1. Hari D. Sharma and Krishna R. Reddy, Geo-Environmental Engineering -John Wiley and Sons, INC, USA, 2004.
2. Daniel B.E., Geotechnical Practice for waste disposal, Chapman and Hall, London 1993.
3. Manoj Datta, Waste Disposal in Engineered landfills, Narosa Publishing House, 1997.
4. Manoj Datta, B.P. Parida, B.K. Guha, Industrial Solid Waste Management and Landfilling Practice, Narosa Publishing House, 1999.
5. Koerner, R.M. (2005). Designing with Geosynthetics. Fifth Edition. Prentice Hall, New Jersey.
6. Donald L. Wise, Debra J. Trantolo, Hilary I. Inyang, Edward J. Cichon (2000) Remediation Engineering of Contaminated Soils, Publisher: Marcel Dekker Inc.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A/Question: <Unit I and Unit II> <50> Marks
Part B/Question: <Unit III and Unit IV> <50> Marks

20CV316T					RS and GIS in Water Resources Engineering					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To understand the fundamental of RS and Image processing
- To understand the fundamentals of GIS and Processes
- To understand the basic utility of RS and GIS in water resources engineering.

UNIT 1 REMOTE SENSING **15 Hrs.**

Remote Sensing Basic principles of remote sensing - Electromagnetic energy and spectrum = Spectral characteristics - Laws of radiation - Interaction with atmosphere and surface - Data and image interpretation - Image classification for extraction of water components

UNIT 2 GEOGRAPHICAL INFORMATION SYSTEM **15 Hrs.**

Geographical Information System Introduction -Basic GIS concepts - Representation of earth features - Map basics - Map projections - Raster and vector data models - representation of GIS - GIS data sources - Map and models - Methods of vector and raster inputs - Remote sensing inputs - Surveys and GPS inputs - Field surveys - Data storage and editing - Errors and corrections of errors

UNIT 3 SPATIAL DATA ANALYSIS **10 Hrs.**

Spatial data function - Data merging - data union - data clip - layer overlay - weight overlay analysis - river morphology delineation - stream line - stream segment - stream ordering - watershed delineation - parameter calculation – attribute - add field - buffering etc

12 Hrs.

UNIT 4 APPLICATION OF RS AND GIS IN WATER RESOURCES ENGINEERING

Case Studies - Application of RS and GIS in flood management and monitoring - draught management and monitoring - water quality monitoring - water body monitoring - watershed modelling - water resources monitoring and modelling

Max. 52 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – **Understand** the basic utility of RS and GIS in water management activities
CO2 – **Apply** the image classification techniques for water body mapping
CO3 – **Calculate** the morpho component using RS and GIS techniques
CO4 – **Develop** a GIS tool for automated hydrological process
CO5 – **Evaluate** field observation through RS and GIS techniques
CO6 – **Create** a different layer for integrated decision-making activities

TEXT/REFERENCE BOOKS

1. Thomas M. Lillesand, Ralph W. Kiefer, Remote sensing and image interpretation, 7th edition, WILEY, 2015
2. Haywood L, Cornelius S and S Carver, An Introduction to Geographical Information Systems, Addison Wiley Longmont, New York, 1998
3. Burgh PA, Principles of geographical Information System for Land Resources Assessment, Clarendon Press, Oxford, 1986
4. Burrough PA, McDonnell PA, Principles of Geographical Information systems, London: Oxford University Press, 2000
5. LoCP, Young KW Albert, Concepts And Techniques of Geographic Information Systems, Prentice-Hall of India Pvt ltd, New Delhi, 2002

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A : 10 Questions of 2 marks each-No choice 20 Marks

Part B : 2 Questions from each unit with internal choice, each carrying 16 marks 80 Marks

20CV404T					Construction Technology and Equipments					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To understand the factors affecting selection of construction equipment and develop ability to compute the owning and operating costs of construction equipment
- To develop ability and knowledge about various operating procedures of earth moving equipment and soil stabilization and compacting equipment
- To develop ability and knowledge about the concrete batching plant equipment and concrete placing equipment, wooden modular formwork, aluminium formwork
- To develop ability and knowledge about wheel mounted cranes, crawler mounted cranes, tower cranes, piling equipment and metro rail construction technology

UNIT 1 SELECTION OF CONSTRUCTION EQUIPMENTS **13 Hrs.**

Construction Equipment management – Identification, planning and selection of construction equipments - Maintenance management - Replacement - Depreciation analysis - Owning and operating cost computations of equipments- Safety management of equipments.

UNIT 2 EARTH MOVING, SOIL COMPACTING AND STABILIZING EQUIPMENTS **12 Hrs.**

Equipment for earthwork- Earth moving operations - Types of earth work equipment – Tractors- Motor Graders- Scrapers - Front end Loaders - Hydraulic excavators- Earth movers- Soil compacting and stabilizing equipments.

UNIT 3 CONCRETE BATCHING, PLACING EQUIPMENTS AND FORMWORK TECHNOLOGY **14 Hrs.**

Equipment for production of aggregate and concreting: Crushers – Feeders – Screening Equipment Handling Equipment – Concrete batching and mixing equipment –Ready mixed concrete batching plant equipments - Concrete pouring and pumping equipment –Transitmixers - Formwork Technology: Wooden Modular Formwork- Aluminium Modular Formwork

UNIT 4 MISCELLENOUS CONSTRUCTION EQUIPMENTS AND MASS RAPID TRANSIT CONSTRUCTION TECHNOLOGY **13 Hrs.**

Cranes: Wheel mounted, Crawler mounted, Tower cranes, Guyed derrick crane, Scotch derrick crane, Gantry cranes, Truck mounted cranes -Miscellenous Equipments: Trenching- Tunneling- Drilling- Blasting - Equipment for dewatering and grouting - Foundation and pile boring equipment - Forklifts and related equipment - Portable Material Bins – Conveyors - Hauling Equipment - MRTS Construction Technology: Underground structures - Elevated segmental structure construction technology- Case studies of underground and elevated metro rail construction technologies

Max. 52 Hrs.

COURSE OUTCOMES

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

CO1 - Understand the factors affecting the selection of construction equipment
CO2 - Analyse about various operating procedures of earth moving equipment
CO3 - Evaluate the operating procedures and build knowledge about the concrete batching plant
CO4 - Create knowledge about wooden modular formwork and aluminium modular formwork
CO5 - Create knowledge about metro rail construction technology
CO6 - Analyse the operating about cranes and piling equipment

TEXT/REFERENCE BOOKS

1. Peurifoy, R.L., Ledbetter, W.B. and Schexnayder, C., Construction Planning, Equipment and Methods, 6th Edition, Tata McGraw-Hill, New Delhi, 2015
2. Sharma S.C. Construction Equipment and Management, Khanna Publishers, New Delhi.
3. Deodhar, S.V. Construction Equipment and Job Planning, Khanna Publishers, New Delhi.
4. Dr.Mahesh Varma, Construction Equipment and its planning and Application, Metropolitan Book Company, New Delhi.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A/Question: 10 Questions of 2 marks each-No choice **20** Marks
Part B/Question: 2 Questions from each unit with internal choice, each carrying 16 marks **80** Marks

COURSE OBJECTIVES

20CV312T					Pavement Engineering					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

- To give an overview about the highway engineering with respect to planning and alignment.
- To know the importance of geometric design.
- To learn the procedure and method of pavement design as per IRC.
- To study the various traffic parameters and its estimation and design.

UNIT 1 INTRODUCTION TO PAVEMENT ENGINEERING **14 Hrs.**

Types and component parts of pavements - Factors affecting design and performance of pavements - Highway and airfield pavements - Requirements and desirable properties of soil, aggregates – bitumen - emulsion and modified bitumen - Characterisation of different pavement materials - Pavement Design Factors - Design wheel load - strength characteristics of pavement materials - climatic variations - traffic - load equivalence factors and equivalent wheel loads - aircraft loading - gear configuration and tyre pressure. Drainage – Estimation of flow - surface drainage - sub-surface drainage systems - design of sub-surface drainage structures

UNIT 2 FLEXIBLE PAVEMENT DESIGN **12 Hrs.**

Empirical - semi-empirical and theoretical approaches - design of highway and airport pavements by IRC - AASHTO Methods - Mechanistic –Empirical design - applications of pavement design software

UNIT 3 RIGID PAVEMENT DESIGN **13 Hrs.**

Types of joints and their functions - joint spacing - design of CC pavement for roads, highways and airports as per IRC – AASHTO - design of joints - Design of continuously reinforced concrete pavements – Reliability - Use of software for rigid pavement design

UNIT 4 PAVEMENT MANAGEMENT SYSTEM **13 Hrs.**

Distresses in pavements - maintenance of highways - structural and functional condition evaluation of pavements - pavement recycling - performance prediction models - ranking and optimization in pavement management

Max. 52 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Understand the different pavement layers and its functions.
CO2 - Understand different stresses, strains and deflections in flexible and rigid pavements.
CO3 - Design Flexible pavement and rigid pavement as per provisions.
CO4 - Analyse the critical stress value and location by considering load and temperature stresses.
CO5 - Evaluate the condition of pavement and can assess the failure of pavement
CO6 - Create a method/Modal for efficient pavement construction and management.

TEXT/REFERENCE BOOKS

1. Yoder and Witczak, Principles of Pavement Design, John Wiley and Sons
2. Yang. H. Huang, Pavement Analysis and Design, Second Edition, Prentice Hall Inc.
3. Rajib B. Mallick and Tahar El-Korchi, Pavement Engineering – Principles and Practice, CRC Press (Taylor and Francis Group)
4. W.RonaldHudson, Ralph Haas and Zeniswki, Modern Pavement Management, Mc Graw Hill and Co
5. IRC – 37 “Guidelines for Design of flexible Pavements”, IRC, New Delhi, 2001.
6. IRC: 58, 2002: “Guidelines for the Design of Plain Jointed Rigid Pavements for Highways”, IRC, N. Delhi, December, 2002.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A: 10 Questions of 2 marks each-No choice 20 Marks
Part B: 2 Questions from each unit with internal choice, each carrying 16 marks 80 Marks

20CV405T					INDUSTRIAL WASTEWATER TREATMENT					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- Understand chemical characterization of industrial wastewater
- Understand physical treatment of industrial wastewater
- Understand chemical treatment of industrial wastewater
- Understand biochemical treatment of industrial wastewater

UNIT 1 WASTE CHARACTERIZATION **08 Hrs.**

Characteristics and composition of wastewater from industries like fertilizer – dying – CETP – Steel – Petroleum – Textile – Tanneries - mineral processing plants - effluent quality standards - Impact of wastewater quality on - water bodies - human health - and agriculture

UNIT 2 PHYSICAL TREATMENT **07 Hrs.**

Flow equalization – sedimentation – proportioning – neutralization – floatation – filters - attached biological treatment - pressure-driven ceramic membrane

UNIT 3 CHEMICAL TREATMENT **12 Hrs.**

Chemical precipitation - activated carbon adsorption - membrane filtration - ultra-filtration - reverse osmosis, nano-filtration, electro-dialysis – sorption – adsorption - ion-exchange - electrochemical oxidation - advance oxidation process (AOP) – fenton - photo-fenton – photocatalysis – hydrogels - hydrogel nanoparticle - magnetic nanocomposite - catalytic wet air oxidation – electrocoagulation - electro-chemical oxidation - polymeric coagulant - ultrasound assisted chemical treatment

UNIT 4 BIOCHEMICAL TREATMENT **12 Hrs.**

Biological process - microalgae biomass application – green – red – golden - diatoms algae – biofilms - anaerobic biochemical - aerobic treatment – Reactors – MBR – RBC – UASB - reactor design - Fluidised bed – granulation - microbial fuel cell - AOP-biological combined - microbial biotechnology

Max. 52 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - **Understand** chemical characterization of industrial wastewater
CO2 - **Understand** effect of industrial pollution on environment
CO3 - **Understand** physical treatment of industrial wastewater
CO4 - **Understand** chemical treatment of industrial wastewater
CO5 - **Understand** biochemical treatment of industrial wastewater
CO6 - **Design** of reactors for industrial wastewater treatment

TEXT/REFERENCE BOOKS

1. Eckenfelder, W. W., Industrial Water Pollution Control, McGraw Hill
2. Nemerow, N. L., Theory and Practice Industrial Waste Treatment, Addition-Wesley Publishing Company, ISBN-10: 0201052601
3. Metcalf and Eddy, Water and Wastewater Engineering, McGraw Hill
4. Sawyer, C.N. and McCarty, P.L., and Parkin, Chemistry for Environmental Engineers, G.F. 4th Edn. McGraw Hill, New Delhi, 1994.
5. Benefield, Judkins and Weand, Process Chemistry for Water and Wastewater Treatment, Prentice Hall

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100	**Exam Duration: 3 Hrs**
Part A: 10 Questions of 2 marks each-No choice	20 Marks
Part B: 2 Questions from each unit with internal choice, each carrying 16 marks	80 Marks

20CV409T					Prestressed Concrete Structures					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES.

- To learn advantages of pre-stressing and losses in prestressed concrete.
- To learn design of pre-stressed concrete structures subjected to flexure and shear.
- To know analysis of end block and composite section.

UNIT1 INTRODUCTION **12 Hrs.**

General principles of pre stressing pre tensioning and post tensioning. Advantages and limitations of pre stressed concrete, Materials, High strength concrete and high tensile steel their characteristics. I.S. Code provisions, Methods and Systems of Pre stressing; Pretensioning and post tensioning methods, Analysis of post tensioning. Different systems of pre stressing like Hoyer System, Magnel System Freyssinet system and Gifford – Udall System.

12 Hrs.

UNIT 2 LOSSES OF PRESTRESS

Loss of pre stress in pre-tensioned and post-tensioned members due to various causes like elastic shortage of concrete, shrinkage of concrete, creep of concrete, Relaxation of steel, slip in anchorage bending of member and frictional losses.

UNIT 3 ANALYSIS OF FLEXURE AND SHEAR MEMBERS **14 Hrs.**

Elastic analysis of concrete beams pr e stressed with straight, concentric, eccentric, bent and parabolic tendons. Design of sections for flexure and shear: Allowable stress, Design criteria as per I.S. Code. Elastic design of simple rectangular and I-section for flexure, shear, and principal stresses, design for shear in beams, Kern - lines, cable profile.

UNIT 4 ANALYSIS OF END BLOCKS AND COMPOSITE SECTION **14 Hrs.**

Analysis of end blocks by Guyon's method and Mugnel method, Anchorage zone trusses, approximate method of design, Anchorage zone reinforcement, Transfer of pre stress pretensioned members.
Introduction to composite section, Analysis of stress, Differential shrinkage, General designs considerations.

Max. 52 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to
CO1- **Classify** different types prestressing systems and their application
CO2 - **Estimate** the losses and deflection in prestress members.
CO3 - **Analyse** the flexure and shear members
CO4 - **Design** the end blocks.
CO5 - **Analyse** the composite sections.
CO6 - **Design** the prestress members for various loading.

TEXT/REFERENCE BOOKS

1. Pre stressed Concrete, Tata Mc. Krishna Raju, Graw Hill Publications, New Delhi, India (2006).
2. Pre stressed Concrete, S. Ramamrutham, 2nd edition, Dhanpat Rai & Sons, New Delhi, India (1994).

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Part A: 10 Questions of 2 marks each-No choice 20 Marks
Part B: 2 Questions from each unit with internal choice, each 80 Marks

20CV416T					Soil Structure Interaction					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To provide an understanding of the relevance and significance of soil-structure interaction in the case of different types of structures
- Ability to evaluate Numerical analysis of finite plates
- Ability to understand Beam on Elastic Foundation.
- Ability to understand Elastic Analysis of Pile.

14 Hrs.

UNIT 1 SOIL-FOUNDATION INTERACTION PROBLEMS

Soil-Foundation Interaction: Introduction to soil-foundation interaction problems, Soil behaviour, Foundation behaviour, Interface behaviour, Scope of soil foundation interaction analysis, soil response models, Winkler, Elastic continuum, Two parameter elastic models, Elastic plastic behaviour, Time dependent behaviour;

UNIT 2 BEAM ON ELASTIC FOUNDATION **12 Hrs.**

Beam on Elastic Foundation- Soil Models: Infinite beam, Two parameters, Isotropic elastic half space, Analysis of beams of finite length, Classification of finite beams in relation to their stiffness.

UNIT 3 PLATE ON ELASTIC FOUNDATION **12 Hrs.**

Plate on Elastic Medium: Thin and thick plates, Analysis of finite plates, Numerical analysis of finite plates, simple solutions.

UNIT 4 PILE SYSTEM INTERACTION WITH ELASTIC DOMAIN **14 Hrs.**

Elastic Analysis of Pile: Elastic analysis of single pile, Theoretical solutions for settlement and load distributions, Analysis of pile group, Interaction analysis, Load distribution in groups with rigid cap ; Laterally Loaded Pile: Load deflection prediction for laterally loaded piles, Subgrade reaction and elastic analysis, Interaction analysis, Pile-raft system, Solutions through influence charts.

Max. 52 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – **Interpret** different soil- foundation interaction problems.
CO2 – **Analyse** soil-foundation interaction problems using soil response models.
CO3 – **Analyse** the beam of finite and infinite length placed on elastic foundation.
CO4 – **Analyse** different plates placed on elastic foundation.
CO5 – **Evaluate** the pile and pile group placed in elastic foundation with different loading condition.
CO6 – **Evaluate** pile-raft system through influence charts.

TEXT/REFERENCE BOOKS

1. N.P. Kurien, Design of Foundation Sytems: Principles & Practices, Narosa, New Delhi 1992,
2. E.S. Melerski, Design Analysis of Beams, Circular Plates and Cylindrical Tanks on Elastic Foundation, Taylor and Francis, 2006.
3. L.C. Reese, Single piles and pile groups under lateral loading, Taylor & Francis, 2000
4. G. Jones, Analysis of Beams on Elastic foundation, Thomas Telford, 1997

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A: Questions from Unit I-II 50 Marks
Part C: Question from Unit III-IV 50 Marks

20CV411T					Hydrologic modelling and simulation					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To understand the basic component of hydrology Processes.
- To learn the hydrological data analysis using statistical programming
- To learn the art of hydrologic modelling

UNIT 1 INTRODUCTION **13 Hrs.**

Introduction, Hydrology as a science, Water Cycle, Surface and Ground Water, River and Aquifer system. Role of hydrology in planning

UNIT 2 HYDROLOGIC DATA AND ANALYSIS **13 Hrs.**

Introduction to Statistical programming, Nature of hydrological data, sources, data compilation, Analysis, Plotting, Time series analysis, Trend Detection. Hydrograph Analysis

UNIT 3 HYDROLOGIC MODELING **13 Hrs.**

Introduction to hydrological modelling, Model Classification, Model inputs, data collection and preparation, model set up and simulation run. Model parameterization, Calibration, Validation, Simulation. Sensitivity and Uncertainty Analysis. Scenarios Generation. Hydrologic and Hydrodynamic modelling, 1D/2D modelling, Governing equations, Urban flooding

UNIT 4 APPLICATION **13 Hrs.**

Case study demonstration: 1D, 2D, 1D/2D HEC-RAS hydrodynamic modelling, HEC-HMS hydrologic modelling, etc

Max. 52 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to
CO1 – Understand the basic of hydrological processes
CO2 – Estimate the surface runoff using hydrograph analysis
CO3 – Analyse hydrological data using analytical methods
CO4 – Apply basic concept and statistics hydrology.
CO5 – Evaluate the hydrological component using a modelling technique
CO6 – Create a model for hydrologic simulation

TEXT/REFERENCE BOOKS

1. Chow VT, Maidment David R and Mays Larry W, “Applied Hydrology”, MacGraw Hill International editions, New Delhi, 1988
2. Mutreja K.N. “Applied Hydrology”Tata McGraw-Hill publishing company Ltd., New Delhi, 1990
3. Subramanya K, Engineering Hydrology, Third Edition-Tata McGraw-Hill Publishing company Ltd., New Delhi, 2012.
4. Singh Vijay.P, Elementary Hydrology Prentice Hall, INDIA, 1992.
5. Ojha C S P, Bhunya P and Brendtsson P, “Engineering Hydrology”Oxford University Press, Canada, 2008.
6. Han D. “Concise Hydrology” Ventus publishing ApS, UK, 2010.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A: 10 Questions of 2 marks each-No choice 20 Marks
Part B: 2 Questions from each unit with internal choice, each carrying 16 marks 80 Marks

20CV414T					Pavement Management Systems					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To know concept of pavement management system
- To Learn various pavement performance models
- To Learn design strategies of pavement design
- To Learn algorithms and other methods can be used for pavement management

UNIT 1 INTRODUCTION TO PAVEMENT MANAGEMENT **13 Hrs.**

Historical perspectives of PMS, Evolution of PMS concepts, basic components of PMS, system, network and project levels of PMS, data Needs, GIS applications, database design, inventory and monitoring databases, planning pavement investments process, benefits of pavement management.

UNIT 2 PAVEMENT PERFORMANCE MODELS **14 Hrs.**

General concepts, pavement evaluation with respect to user cost, , pavement evaluation technologies, techniques for developing prediction models deterministic, probabilistic, expert system of PMS models; remaining service life, AASHO, CRRI and HDM models, deterioration concepts and modelling, priority programming methods, pavement life cycle cost analysis, decision tree, PMS analysis software.

UNIT 3 DESIGN ALTERNATIVES **12 Hrs.**

Design Alternatives, evaluation and selection, framework for pavement design, design objectives and constraints, generating alternative pavement design strategies, methods of economic evaluation, economic evaluation of alternative pavement design strategies and selection of optimal design strategies. Perpetual pavements.

UNIT 4 PAVEMENT PRIORITIZATION TECHNIQUES **13 Hrs.**

Pavement Prioritization Techniques: General concepts, ranking methods and procedures, prioritization based on befit cost ratio, mathematical optimization for prioritization of M, R&R Work Programs, Markov and heuristic approaches and ANN techniques for Prioritization of M, R&R Work programs.

Implementation of PMS and Technologies: Major steps in Implementation of PMS, operational Issues, system complexity, feedback, other Institutional Issues and PMS case studies **Max. 52 Hrs.**

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Understand the need and select suitable design strategies for a given pavement.
CO2 – Apply the basic learning for determination of pavement condition using functional and structural methods.
CO3 – Design alternative method of pavement evaluation by considering economic and quality.
CO4 – Analyse the type and timing of maintenance required for given pavement.
CO5 – Evaluate life cycle cost of pavements.
CO6 – Create methods - strategies for cost effective PMS.

TEXT/REFERENCE BOOKS

1. Hudson, W. R., R. Haas and W. Uddin. Infrastructure Management: Integrating Design, Construction, Maintenance, Rehabilitation, and Renovation. McGraw Hill. New York, 1997.
2. Proceedings of International Conference on Structural Design of Asphalt Pavements NCHRP, TRR and TRB Special Reports.
3. Proceedings of North American Conference on Managing Pavement, 1987, 1994.
4. Ralph C.G. Haas and Ronald W. Hudson, Pavement Management System, McGraw Hill Book Co. 1978.
5. Ralph C.G. Haas, W. Ronald Hudson and Zanieswki, Modern Pavement Management, Kreiger Publications, 1994.
6. Shahin, M.Y. Pavement Management for Airports, Roads and Parking Lots. Chapman & Hall, New York, 1994.
7. Southeast Michigan Council of Governments. Pavement Management System, SEMCOG, 1997.
8. Transportation Association of Canada. Pavement Design and Management Guide. Transportation Association of Canada, Ottawa, 1997.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A: 10 Questions of 2 marks each-No choice 20 Marks
Part B: 2 Questions from each unit with internal choice, each carrying 16 marks 80 Marks

20CV415T					ENVIRONMENTAL DATA ANALYSIS					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- Visualization of environmental data and statistics
- Understanding uncertainly and error in environmental data
- Understanding different types of hypothesis testing and regression analysis
- Understanding big climate data and climate science

UNIT 1 DATA VISUALIZATION 13 Hrs.

Data Visualization using Matlab/Python, descriptive statistics, robust measures, histograms, PDF, CDF; line, area, surface plots.

UNIT 2 UNCERTAINTY AND ERROR 13 Hrs.

Standard error, uncertainty, confidence interval, error propagation, Gaussian error propagation, moment methods, aggregation error in systems, sample bias, outliers, plotting uncertainties.

UNIT 3 HYPOTHESIS TESTING and REGRESSION 13 Hrs.

One/Two way T-Test, significance of sample size, rank-sum test, paired sample test, ANOVA, Tukey Test , F-Test, Chi-squared, linear regression, uncertainty in regression parameter, use of residual, testing for randomness, multiple regressions: significance test and diagnosis; multi-colinearity, dummy variable, covariance analysis, Interactive response surface modelling, PCA, factor analysis

UNIT 4 BIG CLIMATE DATA AND CLIMATE SCIENCE 13 Hrs.

Big data and environment, sources of big data like satellite, data for climate simulation and urban microclimate, data analytics with matlab/python, Climate informatics, NetCDF, GRIB, machine learning, deep learning for climate pattern, feature extraction of big climate data, climate network and entropy, spectra of climate network, Monte Carlo of climate system

TOTAL 52 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to:
CO1 - **Understand** environmental data requirements
CO2 - **Understand** uncertainty and error in environmental data and their visualization
CO3 - **Apply** different types of hypothesis testing for data comparison and interpretation
CO4 - **Apply** regression analysis for interpreting environmental data
CO5 - **Understand** big climate data and their sources
CO6 - **Apply** different tools and technique on big climate data for climate change mitigation.

TEXT/REFERENCE BOOKS:

1. Emetere, M. E., Introduction to environmental data analysis and modelling, Springer, ISBN: 978330362072
2. Hewitt, C. N., Method for Environmental Data Analysis, Springer, ISBN: 9789401129206
3. Peck, R., Statistics: The exploration and Analysis of Data, ISBN-10: 0840058012
4. Zhang, Z., Big data mining for climate change, Elsevier, ISBN: 9780128187043

20CV412T					Course Name: Prefabricated Structures					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES.

- Able to understand the principles of prefabrication.
- Able to design prefabricated elements.
- Able to understand various production technology

UNIT1:- INTRODUCTION **12 Hrs.**

Need for prefabrication, Principles, Materials, Modular coordination, Comparison with monolithic construction, types of prefabrication, site and plant prefabrication, economy of prefabrication, Standarization, Systems, Production, Transportation, Erection.

UNIT 2 : Prefabricated Load Carrying Members **14 Hrs.**

Planning for components of prefabricated structures, disuniting of structures, design of simple rectangular beams and I-beams, handling and erection stresses, elimination of erection stresses, beams, columns, symmetric frames.

UNIT3:- Prefabricated Elements **12 Hrs.**

Roof and floor panels, ribbed floor panels, wall panels, footings. Joints - Joints for different structural connections, effective sealing of joints for water proofing, provisions for non-structural fastenings, expansion joints in precast construction

UNIT 4 : Production Technology **14 Hrs.**

Choice of production setup, manufacturing methods, stationary and mobile production, planning of production setup, storage of precast elements, dimensional tolerances, acceleration of concrete hardening.

Hoisting Technology - Equipment for hoisting and erection, techniques for erection of different types of members like beams, slabs, wall panels and columns, vacuum lifting pads.

Total 52 Hrs.

COURSE OUTCOMES

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

CO.1:- **Understand** the modular construction, industrialized construction.

CO.2:-**Design** different prefabricated systems subjected to various loads.

CO.3:- **Design** prefabricated joints.

CO.4:- **Apply** different construction techniques for various members.

CO.5:- **Use** proper equipments for transportation of precast elements.

CO.6:- **Design** a single-storied simple frame.

TEXT/REFERENCE BOOKS

1. Hass, A.M. (1983), Precast Concrete, Design and Applications, *Taylor & Francis, UK.*
2. Phillips, W.R. and Sheppard, D.A. (1980), Plant cast, Precast and Prestressed Concrete, McGraw Hill, New York.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A/Question: <Details> <> Marks

Part B/Question: <Details> <> Marks

COURSE STRUCTURE FOR B. TECH. IN CIVIL ENGINEERING														
List of Open Electives			B. Tech. in Civil Engineering											
Sr. No.	Course/ Lab Code	Course/ Lab Name	Teaching Scheme					Examination Scheme						
								Theory			Practical		Total	
			L	T	P	C	Hrs/Wk	MS	ES	IA	LW	LE/Viva	Marks	
1	20CV201T	Geo-Spatial Techniques	3	0	0	3	3	25	50	25	--	--	100	
2	20CV211T	Finite Element Method	3	0	0	3	3	25	50	25	--	--	100	
3	20CV329T	Environmental Impact Assessment	3	0	0	3	3	25	50	25	--	--	100	
4	20CV305T	Disaster Management	3	0	0	3	3	25	50	25	--	--	100	
5	20CV212T	Green Building Management	3	0	0	3	3	25	50	25	--	--	100	
6	20CV306T	Smart Infrastructure and Cites	3	0	0	3	3	25	50	25	--	--	100	
7	20CV331T	Computing Techniques and Design of Experiments	3	0	0	3	3	25	50	25	--	--	100	
8	20CV330T	Computational Geomechanics	2	1	0	3	3	25	50	25	--	--	100	

20CV201T					Elective: Geo-spatial Technologies					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
03	01	00	04	04	25	50	25	--	--	100

COURSE OBJECTIVES

- To understand the fundamental of RS and Image processing
- To understand the fundamentals of GIS and Processes.
- To understand the utilization of GPS and UAV for engineering mapping
- To learn the complex engineering application using Geospatial Techniques

UNIT 1 INTRODUCTION **07 Hrs.**

Introduction to remote sensing - Geographical information systems and global positioning systems - Benefits and applications of remote sensing – GIS, GPS, UAV techniques .

UNIT 2 REMOTE SENSING **15 Hrs.**

Fundamentals of remote sensing - Energy interactions - Ideal remote sensing systems, - Fundamentals of interpretation - Basic equipment's used for interpretation - Elements of air photo interpretation - Interpretation keys - Different types of sensors - Platforms and remote sensing images; Digital Image processing: Characteristics of a digital image - Image enhancement - Contrast manipulation – Image registration – Digital image interpretation techniques

UNIT 3 GEOGRAPHICAL INFORMATION SYSTEM **15 Hrs.**

Introduction - Geo referenced data - Data input & output - Data quality and management - GIS analysis functions - Implementation of GIS - Airborne Laser Thematic Mapper (ALTM) LIDAR, Principles and methods of data collection – Digital Elevation Models; GPS and UAV: Earth Surface, datum – Co-ordinate systems - Segments of GPS System - GPS receivers and its components - Different methods of observation; Type of UAV, UAV components; Application of UAV

15 Hrs.

UNIT 4 ENGINEERING APPLICATIONS

Landuse / Landcover mapping - resources mapping - Utility mapping - Urban and regional planning and environmental and other engineering applications

Max. <52> Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – **Understand** the basic concept of Remote Sensing and GIS techniques
CO2 – **Classify** the advance instrument techniques (GPS and UAV) in surveying
CO3 – **Analyse** a data using a spatial analysis techniques
CO4 – **Illustrate** the application of RS and GIS in decision making activities
CO5 – **Appraise** the use of advance software techniques for map making activities.
CO6 – **Create** an art of map making activities.

TEXT/REFERENCE BOOKS

1. Remote sensing and image interpretation by Thomas M. Lillesand, Ralph W. Kiefer
2. Advances in land remote sensing system, Modelling, Inversion and application by Shunlin Liang
3. Haywood L, Cornelius S and S Carver (1988) An Introduction to Geographical Information Systems, Addison Wiley Longmont, New York.
4. Burgh PA (1986) Principles of geographical Information System for Land Resources Assessment, Clarendon Press, Oxford.
5. Burrough PA, McDonnell PA (2000) Principles of Geographical Information systems, London: Oxford University Press.
6. LoCP, Young KW Albert (2002) Concepts And Techniques of Geographic Information Systems, Prentice-Hall of India Pvt ltd, New Delhi

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A : 10 Questions of 2 marks each-No choice 20 Marks
Part B : 2 Questions from each unit with internal choice, each carrying 16 marks 80 Marks

20CV211T					Finite Element Method					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	2	4	5	25	50	25			100

COURSE OBJECTIVES:

- To understand the concept of FEM
- To formulate 1D and 2D finite elements

UNIT 1 Introduction to Solid Mechanics **9 Hrs**

Introduction to theory of elasticity, Stress at a point. Rectangular stress components in 3D problems, Strain components in 3D Problems. Strain-Displacement Relations. Equilibrium Equations, Cauchy's stress formulae, Strain-Displacement Relations stress-strain relations, stress / strain transformations, Plane stress/ Plane strain Problems

UNIT 2 Introduction to FEM and FE formulation of bar element **10 Hrs**

Introduction to FEM, Brief history of the Development, Advantages and Disadvantages of finite element method, Finite element procedure, displacement model, convergence, compatibility, geometric invariance requirements, degrees of freedom, Shape functions, Types of finite elements in FEM Library. Principle of minimum potential energy, related problems. FE formulation for bar in local and global coordinate system, stiffness matrices, and related problems and analysis of trusses.

UNIT 3 FE formulation of beam, triangular and rectangular elements **10 Hrs**

FE formulation for beam element in local and global coordinate system, stiffness matrices, and related problems of continuous beams and frames. Two dimensional FE formations for Constant strain triangular element(CST), Linear Strain Triangle (LST), rectangular plane elements. Natural Coordinate system. Iso-parametric, sub-parametric and super-parametric concept FE formulation concept. Shape functions for two node and 3-node bar elements and 2 node beam element and 4-node quadrilateral elements natural coordinate system.

UNIT 4 Iso-parametric formulations and 3D finite elements **10 Hrs**

Iso-parametric formulations for triangular and quadrilateral elements, Jacobian matrix, related problems, Consistent and lumped load vector concept. Introduction to three dimensional problem, types 3D finite elements, Introduction to material and geometrical nonlinearity

Max. 39 Hrs

COURSE OUTCOMES

On completion of the course, student will be able to

CO1-**Compute** rectangular stress components in 3D problems
CO2-**Formulate** the bar element and to solve related problems
CO3-**Determine** the member forces in plane truss problems
CO4-**Formulate** the beam element and solve related continuous beam problems
CO5-**Derive** shape functions for bar, beam and 2D plane elements in natural coordinate system
CO6-**Formulate** the iso-paremetric 2D finite elements and introduction 3D finite elements

TEXT/REFERENCE BOOKS:

1. R D Cook, D S. Malkus, M E Plesha and R J Witt, "Concept and applications of finite element analysis,", Forth Edition, Wiley Student Edition publication , Delhi
2. T.K. Chadrupatla and A D Belegundu, Introduction to Finite Elements in Engineering", Prentice Hall of India Publications New Delhi
3. J.N.Reddy, Än introduction to non linear finite element analysis", Oxford University Press, New Delhi
4. C S Krishnamoorthy, "Finite Element Analysis, Second Edition, Tata McGraw Hill Pubilcations New Delhi

END SEMESTER EXAMINATION QUESTION PAPER PATTERN:

Max Marks : 100; **Exam Duration : 3 Hours**

Part A: 5 Marks theory from each unit : 5 x 4 = 20 Marks

Part B: 20 Marks numerical problems from each unit : 20 x 4 = 80 Marks

20CV329T					ENVIRONMENTAL IMPACT ASSESSMENT					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- Understanding environmental problems due to project activities.
- Understanding methods for environmental impact assessment
- Understanding models to assess impacts and life cycle assessment
- Writing report for environmental impact assessment

UNIT 1 METHODOLOGY **12 Hrs.**

Evolution of EIA, screening, scoping, base line studies, term of reference; Methods for impact assessment: checklist method, leopold matrix, interaction matrix methodologies, network methodologies, principal component analysis; multivariate analysis, red listing process

UNIT 2 ASSESSMENT OF ENVIRONMENT **11 Hrs.**

Prediction and assessment of impact for air, water, soil and noise environment; type and quantity of pollutants; Basic information of quality standards; Models for air, water, soil, noise pollution assessment: AERMOD, MODFLOW, CADNA etc; Prediction and assessment of impact on cultural and socioeconomic environment; ecological model

UNIT 3 LIFE CYCLE ANALYSIS **08 Hrs.**

Life Cycle Analysis (LCA): product and process; Models for LCA: GABI, USEEIO

UNIT 4 DOCUMENTATION **08 Hrs.**

EIA notification by Ministry of Environment and Forest (Govt. of India): Provisions in the EIA notification, Rapid and Comprehensive EIA, general structures of EIA document, Environmental management plan, post environmental monitoring, Environmental Clearance, Case studies in EIA

TOTAL 39 Hrs.

COURSE OUTCOMES

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

CO1- **Understanding** impact of project activities on environment
CO2-**Applying** methods for carrying out environmental impact assessment
CO3-**Appling** models to assess impacts
CO4-**Understanidng** life cycle analysis of product and process
CO5-**Applying** model for carrying out life cycle assessment
CO6-**Writing** report for environmental impact assessment

TEXT/REFERENCE BOOKS:

1. Canter R.L., Environmental Impact Assessment, Mc Graw Hill International Edition, 1997.
2. John G. Rau and David C. Wooten (Ed), Environmental Impact Analysis Handbook, McGraw Hill Book Company.
3. Gilpin A., Environmental Impact Assessment (EIA)- Cutting Edge for the 21st Century-1st Edition, Cambridge University Press 1994
4. Handbook of environmental management and technology: Gwendolyn Holmes, Ben Ramnarine Singh, Louis Theodore.
5. Michael Z., H., Ralph K. S., Life cycle assessment: theory and practice, Springer, 2018, ISBN-10: 3319564749

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

Part A: $\sum W_{Q_i}$ 100 Marks

$Where, W_{Q_i}$=Weight of i^{th} question Q

20CV305T					Elective: Disaster Management					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
03	00	00	03	03	25	50	25	--	--	100

COURSE OBJECTIVES

- To orient students about various natural and manmade disasters.
- To study the concept of GIS and its applications in the field of Disaster Management.
- To study the concept of RS and its applications in the field of Disaster Management.
- To train students in doing Risk assessment and Vulnerability analysis

UNIT 1 INTRODUCTION **07 Hrs.**

Introduction to Hazard, Risk, Vulnerability and Disaster – Natural Disasters (Hydrological, Geological, Wind, Heat and cold waves, Climate change, Global Warning, Sea level Rise, Ozone Depletion) – Manmade Disaster (CBRN, Fire, Accidents, Pollution and Deforestation) – Factors affecting mitigation measures, prediction and preparation.

15 Hrs.

UNIT 2 Geographical Information System in Disaster Management

Geographical Information Systems - definition, development, data sources, data structures, raster and vector, data capturing, pre-processing, Data acquisition system using GPS On line GPS applications - Spatial data analysis for Disaster management; GIS visualizations and assessment for Disaster Management- Different Case studies- Flood assessment, Earthquake Assessment, Cyclone studies, Climate Change, forest fire.

15 Hrs.

UNIT 3 Remote Sensing in Disaster Management

Introduction to Remote Sensing, Fundamentals of Remote Sensing, Electromagnetic Radiation, Electromagnetic Spectrum, Energy interaction with Atmosphere, Energy interaction with Earth Surface, Platform and Sensors - Characteristics of Image, Image Interpretation and Analysis – Visual Image Interpretation & Digital Image Processing - Microwave Remote Sensing - Remote Sensing Application in Disaster Management.

15 Hrs.

UNIT 4 Risk Assessment & Vulnerability Analysis

Hazard, Risk and Vulnerability, Risk Concepts, Elements of Risk, Perception of Risk, Acceptable risk, Requirements in Risk assessment – Risk reduction – Risk analysis techniques - Participatory risk assessment - Vulnerability analysis and Risk assessment - Hazard mapping using GIS

Max. <52> Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – **Understand** the basics of disaster management.
CO2 – **Classify** the different types of disaster and its mitigation techniques
CO3 – **Analyse** a data using a spatial analysis techniques
CO4 – **Illustrate** the application of RS and GIS in disaster assessment.
CO5 – **Appraise** the use of advance software techniques for Disaster management.
CO6 – **Create** a maps for decision making activities

TEXT/REFERENCE BOOKS

1. Disaster Management- G.K Ghosh-A.P.H. Publishing Corporation
2. Remote Sensing Principles & Applications - B.C. Panda - Viva Book Pvt.Ltd.
3. Burrough PA, McDonnell PA (2000) Principles of Geographical Information systems, London: Oxford University Press.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A : 10 Questions of 2 marks each-No choice	20 Marks
Part B : 2 Questions from each unit with internal choice, each carrying 16 mark	80 Marks

20CV212T					GREEN BUILDING MANAGEMENT					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

Course Objectives

- Introduction to the Green Building Philosophy
- Introduction to various Building Energy themes
- Introduction to the Water, Wastewater and Solid waste management concepts
- Introduction to the Green Building Rating System

UNIT-I **[12 HOURS]**

Sustainable Development: Definition, urbanization across the globe, need for sustainable development.

Green Buildings: What are Green Buildings, Benefits of Green Buildings – financial, in reducing the carbon footprint (in construction and operation)

Green Materials: Natural Materials like bamboo, timber, rammed earth, etc, various paints reducing the heat gain of the building

UNIT-II **[14 HOURS]**

Passive Cooling: Building planning and passive cooling, cool materials, Phase change materials, Garden roofs, case studies for passive cooling and thermal comfort

Solar Energy Harvesting: Potential of solar energy in India and world, construction and operation of various solar appliances, success case studies of fully solar energy based buildings in India.

UNIT-III **[12 HOURS]**

Rain Water Harvesting: Water resources and water usage, introduction and need for rainwater harvesting techniques, case studies of building integrated rooftop rainwater harvesting system.

Wastewater Treatment Techniques: Introduction to wastewater quality, concepts of wastewater treatment, treatment and recycling of wastewater, Advances in water treatment techniques, case studies of decentralized wastewater treatment techniques.

Solid Waste Management: Introduction solid waste, characterization of solid waste, solid waste management technology – vermin-composting, etc.

UNIT-IV **[14 HOURS]**

Green Building Rating Systems: Introduction to Leadership in Energy and Environment Design (LEED), Green Rating for Integrated Habitat Assessment (TERI-GRIHA), Case Studies of Green Buildings in India

Max. 52 Hrs.

Course Learning Outcomes:

CO1 : **Describe** the various aspects of Green Buildings
CO2 : **Explain** the various Green building materials
CO3 : **Demonstrate** the solar energy harvesting concepts
CO4 : **Explain** the Water harvesting and treating concepts
CO5 : **Articulate** the various Solid Waste management concepts
CO6 : **Evaluate** the buildings using the Green Building framework

Reference Books/Course Materials:

1. Wastewater engineering by Metcalf Eddy
2. Non-conventional energy resources by G. D. Rai, Khanna Publishers
3. NPTEL Course on Sustainable Materials and Green BuildingsEnergy Conscious Design – A primer for Architects by John R. Goulding, J. Owen Lews and Theo C. Steemers
4. Green Building and Remodeling by Jobn Barrows and Lisa Lannucci
5. Green Building Codes

End semester exam paper scheme (Max Marks : 100)

Part A	8 Questions of 5 Marks each., 2 Questions from every unit.	40
Part B	6 Questions of 10 Marks each, 1 Question from unit 1 & 2 and 2 Questions from Unit 3 & 4	60

20CV306T					Smart Infrastructure and Cities					
Teaching Scheme					Examination Scheme					
					Theory			Practical		
L	T	P	C	Hrs/ Week	MS	ES	IA	L W	LE/ Viva	Total Marks
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To learn about the concepts and scope of Smart Cities
- To learn the methodology for development of smart city framework, enablers and responsibilities
- To learn about the latest smart and sustainable smart development
- To learn about digital transformation and big data analytics

UNIT 1 INTRODUCTION TO SMART CITIES **09 Hrs.**

Definition, Drivers, barriers and benefits of smart cities, characteristics and factors of smart cities, understanding Liveability, Affordability and Inequality, Development standards, Smart indicators, smart city rankings, emerging trends and technologies.

UNIT 2 SMART CITIES FRAMEWORK, RESPONSIBILITIES AND ENABLERS **10 Hrs.**

Smart Cities Framework: Aligning Responsibilities and Enablers, **Smart city responsibilities:** Built environment, Energy, Telecommunications, Transportation, (health and human services) Water and wastewater, Public safety and payments. **Smart city enablers:** Instrumentation and control, connectivity, interoperability, security and privacy, data management, computing resources and analytics process of building a smart cities roadmap. Case studies.

UNIT 3 SMART AND SUSTAINABLE URBAN DEVELOPMENT **10 Hrs.**

Principles of Sustainable Development and smart growth, low carbon and renewable energy technologies, water, waste and carbon management, pollution prevention, climate adaptation and resilience and integrated environmental systems management, smart buildings and infrastructure. Case studies.

UNIT 4DIGITAL TRANSFORMATION AND BIG DATA ANALYTICS **10 Hrs**

Big Data Analytics: Big data platforms and cloud computing urban informatics GIS and spatial analysis measuring impact and data visualization, Smart Technologies: Internet of things, remote sensing and communication technologies
ICT initiatives in Indian cities. Case studies.

39 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to:
CO1- **Understand** the concepts and philosophy of Smart Infrastructure and Cities
CO2- **Learn** the methodology and principles for sustainable development
CO3- **Understand** and **learn** the methodology of smart growth
CO4- **Learn** the methodology of Big Data Analytics
CO5- **Create** ability for application of smart technologies
CO6- **Analyze** and apply the techniques for ICT intiatives

TEXT/REFERENCE BOOKS

1. Townsend, A.M. (2014) Smart cities: Big Data, Civic Hackers and the Quest for a new Utopia, Norton & Company Inc, New York.
2. Vasudevan, S.K., Nagarajan, A.S. Internet of Things, Wiley
3. Sachs, J. D. The Age of Sustainable Development, Columbia University Press

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks 100 **Exam Duration: 3 hrs**

Part A/Question: 10 Questions of 2 marks each-No choice **20** Marks
Part B/Question: 2 Questions from each unit with internal choice, each carrying 16 marks **80** Marks

20CV331T					Computing Techniques and Design of Experiments					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
2	1	-	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To get familiar with use of programming platforms.
- To explain the application of programming in engineering problems
- To explain the design experiment model as per requirement.
- To explain the handling of large scale data

UNIT 1 **10 Hrs.**

Basics of Programming in MATLAB/R, Basics of MATLAB/R, Script and functions, Loops and conditional evaluation, Flow control, Basic statistical analysis, Descriptive statistics in MATLAB/R/MS-Excel, Central tendencies, Introduction to Random variable, Relationship between two datasets.

UNIT 2 **10 Hrs.**

Linear Algebraic Systems, Eigen Values and Eigen Vectors, Basics of matrices operation, Gauss elimination method, LU decomposition method, Basics of Optimization techniques, Application of optimization techniques, Evolutionary algorithm.

UNIT 3 **10 Hrs.**

Strategy of Experimentation, Typical applications of Experimental design, Basic Principles, Guidelines for Designing Experiments, Factorial Experiments, Brief discussion on Factors, levels, interaction, Different types of design, Brief discussion on Randomness and variability.

UNIT 4 **10 Hrs.**

Analysis of variance (ANOVA) in Factorial Experiments, Regression analysis, Mathematical models from experimental data, Basics of Taguchi Techniques, Large scale data handling in engineering, data generation, organization, manipulation and processing.

Max. 40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – **Learn** Basic mathematical operation in MATLAB/R/MS-Excel
CO2 – **Solve** the linear algebraic related equations and problems in MATLAB/R/MS-Excel
CO3 – **Apply** the optimization techniques.
CO4 **- Explain** the practical implications of Design of experiments
CO5 – **Adopt** ANOVA techniques to identify sufficient factors.
CO6 – **Design** any experiment model as per requirement and handle big scale data.

TEXT/REFERENCE BOOKS

1. Fundamentals of Engineering Numerical Analysis by Parviz Moin (2nd Edition)
2. Applied Numerical Methods for Engineers by Robert J. Schilling and Sandra L. Harries (2nd Edition)
3. Getting Started with MATLAB by Rudra Pratap
4. Design and Analysis of Experiments, Douglas C. Montgomery, 7th Edition, ISBN # 978-0-470-12866-4
5. Design of Experiments: statistical Principles of research design and analysis. Second edition. Rober O. Kuehl, Duxbury Press, 2000. ISBN 0-534-36834-4
6. Experiments: Planning, Analysis, and parameter Design optimization, C. F. Jeff Wu and Michael Hamada, 2000. Wiley Interscience publication, John Wiley & Sons, Inc. NY. ISBN 0-471-25511-4
7. Bagchi, T.P. Taguchi Methods explained, PHI, 2002.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A/Question: <Unit I and Unit II> <50> Marks

Part B/Question: <Unit III and Unit IV> <50> Marks

20CV330T					Computational Geomechanics					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	--	3	3	25	50	25	--	--	100

COURSE OBJECTIVES:

- To explain the fundamental principles of vectors and tensors., different types of tensors.
- To explain stress analysis, strain analysis and equilibrium equations.
- To explain stress development in soil domain due to external loading.
- To explain rheological properties of geomaterials.
- To explain the development of failure theories and application in different soil materials.

UNIT 1 Fundamentals of Vectors and Tensors: **10 Hrs**.

Introduction, coordinate system, Vector algebra, scalar product, vector product, triple product, scalar and vector fields, indicial notation and summation Convention, kronecker delta, alternating delta, transformation of coordinates, definition of Cartesian tensor , isotropic tensor, quotient rule, surface-volume integral(divergence theorem)

UNIT 2 Analysis of stress and strain: **16 Hrs**.

Analysis of stress.Analysis of strain. Equilibrium equations -Compatibility equations -stress strain relationship. Generalized Hooke's law. Octahedral shear, Stress function .Plane stress and plane strain -Simple two dimensional problems in Cartesian and polar co-ordinates.

UNIT 3 Stresses in soil and Rheological properties: **12 Hrs**.

Stresses in Soil: Description of state of stress and strain at a point, stress distribution problems in elastic half pace Boussnesque's analysis for concentrated force. Pressure bulb. Uniformly loaded circular and rectangular areas. Newmark influence diagram. Triangular and other loadings. Westergaard's analysis. Burmister's two layer theory. Stress distribution around tunnels and vertical shafts. Rheological properties of material-equation of state, models, stress deformation behavior of soil subject to loading, solution of problems of linearly elastic solids. Deformation of Rheological constants. Pore pressure developed, settlement computations.

UNIT 4 Failure theories in Soil: **14 Hrs.**

Failure theories, Yield criteria, Tresca, Von Mises , Mohr-Coulomb failure conditions. Failure loci in deviatoric plane and principal stress space, influence of intermediate principal stress on failure. Constitutive Models in Soil Mechanics: Isotropic Elastic, Anisotropic Plasticity and Viscous Models. Representing Soil Behaviour using these Models. ; Advances in Constitutive models

Max. 52 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1: **Explain** the basic concepts of vectors and tensors, and able to develop different tensors.
CO2: **Demonstrate** an ability to do the analysis of different practical stress strain condition.
CO3: **Calculate** stress developed in soil domain for different external surface loading condition.
CO4: **Interpret** properties of geomaterial like stress deformation, pore pressure development and settlement.
CO5: **Evaluate** different basic failure theories used for soil.
CO6: **Evaluate** advance constitutive models incorporating anisotropy, plasticity; and viscous models.

TEXT/REFERENCE BOOKS

1. Y. C. Fung, "Foundations of Solid Mechanics", Prentice - Hall Publishers.
2. S.P.Timoshenko and J.N. Goodier, "Theory of Elasticity", McGraw-Hill Book Company.,1988
3. C.T. Wang, "Applied Elasticity", McGraw-Hill Book Company
4. Wai-Fah Chang and Atef Saleeb, "Constitutive Equations for Engineering material: Volume 1: Elasticity and Modelling", Wiley-Interscience Publication
5. Slater R.A.C, "Engineering Plasticity", John Wiley and Son, New York, 1977.
6. Selvadurai A.P.S., "Plasticity & Geomechanics", Cambridge University Press, 2002

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A/Question: <Unit I and Unit II> <50> Marks

Part B/Question: <Unit III and Unit IV> <50> Marks