SYLLABUS FOR BATCH 2019-23

CIVIL ENGINEERING DEPARTMENT

2019-23: 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 2019-23

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	16SP1XX	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 practice	0	0	2	2	1
	HSC	16TP110	Civic Services and Social Internship	0	0	0	0	1
				13	**1**	**8**	**22**	**18**

Course structure of B.Tech (Civil Engineering) for batch 2019-23

Semester 3	**BSC**	20MA204T	Maths-III	3	1	0	4	4
	OE	20CV201T	Open Elective-1	3	0	0	3	3
	PC	20CV202T	Concrete Technology & Construction Materials	3	0	0	3	3
	PC	20CV202P	Concrete Technology & Construction Materials - Lab	0	0	2	2	1
	PC	20CV203T	Fluid Mechanics	3	0	0	3	3
	PC	20CV203P	Fluid Mechanics - Lab	0	0	2	2	1
	PC	20CV204T	Mechanics of Materials	3	0	0	3	3
	PC	20CV206P	Building Planning and Drawing - Lab	0	0	4	4	2
	HSC	20HS201P	Communication Skills - II	0	0	2	2	1
				15	**1**	**10**	**26**	**21**
Semester 4	**PC**	20CV207T	Hydrology & Water Resources	3	0	0	3	3
	PC	20CV207P	Hydrology & Water Resources - Lab	0	0	2	2	1
	PC	20CV208T	Structural Analysis	4	0	0	4	4
	PC	20CV209T	Surveying	3	0	0	3	3
	PC	20CV209P	Surveying - Lab	0	0	4	4	2
	PC	20CV210T	Geology & Soil Mechanics	4	0	0	4	4
	PC	20CV210P	Geology & Soil Mechanics - Lab	0	0	2	2	1
	OE	20CV211/212T	Open Elective II	3	0	0	3	3
	Ind	20IF201T	Industry 4.0	2	0	0	2	2
	Ind	20IF201P	Industry 4.0 - Lab	0	0	2	2	1
	Project	TP210	Industrial Orientation (3 weeks)	0	0	0	0	1
				19	**0**	**10**	**29**	**25**

Course structure of B.Tech (Civil Engineering) for batch 2019-23

Semester 5	**PC**	20CV301T	Highway and Traffic Engineering	4	0	0	4	4
	PC	20CV301P	Highway and Traffic Engineering - Lab	0	0	2	2	1
	PC	20CV302T	Foundation Engineering	4	0	0	4	4
	PC	20CV302P	Soil Mechanics and Foundation Engineering - Lab	0	0	2	2	1
	PC	20CV303T	Design of RCC Structures	3	0	0	3	3
	PC	20CV304T	Environmental Engineering	4	0	0	4	4
	PC	20CV304P	Environmental Engineering - Lab	0	0	2	2	1
	OE	20CV305/6T	Open Elective-III	3	0	0	3	3
	HSC	20HS301P	Communication Skills - III	0	0	2	2	1
				18	**0**	**10**	**28**	**22**
Semester 6	**PC**	20CV307T	Estimation Costing Contracts and Valuations	3	0	0	3	3
	PC	20CV308T	Design of Steel Structures	3	0	0	3	3
	PC	20CV309P	Structural Drawing - Lab	0	0	2	2	1
	CE	20CV3XXT	Professional Core Elective-1	3	1	0	4	4
	CE	20CV3XXT	Professional Core Elective-2	3	0	2	5	4
	CE	20CV3XXT	Professional Core Elective-3	3	1	0	4	4
	OE	20CV3XXT	Open Elective-4	3	0	0	3	3
	Project	20TP310	Industrial Training/ IEP (6 weeks)	0	0	0	0	2
				18	**2**	**4**	**24**	**24**

Course structure of B.Tech (Civil Engineering) for batch 2019-23

Semester 7	**PC**	20CV417T	Project Management	2	0	0	2	2
	PC	20CV417P	Project Management- Lab	0	0	2	2	1
	CE	20CV4XXT	Professional Core Elective-4	3	1	0	4	4
	CE	20CV4XXT	Professional Core Elective-5	3	1	0	4	4
	CE	20CV4XXT	Professional Core Elective-6	3	0	2	5	4
	Project	20TP410	Minor Project	0	0	0	0	3
				11	**2**	**4**	**17**	**18**
Semester 8	**Project**	20TP420	Major Project/Comprehensive Project					**10**

Component wise Distribution:

Code	Component	Lec	Tutorial	Practical	Hrs	Credits
HSC	Humanities & Social Science Including Management Courses	4	0	8	12	9
BSC	Basic Science Courses	15	3	4	22	20
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	2	0	2	4	3
PC	Professional Core Courses	46	0	26	72	59
CE	Professional Elective Courses related to chosen specialization	18	4	4	26	24
OE	Open Elective Subjects from Other technical / emerging subjects	12	0	0	12	12
Project	Project work, Seminar or Internship in Industry or elsewhere	0	0	0	0	16
Overall		111	7	50	168	160

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
	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

COURSE STRUCTURE FOR B. TECH. IN CIVIL ENGINEERING													
Semester III			**B. Tech. in Civil Engineering**										
Sr. No.	**Course/ Lab Code**	**Course/ Lab Name**	**Teaching Scheme**					**Examination Scheme**					
			L	**T**	**P**	**C**	**Hrs/Wk**	**Theory**			**Practical**		**Total**
								MS	**ES**	**IA**	**LW**	**LE/Viva**	**Marks**
1	20MA204T	Mathematics-III	3	1	0	4	4	25	50	25	--	--	100
2	20CV201T	Open Elective-1	3	0	0	3	3	25	50	25	--	--	100
3	20CV202T	Concrete Technology & Construction Materials	3	0	0	3	3	25	50	25	-	-	100
4	20CV202P	Concrete Technology & Construction Material Lab	0	0	2	1	2	--	--	--	25	25	50
5	20CV203T	Fluid Mechanics	3	0	0	3	3	25	50	25	--	--	100
6	20CV203P	Fluid Mechanics Lab	0	0	2	1	2	--	--	--	25	25	50
7	20CV204T	Mechanics of Materials	3	0	0	3	3	25	50	25	--	--	100
8	20CV206P	Building Planning and Drawing Lab	0	0	4	2	4	--	--	--	25	25	50
9	20HS201P	Communication Skills – II	0	0	2	1	2	--	--	--	25	25	50

Pandit Deendayal Petroleum University **School of Technology**

20MA204T					Mathematics-III					
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 a broad coverage of various mathematical techniques that are widely used for solving and to get analytical solutions to partial differential equations of first and second order.
- To introduce various applications of partial differential equations in many fields of science and engineering.
- To introduce the basic concepts of solving algebraic and transcendental equations.
- To introduce the numerical techniques of interpolation in various intervals in real life situations.

UNIT 1 PARTIAL DIFFERENTIAL EQUATIONS OF FIRST ORDER **10 Hrs.**

Formation of Partial Differential Equations (PDEs), Solutions of PDEs of first order, Cauchy problem for first order PDEs, Lagrange's method, Charpit and Jacobi methods for solving first order nonlinear PDEs

UNIT 2 PARTTIAL DIFFERENTIAL EQUATIONS OF SECOND ORDER AND APPLICATIONS **10 Hrs.**

Classification of second order PDEs, Method of separation of variables – Fourier Series Solutions of one-dimensional wave equation, One dimensional equation of heat conduction, Steady state solution of two-dimensional equation of heat conduction.

UNIT 3 NUMERICAL SOLUTION OF SYSTEM OF LINEAR EQUATIONS & NON-LINEAR EQUATIONS **10 Hrs.**

Solution of transcendental and non-linear equations by Bisection, Regula Falsi, Newton's Raphson and Secant method. Concept of Ill conditioned system. Solution of a system of linear simultaneous equations by LU Decomposition, Cholesky Decomposition, Jacobi and Gauss Seidel methods.

UNIT 4 INTERPOLATION AND APPROXIMATION **10 Hrs.**

Interpolation with unequal intervals – Lagrange's interpolation, Newton's divided difference interpolation, Cubic Splines, Difference operators and relations, Interpolation with equal intervals – Newton's forward and backward difference formulae.

40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Understand the formation and solution of PDEs of first, second and higher order.

CO2 – Identify real phenomena as models of partial differential equations.

CO3 – Apply various analytic methods to obtain solutions to PDEs of first and second order, which occur in science and enginering.

CO4 - Solve algebraic and transcendental equations by various numerical methods.

CO5 - Estimate the missing data through interpolation methods.

CO6 – Analyse properties of interpolating polynomials and derive conclusions.

TEXT/REFERENCE BOOKS

1. K. S. Rao: Introduction to Partial Differential Equations, PHI Learning Pvt Ltd, New Delhi, 2010
2. T. Amaranath: An Elementary Course in Partial Differential Equations, Narosa Publishing House, New Delhi.
3. L.C. Evans, Partial Differential Equations, Graduate Studies in Mathematics, Vol. 19, American Mathematical Society, 1998
4. M.K. Jain, S.R.K. Iyenger and R.K. Jain, Numerical Methods for Scientific and Engineering Computation, 5thEd., New Age International (2007).
5. S.S. Sastry, Introductory Methods for Numerical Analysis,4th Ed., Prentice Hall of India (2009).
6. R.K. Jain & S.R.K. Iyenger, Advanced Engineering Mathematics, 3rd Ed., Narosa (2002).
7. B.S. Grewal, Numerical Methods in Engineering and Science with Programs in C & C++,Khanna Publishers (2010).

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100	**Exam Duration: 3 Hrs.**
Part A: 6 questions 4 marks each	24 Marks (40 min)
Part B: 6 questions 8 marks each	48 Marks (60 min)
Part C: 2 questions 14 marks each	28 Marks (40 min)

20CV202T					Concrete Technology and Construction Materials					
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 the various conventional construction materials, properties and their uses.
- To create mix design of concrete and evaluate the properties of concrete as per latest IS codal provision.
- To introduce the basic building components and their location.
- To develop the various techniques which are useful for the superstructure and substructure construction

UNIT 1 BUILDING MATERIALS **10 Hrs.**

Cement: Production – composition – structure – hydration – properties – tests - types and uses - Different chemical, physical and mechanical properties of materials i.e ; Stone, Aggregates, Brick, Steel, Lime, Wood, Mortar, Paint and Varnish etc. -**Green Building Materials - Properties** and requirements of different types green building materials - green building construction.

Mineral Admixtures: properties of Fly ash – slag - silica fume – metakaolin - rice husk ash - Lime powder. **Chemical Additives:** plasticizers - super plasticizers – retarders - water reducers - air entraining admixture.

UNIT 2: DESIGN AND PROPERTIES OF CONCRETE **12 Hrs.**

Mix Design of Concrete: as per IS methodology - particle packing density - **Fresh properties of concrete**: Workability – rheology – shrinkage – bleeding – segregation - test methods **Mechanical Properties of Concrete:** Strengths of hardened concrete (Tensile & Compressive strength, Flexural & Bond strength) - standard test methods as per IS standard. **Durability and Permeability of Concrete:** carbonation - chloride ingress - sulphate attack - alkali silica reaction - creep – shrinkage - repair and rehabilitation.

UNIT 3: BUILDING COMPONENT **7 Hrs.**

Floors and Roofs: Requirements - terminology used for roofs and types of roofs and flooring material. **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.

UNIT 4: FOUNDATION AND BUILDING PLANNING **10 Hrs.**

Foundation: Sub-structure and super-structure with their function in the building - Requirement of foundation - Type of Shallow - Types of Deep Foundation **Damp Proof Course:** Effect and causes of dampness - materials and methods used for DPC - Types of treatment used for DPC. **Scaffolding:** Requirements and types. **Building Planning:** Building Bye-Laws - drawing requirements - Principles of planning – FAR - Carpet Area - Plinth Area

Total 39 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1- Describe the functional role of ingredients of concrete, different types of building materials, sustainable materials and apply this knowledge to mix design philosophy.

CO2- Compute the design of concrete mix which fulfils the required properties for fresh, hardened and durability properties of concrete.

CO3: Demonstrate the effect of the environment on service life performance, properties and failure modes of structural concrete.

CO4: Illustrate the general building component and their sequences.

CO5: Determine the various techniques which are useful for the substructure and superstructure construction and plan various building as building by laws

CO6: Explain the factors to be considered in building planning and principal of planning.

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 Question from each unit – 2 Marks Each	20 Marks
Part B: 8 Questions from each unit - 10 Marks Each	80 Marks

20CV202P					Concrete Technology & Construction Material 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 understand the importance of testing of aggregates and its properties.
- To understand the importance of testing of cement
- To measure the properties of concrete
- To measure the strength of bricks and blocks.

LIST OF EXPERIMENTS:

1. Introduction to Concrete Engineering Laboratory Equipment (Introduction class)
2. Fineness modulus of fine and coarse aggregate
3. Flakiness & Elongation Index
4. Specific Gravity of aggregates
5. Water Absorption
6. Los Angeles Abrasion test
7. Fineness of cement by sieve analysis
8. Specific gravity of cement
9. Standard consistency of cement
10. Initial and final setting time of cement
11. Soundness of cement by Le-chatelier method
12. Compressive strength of cement mortar cube
13. Workability test of concrete by measuring slump
14. Compressive strength, flexural and tensile strength of concrete cube
15. Non-destructive test of concrete
16. Tile abrasion test

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - **Identify** engineering properties of aggregates by performing laboratory tests necessary for building construction
CO2 - **Explain** engineering properties of cement by performing laboratory tests necessary for building design and construction
CO3 - **Compute** the grade & properties of concrete by performing laboratory tests necessary for building construction
CO4 - **Design** mortar mixes
CO5 - **Determine** the mechanical and durability test results and evaluate the suitability for construction purpose
CO6 - **Create** smart concrete mix design which can be used for cost effective construction of building

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

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

Pandit Deendayal Petroleum University

20CV203T					Fluid Mechanics					
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 learn basic concept of fluid mechanics
- To establish the relevance of Fluid Mechanics in Civil Engineering.
- To study the Fundamental principles of Fluid Mechanics concept of pipe flow and boundary layer.
- To demonstrate how these principles are used in Engineering.

UNIT 1: FUNDAMENTALS OF FLUID MECHANICS **7 Hrs.**

Properties of Fluids: Properties of fluid and their explanation - Newtonian and Non-Newtonian fluid - **Fluid Statics**: Pressure and Its Measurement: Pascal's law – Manometers

Hydrostatic Forces on the Surface: Total and Centre of pressure - Pressure force on Horizontal - Vertical and Inclined lamina - **Buoyancy and Floatation:** Buoyancy - Archimedes' principle - Centre of buoyancy - Meta-centre and meta-centric height and its determination.

UNIT 2: FLUID KINEMATICS AND DYNAMICS **10 Hrs.**

Fluid Kinematics: Types of flow - Continuity equation - Velocity and Acceleration with functions - Vortex Flow - **Fluid Dynamics**: Euler's and Bernoulli's equation - Momentum equation- Free liquid jets.

UNIT 3: TYPES OF FLOW **11 Hrs.**

Viscous Flow: Laminar flow through circular pipe and between parallel plate - Energy and Momentum energy correction factors - Power absorbed in viscous flow - Loss of head due to friction in viscous flow.

Turbulent Flow: Reynolds's experiment - Darcy-Welsbach equation - Coefficient of friction - Prandtl mixing length theory - Pipe Flow: Loss of energy (major and minor) – Introduction - Hydraulic and Total energy line - Pipes in series-parallel - Flow through pipes in series-equivalent-parallel, Surge tank (Time Permits).

UNIT 4: DIMENSIONAL AND MODEL ANALYSIS **11 Hrs.**

Dimensional and Model Analysis: Systems of units - Dimensions of quantities - Equation of dimensional homogeneity - Methods of Dimensional analysis - Models and analysis, Similitude – types of similarities - Forces on moving fluid - Dimensionless numbers - Model laws - Partially submerged bodies - Model classification.

Total 39 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Define the fundamental properties of fluid

CO2 – Understand the concepts of fluid in static and dynamics condition

CO3 – Classify the different types of flow and it characteristics

CO4 – Illustrate the application of dimension and model analysis

CO5 – Evaluate the laminar and turbulent flow using Reynolds's experiment

CO6 – Create a model using model analysis

TEXT/REFERENCE BOOKS

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, 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.

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

20CV203P					Fluid 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	--	--	--	25	25	50

COURSE OBJECTIVES

- To gain the particle knowledge on fluid properties through experimental methods
- To demonstrate the fundamental principles using experimental method.
- To understand the utility of analytical and experimental methods in fluid mechanics

List of Experiments:

1. Measurement of Viscosity of liquid by Efflux time.
2. Experimental analysis of Reynolds experiment.
3. Measurement of flow by calibrating Rotameter,
4. Measurement of flow Venturimeter
5. Measurement of flow Orificemeter.
6. Experimental determination of Metacenter and Metacentric height.
7. Experimental determination of Friction Factor in close conduits.
8. Experimental determination of minor losses in pipe assembly.
9. Experimental verification of Bernoulli's theorem.
10. Determination of Hydraulic Co-efficient by Orifice.
11. Determination of Hydraulic Co-efficient by Mouthpiece.
12. Measurement of velocity distribution in open channel using Pitot tube

COURSE OUTCOMES

On completion of the course, student will be able to
CO1 – **Understand** the fundamental properties of fluid.
CO2 – **Calculate** various properties of fluid through experiment
CO3 – **Analyse** the fluid properties using experimental methods.
CO4 – **Utilize** the dimensional analysis for modelling
CO5 – **Judge** the parameter ranges using the experiment
CO6 – **Choose** appropriate dimension for hydraulic design

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

Part A: Lab Work – Continuous Assessment 25 Marks
Part B: Lab Exam and Viva 25 Marks

Pandit Deendayal Petroleum University					School of Technology					
20CV204T					Mechanics of Materials					
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 study compound stresses and to draw SFD and BMD
- To learn combined stresses and deflections in beams
- To study Trusses and thin cylinders

UNIT 1: Compound Stresses, SFD and BMD **10 Hrs**

Shear force and bending moment diagrams for statically determinate beams with complex loading. Compound stresses-Analytical and graphical method

Unit 2: Combined stresses and thin cylinders **10 Hrs**

Stresses under the combined action of direct loading and bending moment, determination of stress in the case of retaining walls, chimney and dams, overturning and sliding, stress due to direct loading and bending moment about both axis. Stresses and strains in thin cylinder.

UNIT 3: Slope and deflection **9 Hrs**

Deflection of beams: Introduction, Elastic curve derivation of differential equation of flexure, Sign convention, Slope and deflection for standard loading classes using Engineering methods

UNIT 4: Analysis of determinate structures **10 Hrs**

Classification of trusses; forces in members of determinate truss by method of joints and sections. Structural systems: Conditions of equilibrium, one, two, three dimensional structural systems, introduction to determinate and indeterminate structures.

Three hinged parabolic arches with supports at same levels-Determination of thrust, shear and bending moment.

Suspension cables - Analysis of cables at same levels.

Max: 39 Hrs

COURSE OUTCOMES:

On completion of the course, student will be able to

1. **Find** stress components on an inclined plane analytically and graphically
2. **Determine** the internal forces in beam and sketch the BMD and SFD.
3. **Find** the combined stresses in retaining walls, chimney and dams.
4. **Determine** stress and strain in thin cylinder.
5. **Evaluate** slope and deflections using Engineering methods.
6. **Analyse** the determinate structures

TEXT/REFERENCE BOOKS

1. B.C Punmia, Ashok Jain, Arun Jain, Mechanics of Materials, Lakshmi Publications, New Delhi.
2. S Ramamrutham, Strength of Materials, Dhanpat rai Publications, New Delhi..
3. Timoshenko and Young, Elements of Strength of Materials, Affiliated East-West Press.
4. R.S. Khurmi, Strength of Materials, S.Chand Publications New Delhi.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN:

Max Marks : 100; Exam Duration : 3 Hours

Part A: 5 Marks question from each unit : 5 x 4 = 20 Marks

Part B: 20 Marks numerical problems from each unit : 20 x 4 = 80 Marks

Pandit Deendayal Petroleum University					School of Technology					
20CV206P					**Building Planning and Drawing Lab**					
Teaching Scheme					**Examination Scheme**					
L	**T**	**P**	**C**	**Hrs/Week**	**Theory**			**Practical**		**Total Marks**
					MS	**ES**	**IA**	**LW**	**LE/Viva**	
0	**0**	**4**	**2**	**2**	--	--	--	25	25	50

COURSE OBJECTIVES

- To study the basic concepts about civil engineering drawing.
- To understand details for residential and public building drawings.
- To make students prepare building plans, 3D drawings of buildings using latest techniques in drafting software.

List of Experiments:

1. List out abbreviations and symbols used in building planning. (2 A-2 size sheet)
2. Draw a layout of different types of doors, windows, trusses and stairs used in building. (4 A-2 separate sheet for each component)
3. Draw typical layout of building principles (1 A-1 size sheet)
4. Draw typical layout of Plan – Section – Elevation for single storied residential building ((1 A-1 size sheet)
5. Draw typical layout of Plan – Section – Elevation for Double storied residential building ((1 A-1 size sheet)
6. Draw typical layout of Plan – Section – Elevation for Public Building (Bank, School, Commercial Complex) (1 A-1 size sheet)
7. Draw a perspective drawing of building (1 A-1 size sheet)
8. Draw typical layout of Plan – Section – Elevation for Double storied residential building in Auto-CAD with basic commend (1 A-1 size sheet printed)

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - **Draw** different abbreviations of buildings

CO2 - **Understand** the fundamental principles, concepts of planning and architecture for buildings.

CO3 - **Prepare** working drawings, foundation plans and other executable drawings with proper details for buildings

CO4 – **Understand** local building bye-laws and provisions of National Building Code in respect of building and town planning.

CO5 - **Explain** building bye laws and Principles of Planning for residential and public buildings.

CO6 - **Execute** building plans, 3D drawings of buildings using software.

TEXT/REFERENCE BOOKS

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.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100		
Part A/Question: 50	25 Marks	
Part B/Question: 50	25 Marks	

20HS201P					Communication Skills – II (Semester – III/IV) (Second 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 **7 hrs**

- Technical Writing
  - ✓ Report Writing
  - ✓ Creating Lab Journals and Manuals
- Portfolio of Critical Writing and Creative Writing
  - ✓ Essay, Story-writing, etc.

UNIT 2 **7 hrs**

- Summarizing
- Writing Reviews (Books/Articles/Movies/websites)
- Reading Skills (Advanced)

UNIT 3 **7 hrs**

- Digital Literacy
  - ✓ Emails
  - ✓ Creating e-content
  - ✓ Editing and proofreading online
  - ✓ Using grammar and spell check software
  - ✓ Using plagiarism checkers

UNIT 4 **9 hrs**

- Group Discussion
- Resume Writing
- Interview Skills

Max. 30 hrs.

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

- Harmer, Jeremy. The Practice of English Language Teaching. Harlow: Pearson Longman, 2007.
- 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	• Essay/Journal Writing – 10 • Report Writing – 10 • Creating e-content – 10 • Blog Writing – 10 • Review Writing - 10
Lab Exam/Viva	25	• Mock Interview – 15 • Group Discussion – 15 • Cover Letter/Curriculum - 20

COURSE STRUCTURE FOR B. TECH. IN CIVIL ENGINEERING														
Semester IV			**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	20CV207T	Hydrology and water resources engineering	3	0	0	3	3	25	50	25	--	--	100	
2	20CV207P	Hydrology and water resources Engineering lab	0	0	2	1	2	--	--	--	25	25	50	
3	20CV208T	Structural Analysis	4	0	0	4	4	25	50	25	-	-	100	
4	20CV209T	Surveying	3	0	0	3	3	25	50	25	--	--	100	
5	20CV209P	Surveying - Lab	0	0	4	2	4	--	--	--	25	25	50	
6	20CV210T	Geology and Soil Mechanics	4	0	0	4	4	25	50	25	--	--	100	
7	20CV210P	Geology and Soil Mechanics Lab	0	0	2	1	2	--	--	--	25	25	50	
8	20CV211/12T	Open Elective II	3	0	0	3	3	25	50	25	-	-	100	
8	20IF201T	Industry 4.0	2	0	0	2	2	25	50	25	-	-	100	
9	20IF201P	Industry 4.0 Lab	0	0	2	1	2	-	-	-	25	25	50	
10	TP210	Industrial Orientation	0	0	0	1	0							

20CV207T					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	3	4	25	50	25	--	--	100

COURSE OBJECTIVES

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

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

Introduction - Hydrologic Cycle, Precipitation –Types - Measurement - Rain Hyetograph and Mass Curve - DAD - IDF curve - Run Off - Evaporation Losses, Infiltration: Process-Capacity-Rate-Capacity Curve-Indices -Computation of Runoff- Unit hydrograph Theory, S-Curve Hydrograph.

UNIT 2 GROUND 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 3 RIVER TRAINING AND RESERVOIR PLANNING **12 Hrs.**

Introduction - Different type of river - classification of Indian river - mender parameters and their relationships - objective of river training Classification of river training work- 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 4 MODELING TECHNIQUES IN WATER RESOURCES ENGINEERING **15 Hrs.**

Introduction of model - Types of model, Introduction of Hydrologic and Hydrodynamic model - Basic of hydrologic model and its application - Introduction of Hydrodynamic model - Basic of 1D, 2D and 1D/2D coupled hydrodynamic model - 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 – **Define** the basic components of hydrology
CO2 – **Understand** the basic of ground water hydrology
CO3 – **Classify** the river and reservoir system for water resource engineering
CO4 – **Analyse and estimate** the rainfall and runoff relations through analytical methods
CO5 – **Estimate** the surface runoff using hydrograph theory
CO6 – **Choose** an appropriate model for hydrologic and hydrodynamic problem analysis

TEXT/REFERENCE BOOKS

1. Santosh Kumar Garg, Hydrology and Water Resource Engineering, Khanna Publishers, New Delhi.
2. W. Viessman, GL Lewis, Introduction to Hydrology, Person Education.
3. HM Raghunath, Hydrology-Principle, analysis and design, New Age Publication
4. BC Punamia, Irrigation and Water Power Engineering, Standard Publication.

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

20CV207P					HYDROLOGY AND WATER RESOURCES 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 gain the particle knowledge on hydrologic components through experimental methods.
- To understand the flow characteristics (uniform and non-uniform) through experiment.
- To learn the software application for hydrologic and hydrodynamic processes.

INTRODUCTION TO HYDROLOGY AND WATER RESOURCES ENGINEERING

Fundamental, Basic component of hydrology i.e. infiltration, runoff, evaporation, flow Characteristics etc.

EXPERIMENTS

1. Conduct the experiments on Pan evaporimeter for evaporation measurement
2. Infiltrometer for infiltration measurement
3. Tilting Hydraulic flume for characteristics (uniform, non-uniform flow) measurement
4. Weather station for Wind velocity
5. Temperature and humidity measurement
6. Hydraulic bench for precipitation and runoff measurement

ANALYTICAL METHODS AND SOFTWARE SOLUTION

1. Reservoir area volume measurement using Planimeter
2. Different software application for hydrology component calculation and solution

COURSE OUTCOMES

On completion of the course, student will be able to
CO1 – **Understand** the basic component of hydrology
CO2 – **Calculate** the various hydrologic component through experiments
CO3 – **Classify** the open channel flow through experiments
CO4 – **Analyse** the runoff using hydrograph
CO5 – **Evaluate** the are-volume using Planimeter
CO6 – **Create** different files using software application

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

Part A: Lab Work – Continuous Assessment	25 Marks
Part B: Lab Exam and Viva	25 Marks

20CV208T					Course Name: STRUCTURAL ANALYSIS					
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 analyze the two hinged arches and moving load problems.
- To calculate slope and deflection in structures using energy method.
- To analyze the beams and frames for end moments.

UNIT 1 Strain Energy, Deflections and Two hinged arches **12 Hrs**

Strain energy: Introduction, Strain energy due to axial load, bending and shear,torsion. 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. Deflection of joints of trusses using unit load method. Analysis of two hinged parabolic arches for various loading cases.

UNIT 2 ILD, moving loads and consistent deformation **12 Hrs**

Influence Line Diagrams for reaction, shear force and bending moments of statically determinate beams. Maximum bending moments and shear forces at specified sections due to static and moving loads. Consistent deformation method: Analysis of single span beams with various loading and boundary conditions

UNIT 3 Slope deflection **15 Hrs**

Static and kinematic indeterminacy of beams and frames. Fixed beams analysis for end moments and introduction to continuous beams

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 4 Moment distribution 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)

Max. 52 Hrs

TEXT/REFERENCE BOOKS

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. Thandava Murthy, Analysis of Structures, Oxford University Press.
5. S Ramamrutham, Theory of structures, Dhanpat rai Publications, New Delhi.

COURSE OUTCOMES

On completion of the course, student will be able to

1. CO1-**Find** the slopes and deflections using energy method .
2. CO2-**Determine** the deflections/reactions of beams/two hinged arches using Castigliano's theorems
3. CO3-**Demonstrate the** concept of rolling load by drawing influence line diagram.
4. CO4-**Determine** the unknown reactions or moments using method of consistent deformation method
5. CO5-**Analyse** the continuous beams and frames for end moments using slope deflection method.
6. CO6- **Analyse** the continuous beams and frames for end moments using Moment distribution method.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN:

Max Marks : 100; **Exam Duration : 3 Hours**

Part A: 5 Marks question from each unit : 5 x 4 = 20 Marks

Part B: 20 Marks numerical problems from each unit : 20 x 4 = 80 Marks

20CV209T					SURVEYING					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	03	25	50	25	--	--	100

COURSE OBJECTIVES

- To understand the principles and procedure for linear, angular measurement and levelling
- To study the various methods of Surveying
- To understand the utilization of Remote sensing, GIS, GPS for location and construction of different civil engineering projects

UNIT 1 BASIC SURVEYING **10 Hrs.**

Linear survey - linear measurements using chains and tapes - chaining and ranging - errors and corrections - Procedure of field work - Angular Survey – Introduction - WCB & QB - Computation of angles from bearings - local attraction and corrections – Levelling - Principle of levelling - methods of levelling - levelling difficulties - curvature and refraction corrections – Contouring - methods of contouring - uses of contour maps.

UNIT 2 AREA-VOLUME SURVEYING **07 Hrs.**

Plane table survey- Theodolite Traversing - Traverse computation - Computation of areas &volumes - Computation of area of regular & irregular boundary - Trapezoidal& Simpson's rule - computation of volume for earthwork in cutting & filling.

UNIT 3 TACHEOMETRIC SURVEYING AND CURVE SETTING **10 Hrs.**

Tacheometric Surveying – Introduction - fundamental principles - field work in tachometry - errors and precisions - Curve setting - methods of curve setting - applications of site distance in transport planning - Modern Surveying Equipment and Land Surveying - digital levels - digital theodolites – EDMs - Total stations - digital land surveying and mapping.

UNIT 4 ADVANCE SURVEYING TECHNIQUES **12 Hrs.**

Principles of RS – EMR - atmospheric windows - sensors and platforms - concept of resolution - Visual and digital image interpretation - drone and UAV survey - GIS - spatial and attribute Data - GIS data structure - vector data and Raster data - GIS data sources – cartography - GIS applications - GPS – Types-Applications in Civil Engineering

Max. 39 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Understand the basic principles of linear, angular and levelling.
CO2 - Illustrate the application of Plane table and Theodolite
CO3 - Examine and measure the area and volume of a given field
CO4 - Learn the basic concept of Tacheometer work
CO5 - Analyse the uses of different other modern tools in survey projects
CO6 - Understand the basic utilization of Remote Sensing, GIS, and GPS for mapping

TEXT/REFERENCE BOOKS

1. NN Basak, Surveying and Levelling, 2nd Edition, Tata McGraw Hill Publication, New Delhi.
2. BC Punmia, Surveying Vol. I, 17th Edition, Laxmi Publishing House, New Delhi
3. RK Arora, Surveying Vol.I, Rajsons Publications PVT. LTD., New Delhi.
4. Haywood L, Cornelius S and S Carver, An Introduction to Geographical Information Systems, Addison Wiley Longmont, New York.

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

20CV209P					SURVEYING LAB					
Teaching Scheme					**Examination Scheme**					
L	**T**	**P**	**C**	**Hrs/Week**	**Theory**			**Practical**		**Total Marks**
					MS	**ES**	**IA**	**LW**	**LE/Viva**	
0	**0**	**4**	**2**	**4**	--	--	--	25	25	50

COURSE OBJECTIVES

- To learn the usefulness of traditional survey methods through chain, tape and compass survey
- To gain practical knowledge in engineering projects by learning the working of dumpy level, theodolite and total station for elevation calculation and contour plotting
- To learn GPS and GIS for engineering mapping.

LIST OF EXPERIMENTS

1. Measurement of bearings of sides of traverse with prismatic compass and Locating given building by chain and compass traversing (One full size drawing sheet).
2. Determination of elevation of various points in a area with dumpy level by collimation plane method and rise & fall method and plotting contour for the same (One full size drawing sheet)
3. Measurement of horizontal and vertical angles from Theodolite and plotting a closed traverse (One full size drawing sheet)
4. Study of planimeter. Determination of area of irregular figure by using planimeter
5. Setting out a simple circular curve by long chord method and tangent method
6. Setting out a simple circular curve using 2-Theodolite method
7. Rapid visual survey for route in a city
8. Visual image interpretation and identification of objects in a satellite image
9. Coordinate collection of points using global positioning system
10. Field project (A): mapping of an area using global positioning system
11. Field project (B): data transfer and processing of GPS data in GPS software

COURSE OUTCOMES

On completion of the course, student will be able to
CO1 - **Explain** the usefulness of traditional survey methods through chain, tape and compass
CO2 - **Use** dumpy level for elevation calculation by different methods and plot the contour
CO3 - **Develop** understanding of determining vertical and horizontal angles from theodolite
CO4 - **Analyse** and learn setting of curves from different methods in civil engineering works
CO5 - **Understand** the utilization of modern technologies
CO6 - **Illustrate** the application of GPS in conducting a survey for real project

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

Part A: Lab Work – Continuous Assessment	25 Marks
Part B: Lab Exam and Viva	25 Marks

Pandit Deendayal Petroleum University

20CV210T					Geology and Soil Mechanics					
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 learn different elements of Engineering Geology such as Mineralogy, Petrology and Structural Geology.
- To impart knowledge to classify the soil based on index properties subsequently find their engineering properties.
- To understand the fundamental concepts of compaction, permeability, stress transformation, stress distribution, consolidation and shear strength of soils.

UNIT 1: FUNDAMENTALS OF ENGINEERING GEOLOGY **12 Hrs.**

Definition and scope of geology - Geological Earth Processes - Study of the rock forming minerals, properties - Classification of rocks - Description - Occurrence - Engineering properties - Structural geology: Dip, strike, folds, faults and joints-their engineering aspects - Case Studies

UNIT 2: SOIL BASICS, INDEX PROPERTIES AND SOIL CLASSIFICATIONS **14 Hrs.**

Soil formation - Clay mineralogy - Surface activity - Volume-weight relationships - Grain size distribution - Sieve analysis and hydrometer analysis - Consistency limits and their determination - Soil classification systems

UNIT 3: COMPACTION, CONSOLIDATION AND STRESS DISTRIBUTION **12 Hrs.**

Compaction – Moisture - density relations - Factors affecting compaction - Field compaction methods - Field compaction control - primary consolidation concept - void ratio - pressure curve - Field curve - Laboratory test - Vertical Stress distribution in soil - Boussinesq equation - line load - Uniformly distributed loads - Influence chart - approximate methods - Westergaard's equation - Pressure bulb

UNIT 4 PERMEABILITY, SEEPAGE AND SHEAR STRENGTH **14 Hrs.**

One dimensional flow through soil - Permeability - Darcy's Law - Field and laboratory permeability tests - Flow through stratified soil - Seepage - Two dimensional flow - Laplace's equation – Introduction to flow nets - Shear Strength of soil - Importance - Mohr Coulomb's Strength theory - Laboratory and field tests - Factors affecting shear strength - Types of shear tests based on drainage condition

Max. 52 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Explain geological earth processes in formation of soils, rock, mineralogy, structural features
CO2 - Develop interrelations between index properties of soils
CO3 - Classify the soil based on Index properties of soils
CO4 - Apply principles of compaction and consolidation to the control field conditions
CO5 - Demonstrate the concept of stress distribution and shear strength of soils
CO6 - Compute permeability and seepage for different soils and hydraulic structures

TEXT/REFERENCE BOOKS

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

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

20CV210P					Geology and 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	--	--	--	25	25	50

COURSE OBJECTIVES

- To discriminate rock forming minerals and different types of rocks
- To interpret topographical and geological map
- To determine index and engineering properties of soils

LIST OF EXPERIMENTS

1. Identifying rock forming minerals by physical properties
2. Study of different igneous, sedimentary and metamorphic rocks
3. Study of topographical and geological maps
4. Determination of moisture content of soils
5. Determination of specific gravity of course grained and fine-grained soils
6. Determination of field density using core cutter method
7. Determination of field density using sand replacement method
8. Determination of relative density of sandy soils
9. Determination of liquid limit and plastic limit of soils
10. Determination of shrinkage limit of soils
11. Grain size analysis of soils
12. Determination of maximum dry density and optimum moisture content using standard Proctor test
13. Determination of permeability of soils using (i) constant head (ii) falling head permeability test
14. Determination of unconfined compression strength of the soils

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Identify minerals and rock

CO2 - Demonstrate the theoretical concept, significance and experimental procedure to measure soil properties

CO3 - Determine index properties of soils

CO4 - Classify the soil based on index properties and physical characteristics

CO5 - Determine Engineering properties of soil

CO6 – Interpret soil properties in the context of soil behaviour and applications

TEXT/REFERENCE BOOKS

1. Laboratory Manual
2. BC Punmia, Ashok Kumar Jain, Arun Jain, Soil Mechanics and Foundations, Laxmi Publication, 16th Edition, 2015
3. KR 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.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

Part A: Lab Work – Continuous Assessment 25 Marks

Part B: Lab Exam and Viva 25 Marks

20IF201T					Industry 4.0					
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

COURSE OBJECTIVES

1. To interpret the core elements and basic technologies of Industry 4.0
2. To understand how the core elements and technologies of Industry 4.0 are interconnected
3. To develop a holistic approach to improve processes and products with Industry 4.0

UNIT I: INDUSTRY 4.0 – CONCEPTS & TERMINOLOGIES **08 Hrs.**

Industry 4.0, Smart business model, Technology road-map, Sensing & actuation, Communication, Internet of things (IoT), Cyber Physical Systems and Next Generation Sensors, Visualization, Cloud Computing.

UNIT II: SMART WORLD & SUSTAINABLE ENVIRONMENT **08 Hrs.**

Sensors and their integration, Renewable Energy System, Hybrid Energy System, Smart Grid, Smart Metering, Communication Protocols, 5G Technology, Smart Agriculture, Smart Infrastructure, Physiological Sensors, Human Machine Interface.

UNIT III: SMART MANUFACTURING **08 Hrs.**

Automation Systems, Additive Manufacturing, Micro-Electro-Mechanical Systems (MEMS), Smart Factories and Interconnection, Advanced Robotics – Autonomous and Swarm, Self-Propelled Vehicles, Drones–Unmanned Aerial Vehicle (UAV), 3d Printing, Spacecrafts.

UNIT IV: TRANSFORMING TECHNOLOGIES IN BIOENGINEERING **08 Hrs.**

Establishment of Smart Biotechnology Factory, Artificial Intelligence in Bioprocess Technology, 3D Bio Printing for Tissue Engineering, Simulation Tools, RSM and Box Model, Cyber Physical System based Telemedicine, Real Time Biosensors, Bio nanotechnology, biofuel.

Total Hours 32 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Understand the core elements and basic technologies for Industry 4.0
CO2 – Apply the different computational techniques and algorithms for realizing Industry 4.0
CO3 – Transform the traditional business approach by integrating the data and intelligence
CO4 – Develop the traditional industries with intelligent and automated machines
CO5 – Utilize data and intelligence for the development of Smart World
CO6 – Understand the concept, significance and means to achieve sustainable development

TEXT/REFERENCE BOOKS

1. Ustundag Alp, and Emre Cevikcan, Industry 4.0: Managing the Digital Transformation, Springer,First Edition, 2018
2. Kaushik Kumar, Divya Zindani, and J. Paulo Davim, Digital Manufacturing and Assembly Systems in Industry 4.0., CRC Press, Taylor & Francis First Edition, 2019.
3. Antonella Petrillo, Raffaele Cioffi, and Fabio De Felice, Digital Transformation in Smart Manufacturing., IntechOpen Publisher, First Edition, 2018.
4. J. Ekanayake, K. Liyanage, J. Wu, A. Yokoyama and N. Jenkins, Smart Grid: Technology and Applications, John Wiley and Sons Ltd., First Edition, 2012
5. Alasdair Gilchrist, Industry 4.0: The Industrial Internet of Things, Apress, First Edition, 2016
6. Ibrahim Garbie, Sustainability in Manufacturing Enterprises: Concepts, Analyses and Assessments for Industry 4.0, Springer, First Edition, 2016

20IF201P					Industry 4.0 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

List of Experiments

1. Basic computations using Python programming.
2. Use simulations to understand the performance/behavior of a system by (i) creating a computational environment that mimics the real world, (ii) generating (synthetic) or loading data from sources, and (iii) testing the hypothesis
3. Introduction to MATLAB programming and SIMULINK
4. 3D printing of Airfoil through rapid prototyping 3D printer
5. Dynamic simulation of drone (unmanned air vehicle) through MATLAB/SIMULINK
6. ANSYS simulation of bending of a beam in an earthquake resist-building
7. Introduction to Arduino Embedded platform.
8. Design of line follower autonomous vehicle.
9. Design of smart meter for recording the electricity consumption
10. Design of smart lighting with the help of proximity sensors.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Understand the concept of Industry 4.0 and its significance
CO2 – Understand the resource requirements for the implementation of Industry 4.0
CO3 – Learn the Simulation Packages for Industry 4.0
CO4 – Explore the concept of Smart Infrastructure through simulation studies
CO5 – Inspect embedded platform applications for Industry 4.0
CO6 – Synthesise the solution for the given Industry 4.0 related problem

COURSE STRUCTURE FOR B. TECH. IN CIVIL ENGINEERING														
Semester V			**B. Tech. in Civil Engineering**											
Sr. No.	**Course/ Lab Code**	**Course/ Lab Name**	**Teaching Scheme**					**Examination Scheme**						
			L	**T**	**P**	**C**	**Hrs/Wk**	**Theory**			**Practical**		**Total**	
								MS	**ES**	**IA**	**LW**	**LE/Viva**	**Marks**	
1	20CV301T	Highway and Traffic Engineering	4	0	0	4	4	25	50	25	--	--	100	
2	20CV301P	Highway and Traffic Engineering Lab	0	0	2	1	2	--	--	--	25	25	50	
3	20CV302T	Foundation Engineering	4	0	0	4	4	25	50	25	--	--	100	
4	20CV302P	Soil Mechanics and Foundation Engineering Lab	0	0	2	1	2	--	--	--	25	25	50	
5	20CV303T	Design of RCC Structures	3	0	0	3	3	25	50	25	--	--	100	
6	20CV304T	Environmental Engineering	4	0	0	4	4	25	50	25	--	--	100	
7	20CV304P	Environmental Engineering -Lab	0	0	2	1	2	--	--	--	25	25	50	
8	20CV305/6T	Open Elective-III	3	0	0	3	3	25	50	25	--	--	100	
9	20HS301P	Communication Skills-III	0	0	2	1	2	-	-	-	25	25	50	

20CV301T					Highway and Traffic Engineering					
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 give an overview about 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 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 IRC37-2001- , 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 TRAFFIC ENGINEERING **13 Hrs.**

Various traffic parameters and its importance in the safe and efficient operation of highway- Different types of traffic regulatory signs- Traffic studies-Traffic volume count- video graphic survey methods- parking surveys etc. Traffic Rotary design- Introduction to Intelligent transportation- Different methods of ITS technologies developed for effective traffic operation and management.

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 check suitability of construction material.
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. Dr. 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

20CV301P					Highway and Traffic Engineering Lab					
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 OBJECTIVES

- To give an overview about different properties of pavement materials
- To know different test performed for aggregate and understand the procedure.
- To know different test performed for Soil and understand the procedure.
- To know different test performed for Bitumen and understand the procedure.
- To know different traffic study methods

List of Experiments:

1. Introduction to Highway Engineering Laboratory Equipment (Introduction class)
2. California Bearing Ratio (CBR) Test
3. Aggregate crushing Test
4. Aggregate Impact Test
5. Flakiness Index and Elongation Index Test for Aggregate
6. Los Angeles Abrasion Test / Deval Abrasion Test
7. Marshall stability test on Bitumen mix
8. Specific gravity and Water Absorption test for Aggregate
9. Penetration test for Bitumen
10. Softening point test for Bitumen
11. Ductility test for Bitumen
12. Flash and Fire Point test for Bitumen
13. Specific gravity test for Bitumen
14. Viscosity Test for Bitumen

Design based Problems (DP)/Open Ended Problem:

Conduct classified traffic volume study and spot speed study on busy rural highway or urban street during peak hour to obtain the peak hour flow and design speed of a selected road section.

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 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

Part A: Lab Work – Continuous Assessment 25 Marks

Part B: Lab Exam and Viva 25 Marks

20CV302T					Foundation Engineering					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
4	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To emphasize the importance of geotechnical investigation and subsoil exploration techniques.
- To explain importance of earth pressure and slope stability in geotechnical structures
- To compute bearing capacity for various foundation systems including settlement considerations
- To explain suitability of appropriate foundation system for various site conditions and their analysis.
-

UNIT 1 SUBSOIL EXPLORATION AND GEOTECHNICAL INVESTIGATION **10 Hrs.**

Objective - Subsurface exploration planning - Methods of Exploration - Soil Sampling and samplers - In situ tests – Geophysical Exploration – Geotechnical Investigation Report – Problems and Solution

UNIT 2 EARTH PRESSURE AND STABILITY OF SLOPE **14 Hrs.**

Introduction - Types of earth pressure - Rankine's theory – Surcharge - Inclined backfill - Soil stratification - Graphical methods - Application Problems and Solution - Types of Slope - Causes of failure - Stability analysis of infinite and finite slopes - Types of failure - slip circle method - friction circle method - Taylor's Stability number and stability curves.

15 Hrs.

UNIT 3 BEARING CAPACITY AND FOUNDATION SETTLEMENT

Definitions– types of failures - Terzaghi's analysis – Skempton's formula - IS formula - Effect of water table on bearing capacity - shape of foundation, inclination of load and eccentricity of load on bearing capacity – allowable bearing pressure - plate load test – penetration tests – Settlement of foundation: Settlement analysis – Types of foundation settlement, Components of settlements - their estimation - Allowable settlement values – Effects - Causes and remedial measures of total and differential settlements

UNIT 4 SHALLOW AND DEEP FOUNDATION **13 Hrs.**

Shallow foundations - Stress distribution (theory only): rectangular combined footing – trapezoidal combined footing – Raft footing:IS code of practice - Deep foundation – Introduction- functions of pile – classification– relative merits –Load carrying capacity of piles: static and dynamic formula – pile load test – penetration tests - pile spacing & group action – design of pile group – settlement of pile group – negative skin friction – Under reamed pile – Carrying capacity – Construction – Load Test

Max. 52 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Develop subsurface investigation program
CO2 - Calculate Earth pressure for different field conditions and soils
CO3 - Analyse the stability of soil slopes
CO4 - Compute the bearing capacity of soils and foundation settlements
CO5 - Analyse Shallow foundations
CO6 - Analyse deep foundations

TEXT/REFERENCE BOOKS

1. B.C.Punmia, Ashok Kumar Jain, Arun Jain, Soil Mechanics and Foundations, Laxmi Publication, 16th Edition, 2015
2. K.R. Arora, Soil Mechanics and Foundation Engineering, Standard Publisher Dist., 2009.
3. Shashi Gulathi, Manoj Dutta, Geotechnical Engineering, Tata Mcgraw Hill Publisher, 2009.
4. Bowles J.E., Foundation Analysis and Design 5th Edition, McGraw Hill Pub. Co. New York, 2009.
5. Gopal Ranjan, 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: 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

20CV302P					Soil Mechanics and Foundation 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.

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

20CV303T					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	0	0	3	3	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 INTRODUCTION **10 Hrs.**

Introduction - Introduction and scope - Design: strength – stability – serviceability - Design methods - Ultimate load method - working stress method - Limit state method - Standard Loadings - Partial safety factors for materials and loads - Grades of concrete - characteristic strength of concrete - yield strength of mild and Tor steels - Analysis of RC Beams (flexural members) - Stress-Strain curve for concrete - stress block for RC beam section - Classification of Beams based on reinforcement and depth of neutral axis - Moment resistance of RC-rectangular - T and L beams - Shear Strength of Beams

UNIT 2 DESIGN OF BEMAS AND SLABS **10 Hrs.**

Design of RC-beams - Rectangular - T and L beams for under- reinforced and balanced sections - & singly and doubly reinforced - Design of shear reinforcement - check for development length and deflection - Design of slabs - Design of one way - and cantilever slabs for flexure and check for shear deflections - Design of two-way slabs with edges free to lift - restrained for flexure and check for shear and deflections

UNIT 3 DESIGN OF COMPRESSION MEMBERS **10 Hrs.**

Design of Compression Members - Effective lengths, slenderness ratio, Short and long columns definitions - Design of short columns subjected to axial load - uni-axial bending and biaxial bending moments

UNIT 4 DESIGN OF FOOTING AND STAIRCASE **9 Hrs.**

Design of Footing - SBC of soil -design of flat and sloped square - rectangular and circular footings for RC columns subjected to axial load - uniaxial and biaxial bending moments - Check for shear - Design RCC Staircase - Types of Staircase – components – landing – going – tread – rise – loading – geometry - load calculations - Design of Dog legged staircase

TOTAL 39 Hrs.

COURSE OUTCOMES

At the end of semester students should able to

CO 1- Find flexural and shear strength of beams
CO 2- Design under reinforced and balanced rectangular and flanged beams
CO 3- Design the one way, two way and cantilever slabs and checking them for shear and deflections
CO 4- Understand concept of short and long columns and to design the same
CO 5- Design flat or sloped isolated footings for columns
CO 6- Design staircases

TEXT/REFERENCE BOOKS

1. P.C.Vergese, Limit State Design of Reinforced Concrete, PHI Publications, New Delhi
2. N Krishna Raju, Design of Reinforced Concrete Structures, CBS Publishers New Delhi
3. Ramamrutham, Design of Reinforced Concrete Structure, Dhanpat & Roy Publishers, New Delhi.
4. Shah H.J, Reinforced Concrete Volume-I, Charotar Publication House Pvt .Ltd
5. IS: 456-2000, Indian Standard Plain and Reinforced Concrete Code of Practice, Bureau of Indian Standards, New Delhi
6. SP:16(6)-1980, Design Aids for Reinforced Concrete to IS: 456-1978, Bureau of Indian Standards, 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: Questions from each unit with internal choice, each carrying 20 marks	80 Marks

20CV304T					Environmental Engineering					
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 understand the various aspects of water - sources, quality, demands
- To learn design of Water Treatment Plant
- To understand the qualitative and quantitative aspects of wastewater
- To design of Wastewater Treatment Plant

UNIT 1: DRINKING WATER **10 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 **14 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: WASTEWATER **12 Hrs.**

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 4: WASTEWATER TREATMENT **16 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 - Disinfection of sewage and sludge - Various methods of disposal of treated Sewage along with their standards - Action plan for efficient plant operation.

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 - Classify wastewater and calculate its amount

CO5 - Design a Wastewater Treatment plant

CO6 - Propose measures for efficient functioning of a wastewater treatment plant

TEXT/REFERENCE BOOKS

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

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

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

Part A: 8 Questions of 5 Marks each. 2 Questions from every unit 40 Marks

Part B: 6 Questions of 10 Marks each. 1 Question from unit 1 & 2 and 2 Questions from Unit 3 & 4 60 Marks

20CV304P					Environmental 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 understand the sampling procedures for water and wastewater collection
- To estimate the pollutants, present in the Water through experimentation
- To estimate the pollutants, present in the Wastewater through experimentation
- To analyse the Water and Wastewater 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, Total Dissolved Solids, Total Suspended Solids
4. Determination of Total Hardness and Calcium Hardness
5. Determination of Chlorides
6. Determination of Coagulant Dosage by Jar Test
7. Determination of Residual Chlorine
8. Determination of Dissolved Oxygen
9. Determination of BOD
10. Determination of COD

COURSE OUTCOMES

On completion of the course, student will be able to
CO1 - **Estimate** the concentration of a pollutant present in the water
CO2 - **Analyse** the quality of water based on water quality standards
CO3 - **Propose** appropriate measures for improving the water quality
CO4 - **Estimate** the concentration of a pollutant present in the wastewater
CO5 - **Analyse** the quality of wastewater based on wastewater quality standards
CO6 - **Propose** appropriate measures for improving the wastewater 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

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

Part A: Lab Work – Continuous Assessment 25 Marks
Part B: Lab Exam and Viva 25 Marks

20HS301P					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

COURSE STRUCTURE FOR B. TECH. IN CIVIL ENGINEERING														
Semester VI			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	20CV308T	Design of Steel Structures	3	0	0	3	3	25	50	25	--	--	100	
2	20CV309P	Structural Drawing - Lab	0	0	2	1	2	--	--	--	25	25	50	
3	20CV307T	Estimation costing contracts and valuations	3	0	0	3	3	25	50	25	--	--	100	
4	20CV310 TO 16T	Professional Core Elective-1	3	1	0	4	4	25	50	25	--	--	100	
5	20CV31T TO 22T	Professional Core Elective-2	3	0	2	4	5	25	50	25	--	--	100	
6	20CV323 TO 28T	Professional Core Elective-3	3	1	0	4	4	25	50	25	--	--	100	
7	20CV329 TO 31 T	Open Elective-4	3	0	0	3	3	25	50	25	--	--	100	
8	20TP310	Industrial Training/ IEP (6 weeks)	0	0	0	2	0	-	-	-	25	25	50	

20CV308T					Design of Steel Structures					
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

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 **12 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.

9 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 **10 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 **8 Hrs.**

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

Max. 39 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

20CV309P					Structural Drawing 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 understand drafting commands to draw plan, elevation and sectional elevation of residential building with one or two storeys.
- To prepare reinforcement details of beams, slabs, columns, footings and staircases using drafting software
- To draw steel connections, slab base and gusseted base foundations for columns
- To analyse trusses, continuous beams and plane frames using FEM software.

UNIT 1 DRAWING OF RESIDENTIAL BUILDING

Familiarising basic commands of drafting software
To draw plan, elevation of a residential buildings of single storey building using drafting software.
To draw sectional elevation of the building specified in the above item using drafting software.

UNIT 2 DRAWING OF REINFORCED CONCRETE STRUCTURES

To draw longitudinal and cross sections of three span continuous beam showing the reinforcement details
To draw plan and sectional elevation of simply supported one way and two-way slabs showing the reinforcement details
To draw plan and sectional elevations of rectangular column with rectangular footings
To draw plan of the staircase room and sectional elevations of flights showing reinforcement details

UNIT 3 DRAWING OF STEEL STRUCTURES

To draw sectional elevation of beam to beam bolted or welded steel connections
To draw sectional elevation of beam to column bolted or welded steel connections
To draw plan of slab base and gusseted base foundation for a given Steel column
To draw a sectional elevation typical simple steel truss showing the details at all joints

UNIT 4 ANALYSES OF STRUCTURES

Introduction to FEM Software and To analyse the continuous beam
To analyze plane truss for member forces using FEM Software
To analyse plane frame for end moments and shear forces using FEM Software

COURSE OUTCOMES

At the end of the semester, students able to

CO1 -**Draw** plan, elevation and sectional elevation of residential building with one or two storeys.
CO2 - **Prepare** reinforcement details of beams, slabs using drafting software
CO3 -**Prepare** reinforcement details of columns, footings, stair case flights using drafting software
CO4 - **Draw** sectional elevation of beam to beam and beam to column bolted or welded steel connections
CO5 - **Draw** plan of slab base and gusseted base foundation for a given Steel column
CO6 - **Analyse** trusses, continuous beams and plane frames using FEM software

TEXT/REFERENCE BOOKS

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

20CV307T					Estimation costing contracts and valuations					
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 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.

UNIT 1 SPECIFICATION AND RATE ANALYSIS **10 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.

13 Hrs.

UNIT 2 ESTIMATE

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

08 Hrs.

UNIT 3 CONTRACTS

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

08 Hrs.

UNIT 4 VALUATION

Definitions of various terms- method of valuation- Freehold & Leasehold properties- Sinking fund- depreciation and method of estimating depreciation- Outgoings. **Max. 39 Hrs.**

- To be able to compute rates of different items of work from the first principles.
- To understand valuation and its necessity.

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

COURSE STRUCTURE FOR B. TECH. IN CIVIL ENGINEERING													
Semester VII			**B. Tech. in Civil Engineering**										
Sr. No.	**Course/ Lab Code**	**Course/ Lab Name**	**Teaching Scheme**					**Examination Scheme**					
			L	**T**	**P**	**C**	**Hrs/ Wk**	**Theory**			**Practical**		**Total**
								MS	**ES**	**IA**	**LW**	**LE/Viva**	**Marks**
1	20CV417T	Project Management	2	0	0	2	2						
2	20CV417P	Project Management - Lab	0	0	2	1	2						
3	20CV401 TO 6T	Professional Core Elective-4	3	1	0	4	4	**25**	**50**	**25**	**--**	**--**	**100**
4	20CV407 TO 11T	Professional Core Elective-5	3	1	0	4	4	**25**	**50**	**25**	**--**	**--**	**100**
5	20CV412 TO 16T	Professional Core Elective-6	3	0	2	4	5	**25**	**50**	**25**	**--**	**--**	**100**
	20TP410	Minor Project	0	0	0	3	0	-	-	-	25	25	50

20CV417T					Project Management					
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

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 06 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 08 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 06 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 06 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. 26 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

20CV417P					Project Management 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 learn the Microsoft project software to develop work break down structures for real life projects
- To learn to develop, bar charts, mile stone charts, project networks and how to monitor a project progress
- To learn the techniques for resource allocation and levelling through MSP software
- To learn the simulation methods for project risk management

MICROSOFT PROJECT SOFTWARE (PLANNING, SCHEDULING, RESOURCE LEVELLING) 14 Hrs

(1) Work Breakdown Structure (WBS) (2) AOA Networks (3) AON Networks (4) Linear Time Monitoring Tools (Bar Charts / Gant Charts) (5) Editing Tasks (6) Mile Stone Charts (7) Resource Allocation (8) Resource Levelling (9) Managing Data & Resources (10) Introduction to Base Line for Monitoring Projects (11) Managing Multiple Projects (12) Project Calendar (13) Use of Filters (14) Creating a Project Report (15) Case Studies from Industry

PROJECT RISK MANAGEMENT THROUGH RISK AMP-SOFTWARE 06 Hrs.

(1) Risk Analysis (Quantitative) (2) Simulation of Risk weightages through Monte Carlo Simulation
(3) Simulation Application for Network Path Analysis (4) Monte Carlo Simulation Application for Computation of Risk Time, Risk Cost, Expected Time Expected Cost of a Project

BUILDING INFORMATION MODELING AND PRIMAVERA 06 Hrs

(1) Application of BIM for enhancing co-ordination and collaboration in infrastructure projects
(2) Application of BIM for clash detection (3) Introduction to Primavera

Max. 26 Hrs

COURSE OUTCOMES

On completion of the course, student will be able to:
CO 1 - **Understand** the features of Microsoft project software and learn to develop work breakdown structure (WBS) for real life structures
CO2 - **Learn** the applications for developing bar charts, milestone charts and project networks
CO3- **Learn** the applications for carrying out resource allocation and levelling
CO4 - **Apply** Monte Carlo simulation to carryout project network path analysis
CO5 - **Apply** Monte Carlo simulation for computation of Risk Time, Risk Cost, and Expected Time Expected Cost of a Project (Expected Value Method of risk analysis)
CO6 - **Learn** the primary applications of BIM and overview of Primavera

TEXT/REFERENCE BOOKS

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

COURSE STRUCTURE FOR B. TECH. IN CIVIL ENGINEERING													
Semester VIII			**B. Tech. in Civil Engineering**										
Sr. No.	**Course/ Lab Code**	**Course/ Lab Name**	**Teaching Scheme**					**Examination Scheme**					
			L	**T**	**P**	**C**	**Hrs /Wk**	**Theory**			**Practical**		**Total**
								MS	**ES**	**IA**	**LW**	**LE/Viva**	**Marks**
1	20TP420	Major Project/ Comprehensive Project	0	0	0	**10**	--	--	--	--	25	25	50

20TP420					Major Project					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
			--	--	--	--	--	25	25	50

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 (Based on research article submitted in journals/ conference etc.)	50 Marks
Part C: Continuous assessment by project guide.	20 Marks

20TP420					Comprehensive Project					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
			--	--	--	--	--	25	25	50

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