RAJALAKSHMI ENGINEERING COLLEGE

(An Autonomous Institution Affiliated to Anna University Chennai)

DEPARTMENT OF CIVIL ENGINEERING

CURRICULUM AND SYLLABUS REGULATION – 2019

B.E. CIVIL ENGINEERING

CHOICE BASED CREDIT SYSTEM

VISION:

To be a department imparting knowledge in Civil Engineering education, research, entrepreneurship and industry outreach services for creating sustainable infrastructure and enhancing quality of life with professional and ethical values.

MISSION:

- To provide an effective teaching – learning environment enabling students to be a competent civil engineer.
- To motivate research and entrepreneurial initiatives in the field of Civil Engineering.
- To inculcate ethical values to serve the society with high order professionalism.

PROGRAMME EDUCATIONAL OBJECTIVES: (PEO's)

1. Graduates will possess fundamental knowledge in all fields of Civil Engineering and be able to apply in the profession in Public and Private Sectors.
2. Graduates will have knowledge and preparation to tackle real-life Complex Problems and provide sustainable solutions to Civil Engineering Industry.
3. Graduates will have the ability to update themselves with developments and new technologies, pursue higher studies to face the Challenges.
4. Graduates will become Entrepreneurs, to meet the infrastructural needs of the society, following professional and ethical values.

PROGRAMME OUTCOMES: (PO'S)

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 analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex 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 the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering Solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: 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 a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES: (PSOs)

PSO 1: The students will be proficient in the fundamental concepts and apply them to various Civil Engineering projects in Structural Engineering, Geotechnical Engineering, Environmental Engineering, Construction Materials and Management, Transportation Engineering, Water Resources and Management for Sustainable Environment.

PSO 2: The students will be competent to solve complex problems using both conventional & modern technologies to prepare cost estimation for Civil Engineering Projects.

PSO 3: The students will be skilled professionals to support the society focusing on sustainable development and uphold professional ethics.

CURRICULUM AND SYLLABUS

SEMESTER I

Course Code	Course Title	Periods /Week				Credits	CAT
		L	T	P	Total		
HS19151	Technical English	2	1	0	3	3	HS
MA19151	Algebra and Calculus	3	1	0	4	4	BS
PH19141	Physics of Materials	3	0	2	5	4	BS
GE19101	Engineering Graphics	2	2	0	4	4	ES
GE19121	Engineering Practices - Civil and Mechanical	0	0	2	2	1	ES
MC19101	Environmental Science and Engineering (Non Credit Course)	3	0	0	3	0	MC
TOTAL		**13**	**4**	**4**	**21**	**16**	

SEMESTER II

Course Code	Course Title	Periods /Week				Credits	CAT
		L	T	P	Total		
MA19251	Differential Equations and Vector Calculus	3	1	0	4	4	BS
CY19143	Applied Chemistry	3	0	2	5	4	BS
GE19141	Programming using C	2	0	4	6	4	ES
EE19242	Basic Electrical and Electronics Engineering	3	0	2	5	4	ES
GE19201	Engineering Mechanics	2	1	0	3	3	ES
CE19211	Computer Aided Building Drawing	0	0	4	4	2	PC
GE19122	Engineering Practices – Electrical and Electronics	0	0	2	2	1	ES
MC19102	Indian Constitution and Freedom Movement (Non Credit Course)	3	0	0	3	0	MC
TOTAL		**16**	**2**	**14**	**32**	**22**	

SEMESTER III

Course Code	Course Title	Periods /Week				Credits	CAT
		L	T	P	Total		
MA19355	Transforms and Applications	3	1	0	4	4	BS
CE19301	Engineering Geology	3	0	0	3	3	PC
CE19302	Construction Materials, Techniques and Practices	3	0	0	3	3	PC
CE19303	Strength of Materials I	2	1	0	3	3	PC
CE19304	Fluid Mechanics	2	1	0	3	3	PC
CE19311	Construction Materials Laboratory	0	0	4	4	2	PC
CE19312	Strength of Materials laboratory	0	0	4	4	2	PC
GE19301	Life Science for Engineers	3	0	0	3	3	BS
TOTAL		**16**	**3**	**8**	**27**	**23**	

SEMESTER IV

Course Code	Course Title	Periods /Week				Credits	CAT
		L	T	P	Total		
MA19451	Numerical Methods	3	1	0	4	4	BS
CE19401	Strength of Materials II	2	1	0	3	3	PC
CE19402	Applied Hydraulic Engineering	3	0	0	3	3	PC
CE19403	Surveying	3	0	0	3	3	PC
CE19411	Surveying Laboratory	0	0	4	4	2	PC
CE19412	Hydraulic Engineering Laboratory	0	0	4	4	2	PC
MC19301	Essence of Indian Traditional Knowledge (Non Credit Course)	3	0	0	3	0	MC
GE19421	Soft Skills I	0	0	2	2	1	EEC
	Open Elective I	3	0	0	3	3	OE
TOTAL		**17**	**2**	**10**	**29**	**21**	

SEMESTER V

Course Code	Course Title	Periods /Week				Credits	CAT
		L	T	P	Total		
CE19501	Design of Reinforced Concrete Elements	3	1	0	4	4	PC
CE19502	Traffic and Highway Engineering	3	0	0	3	3	PC
CE19503	Structural Analysis I	2	1	0	3	3	PC
CE19504	Soil Mechanics	2	1	0	3	3	PC
CE19505	Water Supply Engineering	3	0	0	3	3	PC
CE19511	Soil Mechanics Laboratory	0	0	2	2	1	PC
CE19512	Survey Camp*	0	0	2	2	1	PC
GE19521	Soft Skills II	0	0	2	2	1	EEC
	Open Elective II	3	0	0	3	3	OE
TOTAL		**16**	**3**	**6**	**25**	**22**	

(* Two weeks at the end of Semester IV)

SEMESTER VI

Course Code	Course Title	Periods /Week				Credits	CAT
		L	T	P	Total		
CE19601	Design of Steel Structures	3	1	0	4	4	PC
CE19602	Structural Analysis II	2	1	0	3	3	PC
CE19603	Foundation Engineering	3	0	0	3	3	PC
CE19604	Waste Water Engineering	3	0	0	3	3	PC
CE19P6_	Professional Elective I	3	0	0	3	3	PE
CE19P6_	Professional Elective II	3	0	0	3	3	PE
CE19611	Industrial Internship*	0	0	2	2	1	EEC

CE19612	Water and Waste Water Analysis Laboratory	0	0	2	2	1	PC
CE19613	Innovation and Design thinking for Civil Engineers	0	0	4	4	2	EEC
CE19614	Highway Engineering Laboratory	0	0	2	2	1	PC
GE19621	Problem solving techniques	0	0	2	2	1	EEC
TOTAL		**17**	**2**	**12**	**31**	**25**	

(* Two weeks at the end of Semester V)

SEMESTER VII

Course Code	Course Title	Periods /Week				Credits	CAT
		L	T	P	Total		
CE19701	Estimation and Quantity Surveying	3	0	0	3	3	PC
CE19702	Water Resources and Irrigation Engineering	3	0	0	3	3	PC
CE19P7_	Professional Elective III	3	0	0	3	3	PE
CE19P7_	Professional Elective IV	3	0	0	3	3	PE
CE19711	Computer Aided design and Drafting Laboratory	0	0	4	4	2	PC
CE19712	Creative and Innovative Project	0	0	6	6	3	EEC
CE19713	Comprehension in Civil Engineering	0	0	2	2	1	EEC
TOTAL		**12**	**0**	**12**	**24**	**18**	

SEMESTER VIII

Course Code	Course Title	Periods /Week				Credits	CAT
		L	T	P	Total		
CE19801	Construction Economics and Project Management	3	0	0	3	3	PC
CE19P8_	Professional Elective V	3	0	0	3	3	PE
CE19P8_	Professional Elective VI	3	0	0	3	3	PE
CE19811	Project	0	0	12	12	6	EEC
TOTAL		**9**	**0**	**12**	**21**	**15**	

PROFESSIONAL ELECTIVES
SEMESTER VI
ELECTIVE – I

Course Code	Course Title	Periods /Week				Credits	CAT
		L	T	P	Total		
CE19P61	Remote Sensing and Geographic Information System	3	0	0	3	3	PE
CE19P62	Concrete Technology	3	0	0	3	3	PE
CE19P63	Environmental and Social Impact Assessment	3	0	0	3	3	PE
CE19P64	Advanced Surveying	3	0	0	3	3	PE
CE19P65	Non Destructive Testing of Materials	3	0	0	3	3	PE

SEMESTER VI
ELECTIVE – II

Course Code	Course Title	Periods /Week				Credits	CAT
		L	T	P	Total		
CE19P66	Construction Equipment	3	0	0	3	3	PE
CE19P67	Railways, Airports and Harbour Engineering	3	0	0	3	3	PE
CE19P68	Urban Planning and Development	3	0	0	3	3	PE
CE19P69	Transport and Environment	3	0	0	3	3	PE

SEMESTER VII
ELECTIVE – III

Course Code	Course Title	Periods /Week				Credits	CAT
		L	T	P	Total		
CE19P71	Prestressed Concrete Structures	3	0	0	3	3	PE
CE19P72	Bridge Structures	3	0	0	3	3	PE
CE19P73	Tall Structures	3	0	0	3	3	PE
CE19P74	Coastal Engineering	3	0	0	3	3	PE
CE19P75	Global Climatic Change	3	0	0	3	3	PE

SEMESTER VII
ELECTIVE – IV

Course Code	Course Title	Periods /Week				Credits	CAT
		L	T	P	Total		
CE19P76	Structural Dynamics and Earthquake Engineering	3	0	0	3	3	PE
CE19P77	Computer Aided Design of Structures	3	0	0	3	3	PE
CE19P78	Air Pollution and Control Engineering	3	0	0	3	3	PE
CE19P79	Rock Mechanics	3	0	0	3	3	PE

SEMESTER VIII
ELECTIVE – V

Course Code	Course Title	Periods /Week				Credits	CAT
		L	T	P	Total		
CE19P81	Ground Water Engineering	3	0	0	3	3	PE
CE19P82	Hydrology	3	0	0	3	3	PE
CE19P83	Participatory Water Resource Management	3	0	0	3	3	PE
CE19P84	Ground Improvement Techniques	3	0	0	3	3	PE
CE19P85	Climate Change and Vulnerability Assessment	3	0	0	3	3	PE

SEMESTER VIII
ELECTIVE –VI

Course Code	Course Title	Periods /Week				Credits	CAT
		L	T	P	Total		
CE19P86	Maintenance, Repair and Rehabilitation of Structures	3	0	0	3	3	PE
CE19P87	Prefabricated Structures	3	0	0	3	3	PE
CE19P88	Municipal Solid waste Management	3	0	0	3	3	PE
CE19P89	Industrial Waste Water Treatment	3	0	0	3	3	PE

Summary

SEMESTER	HS	BS	ES	PC	EEC	PE	OE	TOTAL
I	3	8	5					16
II		8	12	2				22
III		7		16				23
IV		4		13	1		3	21
V				18	1		3	22
VI				15	4	6		25
VII				8	4	6		18
VIII				3	6	6		15
Total	**3**	**27**	**17**	**75**	**16**	**18**	**6**	**162**

SEMESTER I

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
HS19151	**TECHNICAL ENGLISH** **Common to all branches of B.E./ B.Tech programmes – I semester**	**HS**	**2**	**1**	**0**	**3**

Objectives:

- To enable learners to acquire basic proficiency in English reading and listening.
- To write in English precisely and effectively.
- To speak flawlessly in all kinds of communicative contexts.

UNIT-I	**VOCABULARY BUILDING**	**9**

The concept of word formation - Root words from foreign languages and their use in English - Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives - Synonyms, antonyms, and standard abbreviations. Compound words – abbreviation – single word substitution – **Listening:** Listening comprehension, listening to motivational speeches, podcasts and poetry. **Speaking:** Short talks on incidents - place of visit – admiring personalities, etc.

UNIT-II	**BASIC WRITING SKILLS**	**9**

Sentence structures - Use of phrases and clauses in sentences - punctuation - coherence - Organizing principles of paragraphs in documents - Techniques for writing precisely. **Reading & Writing** – Free writing – paragraphs - article reading and writing criticism - change of tense forms in short text or story – inferential reading – rewrite or interpret text - prepare questions based on the text. **Speaking:** Everyday situations – conversations and dialogues, speaking for and against.

UNIT-III	**GRAMMAR AND LANGUAGE DEVELOPMENT**	**9**

Subject-verb agreement- Noun-pronoun agreement - Articles – Prepositions – Redundancies. **Reading & Writing:** Read from innovation and ideas that changed the world, newspaper column writing – **Speaking:** Demonstrative speaking practice using visual aids (charts, graphs, maps, pictures, etc.).

UNIT-IV	**WRITING FOR FORMAL PRESENTATION**	**9**

Nature and Style of sensible Writing - Describing – Defining – Classifying - Providing examples or evidence - Writing introduction and conclusion. Reading & Writing – Read from Literary pieces – identify different parts text – difference between print and digital writing. Writing: Recommendations - Foreword - Review of book. Speaking- Formal Presentations – Debate on social issues/taboos and solutions.

UNIT-V	**EXTENDED WRITING AND SPEAKING**	**9**

Writing: Précis writing – Essay writing – workplace communication: Resume – Business letters and emails – Proposals. Speaking: Panel discussion – reporting an event – mock interview – Master Ceremony.

Total Contact Hours	**:**	**45**

Course Outcomes:

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

- Discuss and respond to the listening content.
- Read and comprehend different texts and appreciate them.
- Understand structures and techniques of precise writing.

□	Analyze different genres of communication and get familiarized with new words, phrases, and Sentence structures.
□	Write and speak appropriately in varied formal and informal contexts.

Text Book (s):

1	English for Technologists & Engineers, Orient Black Swan Publications, Chennai 2012.

Reference Book (s) / Web links:

1	Technical Communication, Meenakshi Raman &Sangeeta Sharma, Oxford University Press.
2	Effective Communication Skills, Kulbushan Kumar, Khanna Publishing House, Delhi.
3	Communication Skills, Pushplata, Sanjay Kumar, Oxford University Press.
4	Practical English Usage. Michael Swan. OUP. 1995.
5	Remedial English Grammar. F.T. Wood. Macmillan.2007.
6	On Writing Well. William Zinsser. Harper Resource Book. 2001.
7	Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
8	Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press.

HS19151	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	1	-	-	-	-	-	1	-	2	3	1	3	-	-	1
CO 2	-	3	-	2	-	-	-	-	-	2	1	1	1	1	1
CO 3	-	-	-	1	-	-	-	-	-	3	-	-	1	1	1
CO 4	-	1	-	1	-	-	-	-	-	3	-	2	-	-	1
CO 5	1	1	1	1	1	1	1	1	2	3	1	1	1	1	1
Average	**0.4**	**1**	**0.2**	**1**	**0.2**	**0.2**	**0.4**	**0.2**	**0.8**	**2.8**	**0.6**	**1.2**	**0.6**	**0.6**	**1**

Subject Code	Subject Name	Category	L	T	P	C
MA19151	**ALGEBRA AND CALCULUS** **Common to I sem. B.E. – Aeronautical Engineering ,Automobile Engineering, Civil Engineering, Mechatronics & Mechanical Engineering**	**BS**	**3**	**1**	**0**	**4**

Objectives:

●	To gain knowledge in using matrix algebra techniques and the limitations of using infinite series approximations for those problems arising in mathematical modelling.
●	To understand the techniques of calculus which are applied in the Engineering problems.

UNIT-I	**MATRICES**	**12**

Symmetric and skew – symmetric matrices , orthogonal matrices – Eigen values and Eigen vectors - Cayley – Hamilton theorem (without proof) and applications - orthogonal transformation and quadratic forms to canonical forms - Nature of quadratic forms.

UNIT-II	**SEQUENCES AND SERIES**	**12**

Convergence of sequence and series – Test for convergence: Comparison Test, D'Alembert Ratio Test, Leibnitz Test, Integral test – Binomial series, Exponential series and logarithmic series: Summations and approximations.

UNIT-III	**APPLICATIONS OF DIFFERENTIAL CALCULUS**	**12**

Curvature in Cartesian co-ordinates – Centre and radius of curvature – Circle of curvature – Evolutes – Envelopes - Evolute as envelope of normals.

UNIT-IV	**FUNCTIONS OF SEVERAL VARIABLES**	**12**

Partial differentiation – Homogeneous functions and Euler's theorem – Total derivative – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor's series for functions of two variables – Maxima and minima of functions of two variables – Lagrange's method of undetermined multipliers.		
UNIT-V	**APPLICATION OF INTEGRATION**	**12**
Centre of Gravity – Moment of inertia - Double integrals in Cartesian and polar coordinates – Change of order of integration - Area of a curved surface - Triple integrals – Volume of Solids.		
	Total Contact Hours :	**60**

Course Outcomes:

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

- Apply the concept of Eigenvalues and eigenvectors, diagonalization of a matrix for solving problems.
- Develop skills in solving problems involving sequences and series.
- Analyze, sketch and study the properties of different curves.
- Analyze, sketch and study the properties of different curves and to handle functions of several variables and problems of maxima and minima.
- Obtain the centre of gravity, moment of inertia for rigid bodies and also surface area and volume using multiple integrals.

Text Book (s):

1. Grewal B.S., " Higher Engineering Mathematics ", Khanna Publishers, New Delhi, 43rd Edition, 2014.
2. T Veerarajan, Engineering Mathematics –I , Mc Graw Hill Education, 2014.

Reference Book (s) / Web links:

1. Ramana. B.V., " Higher Engineering Mathematics ", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.
2. Erwin Kreyszig ," Advanced Engineering Mathematics ", John Wiley and Sons, 10th Edition, New Delhi, 2016.
3. Bali, N.P. and Manish Goyal, A Text Book of Engineering Mathematics, Lakshmi Publications Pvt. Ltd., New Delhi, 2006.

MA19151	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	3	3	3	1	-	-	-	-	2	2	3	3	1
CO 2	3	3	3	3	2	1	-	-	-	-	-	2	3	3	1
CO 3	3	3	3	3	3	1	1	-	-	-	2	3	3	3	1
CO 4	3	3	3	3	3	1	1	-	-	-	2	2	3	3	1
CO 5	3	3	3	3	3	1	-	-	-	-	1	2	3	3	1
Average	**3**	**3**	**3**	**3**	**2.8**	**1**	**1**	**-**	**-**	**-**	**1.8**	**2.2**	**3**	**3**	**1**

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
PH19141	**PHYSICS OF MATERIALS** **Common to I sem. B.E. – Aeronautical Engineering, Automobile Engineering, Civil Engineering, Mechanical Engineering & Mechatronics**	BS	3	0	2	4

Objectives:

- To enhance the fundamental knowledge in Physics and its applications relevant to mechanical engineering streams.
- To familiarize students in various experimental setups and instruments that are used to study / determine the various properties of materials.

UNIT-I	MECHANICS & PROPERTIES OF MATTER	9

Basic definitions - Newton's laws – forces -solving Newton's equations - constraints and friction - cylindrical and spherical coordinates - potential energy function - conservative and non-conservative forces - central forces - conservation of angular momentum - non-inertial frames of reference - rotating coordinate system - centripetal and coriolis accelerations – Elasticity - stress-strain diagram - bending of beams - cantilever depression - Young's modulus determination - I-shape girders.

UNIT-II	CRYSTAL PHYSICS	9

Basis – lattices - symmetry operations and crystal systems -Bravaislattics - atomic radius and packing fraction - SC, BCC, FCC, HCP lattices - Miller indices - diffraction by crystals - reciprocal lattice - interpreting diffraction patterns - crystal growth techniques-Czochralski and Bridgmann, crystal defects.

UNIT-III	PHYSICS OF MATERIALS	9

Solid solutions - Hume-Rothery's rules –Gibb's phase rule - binary phase diagrams -isomporhpus systems - tie-line and lever rule - eutectic, eutectoid, peritectic, peritectoid, monotectic and syntectic systems - formation of microstructures - homogeneous and non-homogenous cooling – nucleation - iron-carbon phase diagram - eutectoid steel - hypo and hypereutectoid steel – diffusion - Fick's laws – T-T-T diagrams.

UNIT-IV	ENGINEERING MATERIALS & TESTING	9

Metallic glasses – preparation and properties - Ceramics – types, manufacturing methods and properties - Composites – types and properties - Shape memory alloys – properties and applications - Nano-materials – top down and bottom up approaches – properties - Tensile strength – Hardness – Fatigue - Impact strength – Creep - Fracture – types of fracture.

UNIT-V	QUANTUM PHYSICS	9

Blackbody problem -Planck's radiation law - duality of light -De Broglie hypothesis - properties of matter waves - wave packets –Schrodinger's equations (time dependent and time independent) - Born interpretation (physical significance of wave function) - probability current - operator formalism (qualitative) - expectation values - uncertainty principle - particle in a box -eigen function and eigen values -Dirac notation (qualitative).

	Contact Hours	:	45

List of Experiments

1	Determination of Laser characteristics (wavelength and angular spread).
2	Determination of Young's modulus by non-uniform bending method

3	Determination of thermal conductivity of a bad conductor – Lee's Disc method.
4	Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer
5	Coupled oscillators - Two compound pendulums;
6	Experiment on moment of inertia measurement- Torsional pendulum by resonance,
7	LC circuit, LCR circuit and Resonance phenomena in LCR circuits;
8	Experiments on electromagnetic induction – BH-Curve experiment
9	Determination of thickness of a thin wire – Air wedge method
10	Determination of solar cell characteristics.
11	Measurement of hysteresis loss:B -H curve.
12	Determination of creep characteristics of a metallic wire

Contact Hours	**:**	**30**
Total Contact Hours	**:**	**75**

Course Outcomes:

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

□	Understand foundational mechanics and elastic nature of materials and determine the elastic moduli of materials.
□	Apply the basic knowledge of crystallography in materials preparation and treatments.
□	Create binary phase diagrams and TTT charts and use them to analyse and measure the properties of alloys.
□	Understand various engineering materials, test or measure their properties and use them in suitable applications.
□	Understand the concepts of quantum theory and the nature of light and determine the characteristics of a given laser source.

Text Book (s):

1	Bhattacharya, D.K. &Poonam, T. *"Engineering Physics".* Oxford University Press, 2018.
2	Raghavan, V. *"Physical Metallurgy: Principles and Practice"*. PHI Learning, 2019.

Reference Book (s) / Web links:

1	Balasubramaniam, R. *"Callister's Materials Science and Engineering".* Wiley India Pvt. Ltd., 2017.
2	Raghavan, V. *"Materials Science and Engineering: A First course"*. PHI Learning, 2019.
3	Resnick, R., Halliday, D., & Walker, J. *"Principles of Physics*", Wiley India Pvt., 2018.
4	Gaur, R.K. & Gupta, S.L. *"Engineering Physics".*DhanpatRai Publishers, 2018.

PH19141	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO 1	3	3	3	2	1	1	1	1	2	1	1	2	1	2	1
CO 2	3	3	3	2	1	1	1	1	2	1	1	2	1	2	1
CO 3	3	3	3	2	1	1	1	1	2	1	1	2	1	2	1
CO 4	3	3	2	2	1	1	1	1	2	1	1	2	1	2	1
CO 5	3	3	2	2	1	1	1	-	2	1	1	2	1	2	1
Average	**3**	**3**	**2.6**	**2**	**1**	**1**	**1**	**1**	**2**	**1**	**1**	**2**	**1**	**2**	**1**

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
GE19101	ENGINEERING GRAPHICS Common to all	ES	2	2	0	4

Objectives:

□	To understand the importance of the drawing in engineering applications.
□	To develop graphic skills for communication of concepts, ideas and design of engineering Products.
□	To expose them to existing national standards related to technical drawings.
□	To improve their visualization skills so that they can apply these skill in developing new products.
□	To improve their technical communication skill in the form of communicative drawings.

CONCEPTS AND CONVENTIONS (Not for Examination) **1**

Importance of graphics in engineering applications–Use of drafting instruments– BIS conventions and specifications–Size, layout and folding of drawing sheets– Lettering and dimensioning. Basic Geometrical constructions.

UNIT-I	PLANECURVES AND FREE HAND SKETCH	11

Curves used in engineering practices: Conics–Construction of ellipse, parabola and hyperbola by eccentricity method– Construction of cycloids, Construction of involutes of square and circle drawing of tangents and normal to the above curves.

Visualization concepts and Free Hand sketching: Visualization principles –Representation ofThree Dimensional objects – Layout of views- Freehand sketching of multiple views from pictorial views of objects

UNIT-II	PROJECTION OFPOINTS, LINES AND PLANE SURFACE	12

Orthographic projection- principles-Principal planes- projection of points. First angle projection - Projection of straight lines inclined to both the principal planes – Determination of true lengths and true inclinations by rotating line method- Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT-III	PROJECTION OF SOLIDS	12

Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one of the principal planes by rotating object method.

UNIT-IV	PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES	12

Sectioning of solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of the section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones.

UNIT-V	ISOMETRIC AND PERSPECTIVE PROJECTIONS	12

Principles of isometric projection–isometric scale–Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders and cones. Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method.

Total Contact Hours	**:**	**60**

Course Outcomes:

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

□	To construct different plane curves and free hand sketching of multiple views from pictorial objects.

□	To comprehend the theory of projection and to draw the basic views related to projection of points, lines and planes.
□	To draw the projection of solids in different views.
□	To draw the projection of Sectioned solids and development of surfaces of solids.
□	To visualize and prepare Isometric and Perspective view of simple solids.
Text Book (s):	
1	Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 50th Edition, 2010.
2	Natrajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2017.
Reference Book (s) / Web links:	
1	Varghese P I., "Engineering Graphics", McGraw Hill Education (I) Pvt. Ltd., 2013.
2	Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P)Limited, 2008.
3	Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Stores, Bangalore, 2017.
4	Basant Agarwal and Agarwal C.M., "Engineering Drawing", McGraw Hill Publishing Company Limited, New Delhi, 2018.

GE19101	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	-	-	-	-	-	-	-	-	1	-	2	-	-	-
CO 2	2	-	-	-	-	-	-	-	-	1	-	2	-	-	-
CO 3	2	-	-	-	-	-	-	-	-	1	-	2	-	-	-
CO 4	2	-	-	-	-	-	-	-	-	1	-	2	-	-	-
CO 5	2	-	-	-	-	-	-	-	-	1	-	2	-	-	-
Average	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**2**	**-**	**-**	**-**

Subject Code	Subject Name (Laboratory Course)	Category	L	T	P	C
GE19121	**ENGINEERING PRACTICES - Civil and Mechanical**	**ES**	**0**	**0**	**2**	**1**

Objectives:

To provide exposure to the students with hands on experience on various basic engineering practices in Civil and Mechanical Engineering.

List of Experiments

CIVIL ENGINEERING PRACTICE	
1.	Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, and elbows in household fittings.
2.	Preparation of basic plumbing line sketches for wash basins, water heaters, etc.
3.	Hands-on-exercise: Basic pipe connections – Pipe connections with different joining components.
Carpentry Works:	
4.	Study of joints in roofs, doors, windows and furniture.
5.	Hands-on-exercise: Woodwork, joints by sawing, planning and chiselling.
MECHANICAL ENGINEERING PRACTICE	
6.	Preparation of butt joints, lap joints and T- joints by Shielded metal arc welding.

7	Gas welding practice.			
Basic Machining:				
8	Simple Turning and Taper turning			
9	Drilling Practice			
Sheet Metal Work:				
10	Forming & Bending:			
11	Model making – Trays and funnels			
12	Different type of joints.			
Machine Assembly Practice:				
13	Study of centrifugal pump			
14	Study of air conditioner			
		Total Contact Hours	**:**	**30**

Course Outcomes:

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

- Perform plumbing activities for residential and industrial buildings considering safety aspects while gaining clear understanding on pipeline location and functions of joints like valves, taps, couplings, unions, reducers, elbows, etc.
- Perform wood working carpentry activities like sawing, planning, cutting, etc. while having clear understanding of the joints in roofs, doors, windows and furniture.
- Produce joints like L joint, T joint, Lap joint, Butt joint, etc. through arc welding process while acquiring in depth knowledge in the principle of operation of welding and other accessories
- Perform operations like Turning, Step turning, Taper turning, etc. in lathe and Drilling operation in drilling machine
- Perform sheet metal operations like Forming, Bending, etc. and fabricating models like Trays, funnels, etc.

GE19121	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	1	-	-	-	-	1	-	-	-	-	-	1	2	-	2
CO 2	1	-	-	-	-	1	-	-	-	-	-	1	2	-	2
CO 3	1	-	-	-	-	1	-	-	-	-	-	1	2	-	2
CO 4	1	-	-	-	-	1	-	-	-	-	-	1	2	-	2
CO 5	1	-	-	-	-	1	-	-	-	-	-	1	2	-	2
Average	**1**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**2**	**-**	**2**

Subject Code	Subject Name	Category	L	T	P	C
MC19101	**ENVIROMENTAL SCIENCE AND ENGINEERING**	**MC**	**3**	**0**	**0**	**0**

Common to I sem. B.E. – Aeronautical Engineering, Automobile Engineering, Biomedical Engineering, Civil Engineering, Mechanical Engineering & Mechatronics
B.Tech. – Biotechnology, Chemical Engineering & Food Technology
and
Common to II sem. B.E. – Computer Science and Engineering, Electrical and Communication Engineering & Electrical and Electronics Engineering
B.Tech. – Information Technology

Objectives:		
□	To understand the importance of natural resources, pollution control and waste management.	
□	To provide the students about the current social issues and environmental legislations.	
UNIT-I	**NATURAL RESOURCES**	**9**
Environment -definition - scope and importance - forest resources -use and overexploitation -water resources -use and over utilization - dams - benefits and problems - water conservation -energy resources - growing energy needs - renewable and non-renewable energy sources - use of alternate energy sources -land resources -land degradation - role of an individual in conservation of natural resources.		
UNIT-II	**ENVIRONMENTAL POLLUTION**	**9**
Definition - causes, effects and control measures of air pollution -chemical and photochemical reactions in the atmosphere - formation of smog, PAN, acid rain, and ozone depletion- noise pollution -mitigation procedures - control of particulate and gaseous emission(Control of SO_2, NOX, CO and HC). Water pollution - definition-causes-effects of water pollutants–marine pollution-thermal pollution-radioactive pollution-control of water pollution by physical, chemical and biological processes–waste water treatment-primary, secondary and tertiary treatment. Soil pollution: definition-causes-effects and control of soil pollution.		
UNIT-III	**SOLID WASTE MANAGEMENT**	**9**
Solid wastes - sources and classification of solid wastes -solid waste management options - sanitary landfill, recycling, composting, incineration, energy recovery options from wastes Hazardous waste -definition -sources of hazardous waste-classification (biomedical waste, radioactive waste, chemical waste, household hazardous waste)-characteristics of hazardous waste ignitability (flammable) reactivity, corrosivity, toxicity -effects of hazardous waste -case study- bhopal gas tragedy - disposal of hazardous waste-recycling , neutralization, incineration, pyrolysis, secured landfill - E-waste management -definition-sources-effects -electronic waste recycling technology.		
UNIT-IV	**SOCIAL ISSUES AND THE ENVIRONMENT**	**9**
Sustainable development -concept, components and strategies - social impact of growing human population and affluence, food security, hunger, poverty, malnutrition, famine - consumerism and waste products - environment and human health - role of information technology in environment and human health -disaster management– floods, earthquake, cyclone and landslide.		
UNIT-V	**TOOLS FOR ENVIRONMENTAL MANAGEMENT**	**9**
Environmental impact assessment (EIA) structure -strategies for risk assessment–EIS-environmental audit-ISO 14000-precautionary principle and polluter pays principle- constitutional provisions- - pollution control boards and pollution control acts- environmental protection act1986- role of non-government organisations- international conventions and protocols.		
	Contact Hours :	**45**
Course Outcomes:		
On completion of the course, the students will be able to		
□	Be conversant to utilize resources in a sustainable manner.	
□	Find ways to protect the environment and play proactive roles.	
□	Apply the strategies to handle different wastes.	
□	Develop and improve the standard of better living.	
□	Be conversant with tools of EIA and environmental legislation.	
Text Book (s):		

1	Benny Joseph, "Environmental Science and Engineering", 2nd edition, Tata McGraw-Hill, New Delhi,2008.
2	Gilbert M.Masters, "Introduction to Environmental Engineering and Science", 2nd edition, Pearson Education, 2004.
Reference Book (s) / Web links:	
1	Dharmendra S. Sengar, "Environmental law", Prentice hall of India Pvt Ltd, New Delhi,2007.
2	ErachBharucha, "Textbook of Environmental Studies", 3rd edition, Universities Press(I) Pvt Ltd, Hydrabad, 2015.,
3	G. Tyler Miller and Scott E. Spoolman, "Environmental Science", 15th edition, CengageLearning India PVT, LTD, Delhi, 2014.
4	Rajagopalan, R, "Environmental Studies-From Crisis to Cure", 3rdedition,Oxford University Press,2015.
5	De. A.K., "Environmental Chemistry", New Age International, New Delhi,1996.
6	K. D. Wager, Environmental Management, W. B. Saunders Co., Philadelphia, USA, 1998.

MC19101	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO 1	3	3	3	2	2	3	3	3	2	2	2	3	3	2	3
CO 2	3	3	3	3	2	3	3	3	2	2	3	3	3	2	3
CO 3	3	3	3	3	2	3	3	3	2	2	3	3	2	2	2
CO 4	3	3	3	2	2	3	3	3	2	2	2	3	2	2	2
CO 5	3	2	2	2	2	3	3	3	2	2	2	2	2	2	2
Average	**3**	**2.8**	**2.8**	**2.4**	**2**	**3**	**3**	**3**	**2**	**2**	**2.4**	**2.8**	**2.4**	**2**	**2.4**

SEMESTER II

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**C**
MA19251	**DIFFERENTIAL EQUATIONS AND VECTOR CALCULUS**	**BS**	**3**	**1**	**0**	**4**

Common to II sem. B.E. – Aeronautical Engineering, Automobile Engineering, Civil Engineering, Mechatronics & Mechanical Engineering
B. Tech. - Biotechnology, Food Technology & Chemical Engineering

Objectives:

- To handle practical problems arising in the field of engineering and technology using differential equations.
- To solve problems using the concept of Vectors calculus, Complex analysis, Laplace transforms.

UNIT-I	**SECOND AND HIGHER ORDER DIFFERENTIAL EQUATIONS**	**12**

Second and higher order Linear differential equations with constant coefficients - Method of variation of parameters – Cauchy's and Legendre's linear equations - Simultaneous first order linear equations with constant coefficients.

UNIT-II	**PARTIAL DIFFERENTIAL EQUATIONS**	**12**

Formation of partial differential equations - Solutions of standard types of first order partial differential equations - Lagrange's linear equation -- Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types.

UNIT-III	**VECTOR CALCULUS**	**12**

Gradient, divergence and curl – Directional derivative – Irrotational and solenoidal vector fields –

Vector integration – Green's theorem in a plane, Gauss divergence theorem and Stokes' theorem (excluding proofs) – Simple applications involving cubes and rectangular parallelopipeds.		
UNIT-IV	**ANALYTIC FUNCTIONS**	**12**
Analytic functions – Necessary and sufficient conditions for analyticity in Cartesian and polar coordinates - Properties – Harmonic conjugates – Construction of analytic function - Conformal mapping and Bilinear transformation-Cauchy's integral theorem and Cauchy's integral formula (proof excluded) – Taylor's series and Laurent's series – Singularities – Residues – Residue theorem (without proof), simple problems.		
UNIT-V	**LAPLACE TRANSFORM**	**12**
Laplace transform – Sufficient condition for existence – Transform of elementary functions – Basic properties – Transforms of derivatives and integrals of functions - Derivatives and integrals of transforms - Transforms of unit step function and impulse functions, periodic functions. Inverse Laplace transform – Problems using Convolution theorem – Initial and final value theorems – Solution of linear ODE of second order with constant coefficients using Laplace transformation techniques.		
	Total Contact Hours :	**60**

Course Outcomes:

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

□	Apply various techniques in solving ordinary differential equations.
□	Develop skills to solve different types of partial differential equations
□	Use the concept of Gradient, divergence and curl to evaluate line, surface and volume integrals.
□	Use the concept of Analytic functions, conformal mapping and complex integration for solving Engineering problems.
□	Use Laplace transform and inverse transform techniques in solving differential equations.

Text Book (s):

1	Grewal B.S., " Higher Engineering Mathematics ", Khanna Publishers, New Delhi, 43rd Edition, 2014.
2	T Veerarajan, Engineering Mathematics –II , McGraw Hill Education, 2018

Reference Book (s) / Web links:

1	Ramana. B.V., "Higher Engineering Mathematics ", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.
2	Erwin Kreyszig ," Advanced Engineering Mathematics ", John Wiley and Sons, 10th Edition, New Delhi, 2016.
3	Bali, N.P. and Manish Goyal, A Text Book of Engineering Mathematics, Lakshmi Publications Pvt. Ltd., New Delhi, 2006.
4	T Veerarajan, Transforms and Partial Differential Equations, Third Edition, 2018.

MA19251	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	3	3	3	2	-	-	-	-	2	2	3	3	-
CO 2	3	3	3	3	3	2	-	-	-	-	2	2	3	3	-
CO 3	3	3	3	3	2	1	-	-	-	-	2	2	3	2	-
CO 4	3	3	2	2	2	1	-	-	-	-	1	1	3	2	-
CO 5	3	3	2	2	2	1	-	-	-	-	1	1	3	2	-
Average	**3**	**3**	**2.6**	**2.6**	**2.4**	**1.4**	**-**	**-**	**-**	**-**	**1.6**	**1.6**	**3**	**2.4**	**-**

Subject Code	Subject Name	Category	L	T	P	C
CY19143	APPLIED CHEMISTRY	BS	3	0	2	4

Common to I sem. B.E. – Electrical and Electronics Engineering & Computer Science Engineering and B.Tech. – Information Technology
II sem. B.E. – Civil Engineering

Objectives:

- To acquire theoretical and practical knowledge on water quality parameters.
- To understand the principles of electrochemistry, corrosion and in turn construction of batteries.
- To get familiarized with engineering materials including polymers.

UNIT-I	WATER TECHNOLOGY	9

Water quality parameters - physical, chemical &biological significance- BOD, COD- definition significance - estimation of hardness by EDTA method - boiler feed water – boiler troubles - softening of water - zeolite process - demineralization process - internal treatment methods - specifications for drinking water BIS - WHO standards - treatment of water for domestic use - desalination - reverse osmosis -electrodialysis – UASB process.

UNIT-II	ELECTROCHEMISTRY AND CORROSION	9

Electrode potential - electrodes - standard and reference electrodes, glass electrode. Nernst equation - emf series–applications. Galvanic cells and concentration cells-applications-pH measurement, acid-base titration, potentiometric redox titration – conductometric titrations. Corrosion - causes-effects of corrosion - theories of chemical and electrochemical corrosion – types of corrosion – galvanic, water-line, intergranular and pitting corrosion - passivity - factors affecting rate of corrosion - corrosion control methods -cathodic protection-sacrificial anode and impressed current cathodic protection.

UNIT-III	BATTERIES AND FUEL CELLS	9

Batteries- types - characteristics-fabrication and working of lead-acid battery- NICAD battery - lithium ion batteries - supercapacitors- introduction - types - electrochemical double layer capacitor - activated carbon - carbon aerogels. Fuel cells - classification – principle,working and applications of hydrogen-oxygen fuel cell - solid oxide fuel cell - direct methanol fuel cell and proton exchange membrane fuel cells-biofuel cells.

UNIT-IV	POLYMERS	9

Introduction to thermoplastics and thermosetting plastics- phenolic and epoxy resins – silicone polymers– polyelectrolytes - polymers with piezoelectric, pyroelectric and ferroelectric properties-photonic polymers -photo resists - conducting polymers - polyaniline, polypyrrole - preparation, structure, properties and applications - liquid crystals -classification, chemical constitution, liquid crystalline polymers-applications in displays- introduction to OLED.

UNIT-V	ENGINEERING MATERIALS	9

Composite materials - definition - classification - fibers - types - properties - matrix - properties - applications of composites - advantages and limitations of composites. Lubricants - definition - characteristics of lubricants-theories of lubrication –properties- viscosity, viscosity index, oiliness, pour point and cloud point, flash point and fire point - additives to lubricants - solid lubricants.

	Contact Hours	:	45

List of Experiments

1	Estimation of mixture of acids by conductometry.
2	Estimation of extent of corrosion of iron pieces by potentiometry.
3	Estimation of the extent of dissolution of copper / ferrous ions by spectrophotometry.

4	Estimation of acid by pH metry.
5	Determination of total, temporary and permanent hardness by EDTA method.
6	Estimation of DO by winkler's method.
7	Estimation of alkalinity by indicator method.
8	Estimation of chloride by argentometric method
9	Estimation of sodium and potassium in water by flame photometry.
10	Determination of flash and fire point of lubricating oil
11	Determination of cloud and pour point of lubricating oil
12	Determination of corrosion rate on mild steel by weight loss method
13	Determination of molecular weight of a polymer by viscometry method.
14	Adsorption of acetic acid by charcoal
15	Determination of phase change temperature of a solid.

	Contact Hours	**:**	**30**
	Total Contact Hours	**:**	**75**

Course Outcomes:

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

□	Analyze the quality of water practically.
□	Apply the knowledge of electrochemistry on corrosion and its control.
□	Be assertive on types of batteries and fuel cells.
□	Apply the knowledge of different types of polymers in various fields.
□	Be conversant on the types of composites and lubricants used in engineering industry.

Text Book (s):

1	P. C. Jain and Monika Jain, "Engineering Chemistry", Dhanpat Rai Publishing Company (P) Ltd,New Delhi, 2015
2	O.G.Palanna, "Engineering Chemistry", McGraw Hill Education (India) PVT, Ltd, New Delhi, 2017

Reference Book (s) / Web links:

1	Gowarikar V. R., Viswanathan N.V. and JayadevSreedhar, "Polymer Science", New Age International (P) Ltd, New Delhi, 2011
2	ShashiChawla, "A Text Book of Engineering Chemistry", DhanpatRai& Co, New Delhi, 2005
3	F.W. Billmayer,"Textbook of Polymer Science", 3rd Edn, Wiley. N.Y. 2007.

CY19143	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO 1	1	2	3	3	2	2	3	1	3	3	2	2	3	2	2
CO 2	2	2	2	1	2	1	2	1	2	2	2	2	2	3	3
CO 3	1	1	1	2	1	1	2	1	2	1	1	2	2	1	1
CO 4	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1
CO 5	3	2	1	2	2	2	2	1	2	2	1	3	2	2	2
Average	**1.6**	**1.6**	**1.6**	**1.8**	**1.8**	**1.4**	**2**	**1**	**2**	**1.8**	**1.4**	**2**	**2**	**1.8**	**1.8**

Subject Code	Subject Name (Lab oriented Theory Course)	Category	L	T	P	C
GE19141	PROGRAMMING USING C	ES	2	0	4	4

Objectives:

- To develop simple algorithms for arithmetic and logical problems.
- To develop C Programs using basic programming constructs.
- To develop C programs using arrays and strings.
- To develop applications in C using functions, pointers and structures.
- To do input/output and file handling in C.

UNIT-I	**GENERAL PROBLEM SOLVING CONCEPTS**	**6**

Computer – components of a computer system-Algorithm and Flowchart for problem solving with Sequential Logic Structure, Decisions and Loops.

UNIT-II	**C LANGUAGE - TYPES OF OPERATOR AND EXPRESSIONS**	**6**

Introduction- C Structure- syntax and constructs of ANSI C - Variable Names, Data Type and Sizes, Constants, Declarations - Arithmetic Operators, Relational Operators, Logical Operators, Type Conversion, Increment and Decrement Operators, Bitwise Operators, Assignment Operators and Expressions, Precedence and Order of Evaluation, proper variable naming and Hungarian Notation.

UNIT-III	**I/O AND CONTROL FLOW**	**6**

Standard I/O, Formatted Output – Printf, Variable-length argument lists- Formatted Input – Scanf, Statements and Blocks, If-Else-If, Switch, Loops – while, do, for, break and continue, GoTo Labels.

UNIT-IV	**FUNCTIONS AND PROGRAM STRUCTURE**	**6**

Basics of functions, parameter passing and returning type, External, Auto, Local, Static, Register Variables, Scope Rules, Block structure, Initialisation, Recursion, C Pre-processor, Standard Library Functions and return types.

UNIT-V	**POINTERS , ARRAYS AND STRUCTURES**	**6**

Pointers and addresses, Pointers and Function Arguments, Pointers and Arrays, Address Arithmetic, character Pointers and Functions, Pointer Arrays, Pointer to Pointer, Multi- dimensional arrays, Strings, Initialisation of Pointer Arrays, Command line arguments, Pointers to functions, complicated declarations. Basic Structures, Structures and Functions, Array of structures, Pointer of Structures, Self-referential Structures, Table look up, Typedef, Unions, Bit- fields, File Access -Error Handling, Line I/O, Miscellaneous Functions.

Contact Hours	**:**	**30**

List of Experiments

1	Algorithm and flowcharts of small problems like GCD.
	Structured code writing with:
2	Small but tricky codes
3	Proper parameter passing
4	Command line Arguments
5	Variable parameter
6	Pointer to functions
7	User defined header
8	Make file utility
9	Multi file program and user defined libraries
10	Interesting substring matching / searching programs
11	Parsing related assignments

Contact Hours	**:**	**60**

	Total Contact Hours	**:**	**90**

Course Outcomes:	
On completion of the course, the students will be able to	
□	To formulate simple algorithms for arithmetic and logical problems.
□	To implement conditional branching, iteration and recursion.
□	To decompose a problem into functions and synthesize a complete program using divide and conquer approach.
□	To use arrays, pointers and structures to formulate algorithms and programs.
□	To apply programming to solve matrix addition and multiplication problems and searching and sorting problems.
Text Book (s):	
1	Brian W. Kernighan and Dennis M. Ritchie, "The C Programming Language", Pearson Education India; 2nd Edition, 2015.
2	Byron Gottfried, "Programming with C", Second Edition, Schaum Outline Series, 1996.
Reference Book (s):	
1	Herbert Schildt, "C: The Complete Reference", Fourth Edition, McGraw Hill, 2017.
2	YashavantKanetkar, "Let Us C", BPB Publications, 15th Edition, 2016.
Web links for virtual lab:	
1	https://www.tutorialspoint.com/compile_c_online.php
2	https://www.codechef.com/ide
3	https://www.jdoodle.com/c-online-compiler
4	https://rextester.com/l/c_online_compiler_gcc

GE19141	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO 1	1	2	2	2	1	-	-	-	1	2	1	1	2	3	-
CO 2	1	1	1	1	1	-	-	-	-	-	1	1	2	2	-
CO 3	1	1	2	1	1	-	-	-	-	-	1	1	2	2	-
CO 4	2	2	3	2	1	-	-	-	1	-	2	1	2	2	2
CO 5	2	2	3	2	1	-	-	-	-	-	2	1	2	2	2
Average	**1.4**	**1.6**	**2.2**	**1.6**	**1.0**	**-**	**-**	**-**	**1.0**	**2.0**	**1.4**	**1.0**	**2.0**	**2.2**	**2.0**

Subject Code	**Subject Name (Lab oriented Theory Courses)**	**Category**	**L**	**T**	**P**	**C**
EE19242	**BASIC ELECTRICAL AND ELECTRONICS ENGINEERING (COMMON TO AERO, CSE, CHEM, CIVIL, FT AND IT)**	**ES**	**3**	**0**	**2**	**4**

Objectives:	
□	To introduce electric circuits and provide knowledge on the analysis of circuits using network theorems.
□	To impart knowledge on the phenomenon of resonance in RC, RL and RLC series and parallel circuits.
□	To provide knowledge on the principles of electrical machines and electronic devices.
□	To learn the concepts of different types of electrical measuring instruments and transducers.

□	To teach methods of experimentally analyzing electrical circuits, electrical machines, electronic devices and transducers.

UNIT-I	**DC CIRCUITS**	**9**

Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff 's current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems.

UNIT-II	**AC CIRCUITS**	**9**

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three phase balanced circuits, voltage and current relations in star and delta connections.

UNIT-III	**ELECTRICAL MACHINES**	**9**

Construction, Principles of operation and characteristics of; DC machines, Transformers (single and three phase), Synchronous machines , three phase and single phase induction motors.

UNIT-IV	**ELECTRONIC DEVICES & CIRCUITS**	**9**

Types of Materials – Silicon & Germanium- N type and P type materials – PN Junction –Forward and Reverse Bias –Semiconductor Diodes –Bipolar Junction Transistor – Characteristics –Field Effect Transistors – Transistor Biasing –Introduction to operational Amplifier –Inverting Amplifier –Non Inverting Amplifier.

UNIT-V	**MEASUREMENTS & INSTRUMENTATION**	**9**

Introduction to transducers - Classification of Transducers: Resistive, Inductive, Capacitive, Thermoelectric, piezoelectric, photoelectric, Hall effect - Classification of instruments - PMMC and MI Ammeters and.Voltmeters – Multimeter -Digital Storage Oscilloscope.

Contact Hours	**:**	**45**

List of Experiments

1	Verification of Kirchhoff's Laws.
2	Load test on DC Shunt Motor .
3	Load test on Single phase Transformer.
4	Load test on Single phase Induction motor.
5	Characteristics of P-N junction Diode.
6	Half wave and Full wave Rectifiers.
7	Characteristics of CE based NPN Transistor.
8	Inverting and Non- Inverting Op-Amp circuits.
9	Characteristics of LVDT, RTD and Thermistor.

Contact Hours	**:**	**30**
Total Contact Hours	**:**	**75**

Course Outcomes:

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

□	Analyse DC and AC circuits and apply circuit theorems.
□	Realize series and parallel resonant circuits.
□	Understand the principles of electrical machines.
□	Understand the principles of different types of electronic devices, electrical measuring instruments and transducers.
□	Experimentally analyze the electric circuits, electrical machines, electronic devices, and transducers.

Text Book (s):

1	J.B.Gupta, "Fundamentals of Electrical Engineering and Electronics" S.K.Kataria& Sons Publications, 2002.

2	D P Kothari and I.J Nagarath, "Basic Electrical and Electronics Engineering", McGraw Hill Education(India) Private Limited, Third Reprint ,2016.
3	Thereja .B.L., "Fundamentals of Electrical Engineering and Electronics", S. Chand & Co. Ltd., 2008.
Reference Book (s) / Web links:	
1	Del Toro, "Electrical Engineering Fundamentals", Pearson Education, New Delhi, 2007.
2	John Bird, "Electrical Circuit Theory and Technology", Elsevier, First Indian Edition, 2006.
3	Allan S Moris, "Measurement and Instrumentation Principles", Elseveir, First Indian Edition, 2006.
4	Rajendra Prasad, "Fundamentals of Electrical Engineering", Prentice Hall of India, 2006.
5	A.E.Fitzgerald, David E Higginbotham and Arvin Grabel, "Basic Electrical Engineering", McGraw Hill Education(India) Private Limited, 2009.

EE19242	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO 1	3	3	3	2	2	-	-	-	1	-	1	-	1	1	1
CO 2	3	3	3	2	2	-	-	-	1	-	1	-	1	1	1
CO 3	3	3	3	2	2	-	-	-	1	-	1	-	1	1	1
CO 4	3	3	3	2	2	-	-	-	1	-	1	-	1	1	1
CO 5	3	3	3	2	2	-	-	-	1	-	1	-	1	1	1
Average	**3**	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**1**	**-**	**1**	**-**	**1**	**1**	**1**

Subject Code	**Subject Name (Theory Course)**	**Category**	**L**	**T**	**P**	**C**
GE19201	**ENGINEERING MECHANICS (Common to Mech, Aero, Auto, Civil and MCT)**	**ES**	**2**	**1**	**0**	**3**

Objectives:

- To understand the basics of mechanics and apply the concept of equilibrium to solve problems of concurrent forces.
- To understand the concept of equilibrium and to solve problems of rigid bodies.
- To learn about the center of gravity and moment of inertia of surfaces and solids.
- To learn the basic concepts of friction.
- To learn the concepts in kinematics and kinetics of rigid bodies in plane motion.

UNIT-I **STATICS OF PARTICLES** **9**

Introduction – Units and Dimensions – Laws of Mechanics – Lami's theorem, Parallelogram and triangular Law of forces – Vectorial representation of forces – Vector operations of forces - additions, subtraction, dot product, cross product – Coplanar Forces – rectangular components – Equilibrium of a particle – Forces in space – Equilibrium of a particle in space – Equivalent systems of forces – Principle of transmissibility.

UNIT-II **EQUILIBRIUM OF RIGID BODIES** **9**

Free body diagram – Types of supports –Action and reaction forces –stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis – Vectorial representation of moments and couples – Scalar components of a moment – Varignon's theorem – Single equivalent force -Equilibrium of Rigid bodies in two dimensions – Equilibrium of Rigid bodies in three dimensions – (Descriptive treatment only).

UNIT-III	PROPERTIES OF SURFACES AND SOLIDS	9
Centroids and centre of mass – Centroids of lines and areas - Rectangular, circular, triangular areas by integration – T section, I section, - Angle section, Hollow section by using standard formula –Theorems of Pappus - Area moments of inertia of plane areas – Rectangular, circular, triangular areas by integration – T section, I section, Angle section, Hollow section by using standard formula – Parallel axis theorem and perpendicular axis theorem – Principal moments of inertia of plane areas – Principal axes of inertia-Mass moment of inertia –mass moment of inertia for prismatic, cylindrical and spherical solids from first principle – Relation to area moments of inertia.		
UNIT-IV	**DYNAMICS OF PARTICLES**	**9**
Displacements, Velocity and acceleration, their relationship – Relative motion – Curvilinear motion - Newton's laws of motion – Work Energy Equation– Impulse and Momentum – Impact of elastic bodies.		
UNIT-V	**FRICTION AND RIGID BODY DYNAMICS**	**9**
Friction force – Laws of sliding friction – equilibrium analysis of simple systems with sliding friction –wedge friction, Ladder friction, Rolling resistance -Translation and Rotation of Rigid Bodies – Velocity and acceleration – General Plane motion of simple rigid bodies such as cylinder, disc/wheel and sphere.		
	Total Contact Hours :	**45**

Course Outcomes:	
On completion of the course, the students will be able to	
□	Comprehend and analysis the forces in the system.
□	Solve problems in engineering systems using the concept of static equilibrium.
□	Determine the centroid of objects such as areas and volumes, center of mass of body and moment of inertia of composite areas.
□	Solve problems involving kinematics and kinetics of rigid bodies in plane motion.
□	Solve problems involving frictional phenomena in machines.

Text Book (s):	
1	Beer, F.P and Johnston Jr. E.R, Cornwell and Sanghi ., "Vector Mechanics for Engineers (In SI Units): Statics and Dynamics", 11thEdition, McGraw-Hill Publishing company, New Delhi (2017).
2	Rajasekaran S and Sankarasubramanian G., "Engineering Mechanics Statics and Dynamics", 3rd Edition, Vikas Publishing House Pvt. Ltd., 2005.

Reference Book (s) / Web links:	
1	Meriam J.L. and Kraige L.G., " Engineering Mechanics- Statics - Volume 1, Dynamics- Volume 2", Third Edition, Wiley India,2017.
2	Hibbeller, R.C and Ashok Gupta, "Engineering Mechanics: Statics and Dynamics", 11th Edition, Pearson Education 2010.
3	Irving H. Shames and Krishna MohanaRao. G., "Engineering Mechanics – Statics and Dynamics" 4thEdition, Pearson Education 2006.
4	S SBhavikatti, Engineering Mechanics, New Age International Publishers, 2016
5	Vela Murali, "Engineering Mechanics", Oxford University Press (2010)

GE19201	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	-	2	-	-	-	-	-	-	-	-	3	1	-	-
CO 2	3	-	2	-	-	-	-	-	-	-	-	3	2	-	-
CO 3	3	-	2	-	-	-	-	-	-	-	-	3	3	-	-

CO 4	3	-	2	-	-	-	-	-	-	-	-	3	1	-	-
CO 5	3	-	2	-	-	-	-	-	-	-	-	3	1	-	-
Average	**3**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**1.6**	**-**	**-**

Subject Code	**Subject Name (Practical Course)**	**Category**	**L**	**T**	**P**	**C**
CE19211	**COMPUTER AIDED BUILDING DRAWING**	**PC**	**0**	**0**	**4**	**2**

Objectives:

- To introduce the students to draft the plan, elevation and sectional views of buildings in accordance with development and control rules satisfying orientation and functional requirements as per National Building Code.

List of Experiments

1	Principles of planning, orientation and complete joinery details (Paneled and Glazed Doors)
2	Buildings with load bearing walls.
3	Buildings with sloping roof.
4	R.C.C. framed structures.
5	Industrial buildings – North light roof structures.
6	BIM

Total Contact : 60

Course Outcomes:

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

- Draft the plan, elevation and sectional views of the buildings, industrial structures, and framed buildings using computer software.

Reference Book (s) / Web links:

1	Chuck Eastman, Paul Teicholz, Rafael Sacks, Kathleen Liston, BIM Hand book: A Guide to building information modeling for Owners, Managers, Designers, Engineers, and Contractors, John Wiley and Sons. Inc., 2011.
2	MarimuthuV.M.,Murugesan R.and PadminiS.,Civil Engineering Drawing-I, Pratheeba Publishers, 2008.
3	Shah.M.G.,Kale. C.M.and Patki.S.Y.,Building Drawing with an Integrated Approach to Built Environment,Tata McGraw Hill Publishers Limited, 2007.
4	Verma.B.P., Civil Engineering Drawing and House Planning, Khanna Publishers, 2010

CE19211	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO 1	3	3	3	3	3	2	2	3	2	1	1	3	1	-	2
CO 2	3	3	3	3	3	2	2	3	2	1	1	3	1	-	2
CO 3	3	3	3	3	3	2	2	3	2	1	1	3	1	-	2
CO 4	3	3	3	3	3	2	2	3	2	1	1	3	1	-	2
CO 5	1	-	-	-	3	-	-	-	-	1	-	3	1	-	-
Average	**2.6**	**2.4**	**2.4**	**2.4**	**3**	**1.6**	**1.6**	**2.4**	**1.6**	**1**	**0.8**	**3**	**1**	**0**	**1.6**

Subject Code	Subject Name (Laboratory Course)	Category	L	T	P	C
GE19122	ENGINEERING PRACTICES - ELECTRICAL AND ELECTRONICS	ES	0	0	2	1

Objectives:

- To provide hands on experience on various basic engineering practices in Electrical Engineering.
- To impart hands on experience on various basic engineering practices in Electronics Engineering.

List of Experiments

A. ELECTRICAL ENGINEERING PRACTICE

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Stair case wiring.
4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.
5. Measurement of resistance to earth of an electrical equipment.

B. ELECTRONICS ENGINEERING PRACTICE

1. Study of Electronic components and equipment's – Resistor, colour coding, measurement of AC signal parameter (peak-peak, rms period, frequency) using CRO.
2. Study of logic gates AND, OR, EOR and NOT.
3. Generation of Clock Signal.
4. Soldering practice – Components Devices and Circuits – Using general purpose PCB.
5. Measurement of ripple factor of HWR and FWR.

Total Contact Hours : 30

Course Outcomes:

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

- fabricate electrical and electronic circuits
- formulate the house wiring
- design the AC-DC converter using diode and passive components

Reference Book (s) / Web links:

1. Bawa H.S., "Workshop Practice", Tata McGraw – Hill Publishing Company Limited, 2007.
2. Jeyachandran K., Natarajan S. &Balasubramanian S., "A Primer on Engineering Practices Laboratory", Anuradha Publications, 2007.
3. Jeyapoovan T., Saravanapandian M. &Pranitha S., "Engineering Practices Lab Manual",Vikas Publishing House Pvt.Ltd, 2006.
4. Rajendra Prasad A. &Sarma P.M.M.S., "Workshop Practice", SreeSai Publication, 2002.

GE19122	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	2	2	1	2	-	-	-	-	-	1	1	2	2	2
CO 2	3	2	2	1	2	-	-	-	-	-	1	1	2	2	2
CO 3	3	2	2	1	2	-	-	-	-	-	1	1	2	2	2
Average	**3**	**2**	**2**	**1**	**2**	-	-	-	-	-	**1**	**1**	**2**	**2**	**2**

Subject Code	Subject Name	Category	L	T	P	C
MC19102	INDIAN CONSTITUTION AND FREEDOM MOVEMENT (Non Credit Course)	MC	3	0	0	0

Objectives:		
□	To create a sense of responsible and active citizenship	
□	To know about Constitutional and Non- Constitutional bodies	
□	To understand sacrifices made by the freedom fighters.	
UNIT-I	**INTRODUCTION**	**9**
Historical Background – Constituent Assembly of India – Philosophical foundations of the Indian Constitution – Preamble – Fundamental Rights – Directive Principles of State Policy – Fundamental Duties – Citizenship – Constitutional Remedies for citizens.Constitution' meaning of the term, Indian Constitution: Sources and constitutional history, Features: Citizenship, Preamble, Fundamental Rights and Duties, Directive Principles of State Policy.		
UNIT-II	**STRUCTURE AND FUNCTION OF CENTRAL GOVERNMENT**	**9**
Union Government – Structures of the Union Government and Functions – President – Vice President – Prime Minister – Cabinet – Parliament – Supreme Court of India – Judicial Review.		
UNIT-III	**STRUCTURE AND FUNCTION OF STATE GOVERNMENT AND LOCAL BODY**	**9**
State Government – Structure and Functions – Governor – Chief Minister – Cabinet – State Legislature – Judicial System in States – High Courts and other Subordinate Courts- Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation, Pachayati Raj: Introduction, Elected officials and their roles, ,Village level: Role of Elected and Appointed officials.		
UNIT-IV	**CONSTITUTIONAL FUNCTIONS AND BODIES**	**9**
Indian Federal System – Center – State Relations – President's Rule – Constitutional Functionaries – Assessment of working of the Parliamentary System in India- CAG, Election Commission, UPSC, GST Council and other Constitutional bodies-. NITI Aayog, Lokpal, National Development Council and other Non –Constitutional bodies.		
UNIT-V	**INDIAN FREEDOM MOVEMENT**	**9**
British Colonialism in India-Colonial administration till 1857- Revolt of 1857- Early Resistance to British Rule-Rise of Nationalism in India-Indian Freedom Struggle under Mahatma Gandhi- Non-Cooperation Movement-Civil Disobedience Movement- Quit India Movement-British – Official response to National movement- Independence of India Act 1947-Freedom and Partition.		
	Total Contact Hours :	**45**
Course Outcomes:		
On completion of the course, the students will be able to		
□	Understand the functions of the Indian government.	
□	Understand and abide the rules of the Indian constitution.	
□	Gain knowledge on functions of state Government and Local bodies.	
□	Gain Knowledge on constitution functions and role of constitutional bodies and non-	
□	Understand the sacrifices made by freedom fighters during freedom movement.	
Text Book (s):		
1	Durga Das Basu, "Introduction to the Constitution of India ", Lexis Nexis, New Delhi., 21st ed 2013	
2	Bipan Chandra, History of Modern India, Orient Black Swan, 2009	
3	Bipan Chandra, India's Struggle for Independence, Penguin Books, 2016	
4	Maciver and Page, " Society: An Introduction Analysis ", Mac Milan India Ltd., New Delhi.2nd ed, 2014	
5	P K Agarwal and K N Chaturvedi , Prabhat Prakashan, New Delhi, 1st ed , 2017	
Reference Book (s) / Web links:		

1	Sharma, Brij Kishore, "Introduction to the Constitution of India:, Prentice Hall of India, New Delhi.
2	U.R.Gahai, "Indian Political System ", New Academic Publishing House, Jalaendhar.

MC19102	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	-	-	-	-	-	1	-	2	2	-	-	1	-	-	-
CO 2	-	-	-	-	-	1	-	2	2	-	-	1	-	-	-
CO 3	-	-	-	-	-	1	-	2	2	-	-	1	-	-	-
CO 4	-	-	-	-	-	1	-	2	2	-	-	1	-	-	-
CO 5	-	-	-	-	-	1	-	2	2	-	-	1	-	-	-
Average	-	-	-	-	-	**1**	-	**2**	**2**	-	-	**1**	-	-	-

SEMESTER III

Subject Code	Subject Name	Category	L	T	P	C
MA19355	**TRANSFORMS AND APPLICATIONS Common to III sem. B.E. Mechanical Engineering, Mechatronics and Civil Engineering**	**BS**	**3**	**1**	**0**	**4**

Objectives:

- To introduce Fourier series and to solve boundary value problems that arise in the field of Engineering.
- To acquaint the student with different transform techniques used in wide variety of situations.

UNIT-I	**FOURIER SERIES**	**12**

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Parseval's identity – Harmonic analysis.

UNIT-II	**BOUNDARY VALUE PROBLEMS – ONE DIMENSIONAL EQUATIONS**	**12**

Classification of second order quasi linear partial differential equations – Fourier series solutions of one dimensional wave equation – One dimensional heat equation: Problems with temperature and temperature gradients.

UNIT-III	**BOUNDARY VALUE PROBLEMS – TWO DIMENSIONAL EQUATIONS**	**12**

Steady state solution of two-dimensional heat equation in Cartesian coordinates: Infinite and finite plates – Steady state solution of two-dimensional heat equation in Polar coordinates: Circular and Semicircular disks.

UNIT-IV	**FOURIER TRANSFORMS**	**12**

Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity - Application to boundary value problems.

UNIT-V	**Z - TRANSFORMS AND DIFFERENCE EQUATIONS**	**12**

Z- transforms - Elementary properties – Inverse Z - transform (using partial fraction and residues) –Convolution theorem - Formation of difference equations – Solution of difference equations using Z- transform.

Total Contact Hours	**:**	**60**

Course Outcomes:

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

□	Develop skills to construct Fourier series for different periodic functions and to evaluate infinite series.
□	Classify different types of PDE and solve one dimensional boundary value problems.
□	Solve two dimensional heat equations.
□	Solve Engineering problems using Fourier transform techniques.
□	Solve difference equations using Z – transforms that arise in discrete time systems.
Text Book (s):	
1	Erwin Kreyszig, "Advanced Engineering Mathematics", 8th Edition, Wiley India, 2007.
2	Veerarajan. T., "Transforms and Partial Differential Equations", Tata McGraw Hill Education Pvt.Ltd.,New Delhi, Second reprint, 2012.
Reference Book (s) / Web links:	
1	Grewal B.S., "Higher Engineering Mathematics", 43rd Edition, Khanna Publishers, Delhi, 2014.
2	Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
3	Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2007.
4	Ray Wylie C and Barrett.L.C, "Advanced Engineering Mathematics" Tata McGraw Hill Education Pvt Ltd, Sixth Edition, New Delhi, 2012.

MA19355	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	3	2	1	-	-	-	-	-	-	2	3	2	2
CO 2	3	3	3	3	2	-	-	-	-	-	-	2	3	2	1
CO 3	3	3	3	3	2	-	-	-	-	-	-	2	3	2	1
CO 4	3	3	3	2	1	-	-	-	-	-	-	2	2	2	1
CO 5	3	3	3	2	1	-	-	-	-	-	-	2	2	2	1
Average	**3**	**3**	**3**	**2.4**	**1.4**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2.6**	**2**	**1.2**

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
CE19301	**ENGINEERING GEOLOGY**	**PC**	**3**	**0**	**0**	**3**

Objectives:	
□	To acquire geological knowledge on structure of earth, weathering phenomena & plate tectonics.
□	To gain an understanding about the physical properties of minerals.
□	To develop an ability to classify the rocks, distinguish between Igneous, Sedimentary and Metamorphic rocks and gain knowledge about engineering properties of rocks.
□	To acquire knowledge on structural geology and various geophysical methods.
□	To develop an understanding on the importance of geological aspects required in various projects and to acquire knowledge on remote sensing.

UNIT-I	**PHYSICAL GEOLOGY**	**9**

Geology in civil engineering – branches of geology – structure of earth and its composition - weathering of rocks – scale of weathering – soils - landforms and processes associated with river, wind, groundwater and sea – relevance to civil engineering. Plate tectonics – Earthquakes – Seismic zones in India.

UNIT-II	**MINEROLOGY**	**9**

Physical properties of minerals – Quartz group, Feldspar group, Pyroxene - hypersthene and augite, Amphibole – hornblende, Mica – muscovite and biotite, Calcite, Gypsum.		
UNIT-III	**PETROLOGY**	**9**
Classification of rocks, distinction between Igneous, Sedimentary and Metamorphic rocks. Engineering properties of rocks. Description, occurrence, engineering properties, distribution and uses of Granite, Dolerite, Basalt, Sandstone, Limestone, Laterite, Shale, Quartzite, Marble, Slate, Gneiss and Schist.		
UNIT-IV	**STRUCTURAL GEOLOGY AND GEOPHYSICAL METHODS**	**9**
Geological maps – attitude of beds, study of structures – folds, faults and joints – relevance to civil engineering. Geophysical methods – Seismic and electrical methods for subsurface investigations.		
UNIT-V	**APPLICATION OF GEOLOGICAL INVESTIGATIONS**	**9**
Remote sensing for civil engineering applications; Geological conditions necessary for design and construction of Dams, Reservoirs, Tunnels, and Road cuttings –Hydrogeological investigations and mining - Coastal protection structures – Case Studies on Past Earthquake - Investigation of Landslides, causes and mitigation.		
	Total Contact Hours : 45	

Course Outcomes

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

□	Acquire knowledge about the structure of earth, process of weathering & plate tectonics and identify the basis for the formation of any natural phenomenon.
□	Interpret the various types of minerals and assess its physical properties.
□	Classify the rocks and identify its suitability for various Civil Engineering projects.
□	Analyze the surface and subsurface geological structures and infer the suitability of the site for different Infrastructures.
□	Assess the geological aspects and to suggest preventive and mitigative measures for any major catastrophes using remote sensing techniques.

Text Book(s):

1	Varghese, P.C., Engineering Geology for Civil Engineering Prentice Hall of India Learning Private Limited, New Delhi, 2012.
2	Parbin Singh. A "Text book of Engineering and General Geology", Katson publishing house, Ludhiana 2009.

Reference Book(s) / Web links:

1	Muthiayya, V.D. " A Text of Geology", Oxford IBH Publications, Calcutta, 1969
2	Blyth F.G.H. and de Freitas M.H., Geology for Engineers, Edward Arnold, London, 2010.
3	Bell .F.G.. "Fundamentals of Engineering Geology", B.S. Publications. Hyderabad 2011.
4	Dobrin, M.B "An introduction to geophysical prospecting", McGraw Hill, New Delhi, 1988.
5	Venkat Reddy. D. Engineering Geology, Vikas Publishing House Pvt. Lt, 2010.
6	Gokhale KVGK, "Principles of Engineering Geology", B.S. Publications, Hyderabad 2011.

CE19301	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	1	1	1	1	1	1	1	-	1	1	1	1	2	1	1
CO 2	1	1	1	1	1	1	1	-	1	1	1	1	2	1	1
CO 3	1	1	1	1	1	1	1	-	1	1	1	1	3	1	1
CO 4	2	2	3	3	3	2	2	1	1	1	1	2	3	2	1
CO 5	2	2	3	3	3	2	3	1	1	1	1	2	3	3	2
Average	**1.4**	**1.4**	**1.8**	**1.8**	**1.8**	**1.4**	**1.6**	**1**	**1**	**1**	**1**	**1.4**	**2.6**	**1.6**	**1.2**

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
CE19302	CONSTRUCTION MATERIALS, TECHNIQUES AND PRACTICES	PC	3	0	0	3

Objectives:

- To acquire knowledge on various construction materials, techniques and practices commonly used in Civil Engineering construction.

UNIT-I	STONES - BRICKS - CONCRETE BLOCKS – LIME	9

Stone as building material - criteria for selection - Tests on stones - Bricks - Classification - Manufacturing of clay bricks - Tests on bricks - Compressive strength - Water Absorption - Efflorescence - Bricks for special use - Lime - Preparation of lime mortar - Concrete hollow blocks - Lightweight concrete blocks.

UNIT-II	CEMENT – AGGREGATES	9

Cement - Ingredients - Manufacturing process - Types and grades - Properties of cement and Cement mortar - Tests on Cement - Fineness - Soundness, Consistency - Setting time - Coarse Aggregate – Grading -Crushing strength - Impact strength - Flakiness Index - Elongation Index – Abrasion resistance - Fine aggregate - Grading – Bulking.

UNIT-III	CONCRETE	9

Concrete - Ingredients - Hydration - Batching plants – RMC - Properties of fresh concrete – Slump, Flow and Compaction factor - Properties of Hardened concrete - Compressive, Tensile and Shear strength -Modulus of rupture tests – Non-destructive testing - Mix Specifications - Concept and design of mix proportion - BIS method - High strength concrete and HPC - Self compacting concrete.

UNIT-IV	TIMBER AND OTHER MATERIALS	9

Timber - Market forms - Plywood - Veneer - False ceiling materials - Laminates - Steel - Mechanical treatment - Aluminum - Uses - Market forms - Glass - Refractories - Composite Materials - FRP.

UNIT-V	CONSTRUCTION PRACTICES & SERVICE REQUIREMENTS	9

Types of Foundations - Shallow and Deep Foundations - Brick Masonry - Plastering and Pointing - Cavity Walls – Diaphragm Walls - Formwork - Centering and Shuttering – Shoring - Scaffolding - Underpinning - Roofing - Flooring - Joints in concrete - Contraction/Construction/Expansion joints - Fire Protection - Thermal Insulation - Ventilation and Air conditioning - Acoustics and Sound Insulation - Damp Proofing.

	Total Contact Hours	:	45

Course Outcomes:

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

- Identify the quality of materials in masonry construction.
- Assess the material properties of cement and aggregates.
- Design the concrete mixes for different exposure conditions.
- Classify the various market forms of timber and other materials.
- Recognize the good practices and techniques of various construction activities.

Text Book(s):

1. Varghese.P.C, Building Construction,Second Edition PHI Learning ltd., 2016.
2. Shetty.M.S., Concrete Technology (Theory and Practice), S Chand and company limited 2015.

Reference Book(s) / Web links:

1. Arora S.P and Bindra S.P Building construction ,Dhanpat Rai and sons,1997.
2. Punmia ,B.C Building construction , Laxmi publication (p)ltd..,2008.
3. Neville A.M Properties of concrete ,fourth edition ,Pearson education ltd.2012.

4	Peurifoy R.L., Schexnayder,C.J., Shapira A., Schmitt.R., Construction Planning Equipment and Methods, Tata mcgraw-hill,2011.

CE19302	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	1	2	-	1	1	1	3	1	1	-	3	3	1	3
CO 2	2	1	2	-	1	1	1	3	1	2	-	3	3	1	3
CO 3	2	1	2	-	1	1	1	3	1	3	-	3	3	1	3
CO 4	1	1	1	-	2	1	2	3	1	1	-	3	3	1	3
CO 5	2	1	2	-	2	1	1	3	1	2	-	3	3	1	3
Average	**1.8**	**1**	**1.8**	**-**	**1.4**	**1**	**1.2**	**3**	**1**	**1.8**	**-**	**3**	**3**	**1**	**3**

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
CE19303	**STRENGTH OF MATERIALS I**	**PC**	**2**	**1**	**0**	**3**

Objectives:

- To assess the stresses and strains in deformable bodies.
- To analyse plane trusses, thin cylinders and shells.
- To illustrate bending and shear in determinate beams.
- To determine the deflection of the beams for different loading conditions.
- To evaluate the stresses and deformation in shafts and springs due to torsion.

UNIT-I SIMPLE AND COMPOUND STRESSES **9**

Rigid bodies and deformable solids – stability, strength, stiffness – tension, compression and shear stresses – strain, elasticity, Hooke's law, limit of proportionality, modulus of elasticity, stress- strain curve, lateral strain – temperature stresses – deformation of simple and compound bars – shear modulus, bulk modulus, relationship between elastic constants – biaxial state of stress – stress at a point – stress on inclined plane – principal planes and principal stresses – Mohr's circle of stresses.

UNIT-II PLANE TRUSSES, THIN CYLINDERS AND SHELLS **9**

Stability and equilibrium of plane frames – types of trusses – analysis of forces in truss members - method of joints, method of sections, method of tension coefficients – thin cylinders and shells under internal pressure – deformation of thin cylinders and shells.

UNIT-III SHEAR AND BENDING IN DETERMINATE BEAMS **9**

Beams – types of supports – types of loads – concentrated, uniformly distributed, varying distributed load, combination of loadings – relationship between bending moment and shear force – bending moment, shear force diagram for simply supported, cantilever and over hanging beams – Theory of simple bending – analysis of bending stresses – variation of shear stresses – shear stress distribution in rectangular, I section, solid circular section, hollow circular section, angle and channel sections – Flitched Beams.

UNIT-IV DEFLECTION OF BEAMS **9**

Deflection of Beams –Double integration method - Macaulay's methods – Moment area method - conjugate beam method for computation of slopes and deflections of determinant beams.

UNIT-V TORSION AND SPRINGS **9**

Theory of torsion - stresses and deformation in circular (solid and hollow shafts) – stepped shafts - shafts fixed at both ends - modulus of rupture – power transmitted to shaft – shaft in series and parallel – closed and open coiled helical springs – leaf springs – springs in series and parallel.

Total Contact Hours : 45

Course Outcomes:

On completion of the course, the students will be able to	
□	Assess the stresses and strains in deformable bodies.
□	Analyse the plane trusses, stresses in thin cylinders and shells.
□	Illustrate bending and shear in determinate Beams.
□	Compute the deflection of beams for different loading conditions.
□	Evaluate the stresses and deformation in shafts and springs.
Text Book(s):	
1	Rajput.R.K. “Strength of Materials”, S.Chand and Co, New Delhi, 2007.
2	Bhavikatti. S., "Solid Mechanics", Vikas publishing house Pvt. Ltd, New Delhi, 2010.
Reference Book(s) / Web links:	
1	Gambhir. M.L., "Fundamentals of Solid Mechanics", PHI Learning Private Limited., New Delhi, 2009.
2	Timoshenko.S.B. and Gere.J.M, “Mechanics of Materials”, Van NosReinbhold, New Delhi 1995.
3	Vazirani.V.N and Ratwani.M.M, “Analysis of Structures”, Vol I Khanna Publishers, New Delhi, 1995.
4	Junnarkar.S.B. and Shah.H.J, “Mechanics of Structures”, Vol I, Charotar Publishing House, New Delhi, 1997.
5	Ugural. A.C., "Mechanics of Materials", Wiley India Pvt. Ltd., New Delhi, 2013.

CE19303	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO 1	3	3	2	1	1	1	1	1	2	1	2	3	3	3	2
CO 2	3	3	2	1	1	1	1	1	2	1	2	3	3	3	2
CO 3	3	3	2	1	1	1	1	1	2	1	2	3	3	3	2
CO 4	3	3	2	1	1	1	1	1	2	1	2	3	3	3	2
CO 5	3	3	2	1	1	1	1	1	2	1	2	3	3	3	2
Average	**3**	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**2**	**1**	**2**	**3**	**3**	**3**	**2**

Subject Code	**Subject Name (Theory Course)**	**Category**	**L**	**T**	**P**	**C**
CE19304	**FLUID MECHANICS**	**PC**	**2**	**1**	**0**	**3**

Objectives:	
□	To enhance the fundamental knowledge in properties of fluids and study of fluid at rest.
□	To acquire knowledge on kinematics of fluids and flownets.
□	To obtain knowledge on dynamics of fluids, Bernoulli’s equation and its applications.
□	To analyse flow through pipes and boundary layer concept.
□	To acquire knowledge on dimensional analysis and model studies.

UNIT-I	**FLUID PROPERTIES AND FLUID STATICS**	**9**

Definitions -Fluid and fluid mechanics - Units and dimensions - Properties of fluids - density, specific weight, specific volume, specific gravity, viscosity, compressibility, vapour pressure, capillarity and surface tension - Fluid statics: concept of fluid static pressure, absolute and gauge pressures - pressure measurements by manometers-forces on planes – centre of pressure – buoyancy and floatation.

UNIT-II	**FLUID KINEMATICS**	**9**

Fluid Kinematics – Classification and types of flow - velocity field and acceleration - continuity equation (one and three dimensional differential forms)- stream line-streak line-path line- stream function - velocity potential function - flow net. Velocity measurement (Pilot tube, current meter, Hot wire and hot film anemometer, float technique, Laser Doppler velocimetry		
UNIT-III	**FLUID DYNAMICS**	**9**
Fluid dynamics - equations of motion -Euler's equation along a streamline - Bernoulli's equation – application - Venturimeter, orifice meter and Pitot tube- linear momentum equation and its application to pipe bend.		
UNIT-IV	**FLOW THROUGH PIPES AND BOUNDARY LAYER**	**9**
Reynold's experiment - laminar flow through circular pipe (Hagen Poiseulle's) - hydraulic and energy gradient – flow through pipes - Darcy -Weisbach's equation - pipe roughness -friction factor- Moody's diagram- major and minor losses of flow in pipes - pipes in series and in parallel. Boundary layer – definition- boundary layer on a flat plate – laminar and turbulent boundary layer - displacement, energy and momentum thickness – Momentum integral equation-Boundary layer separation and control – drag on flat plate.		
UNIT-V	**DIMENSIONAL ANALYSIS AND MODEL STUDIES**	**9**
Fundamental dimensions - dimensional homogeneity - Rayleigh's method and Buckingham Pi theorem - dimensionless parameters - similitudes and model studies - distorted models.		
	Total Contact Hours : 45	

Course Outcomes:

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

□	Apply the concept of basic properties of fluids and behavior of fluids at rest and its applications in real world problems.
□	Compute the rate of flow through pipes and flownets without considering pressure causing the motion.
□	Apply the concept of Bernoulli's equation to solve a variety of fluid flow problems.
□	Estimate the major and minor losses in pipe flow and calculate the flow through pipes connected in series and in parallels and boundary layer thickness and its separation during different types of fluid flow
□	Employ the knowledge in dimensional analysis and model studies in real time.

Text Book (s):

1	Dr.Modi P.N and Seth "Hydraulics and Fluid Mechanics including Hydraulic Machines", Standard Book House New Delhi, 2009.
2	K. Subramanya "Fluid Mechanics and Hydraulic Machines", Tata McGraw Hill Education Private Limited, New Delhi, 2010.

Reference Book (s) / Web links:

1	Streeter, V.L., and Wylie, E.B., "Fluid Mechanics", McGraw Hill, 2000.
2	Fox W.R. and McDonald A.T., Introduction to Fluid Mechanics John-Wiley and Sons, Singapore, 2013.
3	White, F.M., "Fluid Mechanics", Tata McGraw Hill, 5th Edition, New Delhi, 2017.
4	Mohd. Kaleem Khan, "Fluid Mechanics and Machinery", Oxford University Press, New Delhi, 2015.
5	Dr.A.K.Jain "Fluid Mechanics" (Including Hydraulic Machines), Khanna Publishers, Twelfth Edition, 2016.

CE19304	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	2	1	1	1	1	1	1	1	1	-	2	1	1	1
CO 2	3	2	1	2	1	1	1	1	1	1	-	2	1	1	1

CO 3	3	2	1	1	1	1	1	1	1	1	-	2	1	1	1
CO 4	3	2	1	2	1	1	1	1	1	1	-	2	1	1	1
CO 5	3	2	1	2	1	1	1	1	1	1	-	2	1	1	1
Average	**3**	**2**	**1**	**1.6**	**1**	**1**	**1**	**1**	**1**	**1**	**-**	**2**	**1**	**1**	**1**

Subject Code	**Subject Name (Practical Course)**	**Category**	**L**	**T**	**P**	**C**
CE19311	**CONSTRUCTION MATERIALS LABORATORY**	**PC**	**0**	**0**	**4**	**2**

Objectives:

- To determine the quality of cement through various laboratory tests on cement.
- To acquire knowledge on the quality of fine aggregates through various tests on fine aggregates.
- To know the quality of bricks through various tests on bricks.
- To acquire knowledge on the quality of coarse aggregates through various tests on coarse aggregates.
- To know the quality of concrete and the materials used in the construction.

List of Experiments

I	**TEST ON CEMENT**
1	Determination of fineness
2	Determination of consistency
3	Determination of initial and final setting time
4	Determination of specific gravity
II	**TEST ON FINE AGGREGATES**
5	Grading of fine aggregates
6	Test for specific gravity
7	Compacted and loose bulk density of fine aggregate
III	**TEST ON BRICKS**
8	Test for compressive strength
9	Test for Water absorption
10	Determination of Efflorescence
IV	**TEST ON COARSE AGGREGATE**
11	Determination of specific gravity
12	Determination of impact value
13	Determination of elongation index
14	Determination of flakiness index
15	Determination of aggregate crushing value
V	**TEST ON CONCRETE**
16	Test for slump
17	Test for Compaction factor
18	Test for Compressive strength - Cube & Cylinder
19	Test for Flexural strength

Total Contact : 60

Course Outcomes:

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

- Find the fineness, specific gravity, initial and final setting time of cement.
- Find the grading, specific gravity and density of fine aggregate.
- Find the compressive strength, water absorption and efflorescence of bricks.

□	Find the specific gravity, impact value, crushing value, elongation and flakiness index of coarse aggregate.
□	Find the slump of fresh concrete and compressive strength of hardened concrete.
References :	
1	Construction Materials Laboratory Manual, Anna University, Chennai-600 025
2	IS 4031 (Part 1) – 1996 – Indian Standard Codes.
3	IS 4031 (Part 3 and Part 5) – 1988
4	IS 2386 (Part 1 to Part 6) – 1963
5	IS 383– 2016 Indian Standard specification for coarse and fine aggregates from natural sources for concrete.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.No.	Description of Equipment	Quantity
1.	Concrete Cube moulds	6 No's
2.	Concrete Cylinder moulds	3 No's
3.	Concrete Prism moulds	3 No's
4.	Sieves	1 Set
5.	Concrete Mixer	1 No
6.	Slump cone	3 No's
7.	Flow table	1 No
8.	Vibrator	1 No
9.	Trovels	3 No's
10.	Compression Testing Machine	1 No
11.	Vee Bee Consistometer	1 No
12.	Aggregate Impact testing machine	1 No
13.	Flexure Testing Machine	1 No
14.	Blains Apparatus	1 No
15.	Hot Air Oven	1 No
16.	Sieve Shaker– Motorized	1 No
17.	Electronic Weigh Balance – 100kg	1 No
18.	Electronic Weigh balance – 30kg	1 No
19.	Pyconometer	2 No's
20.	50ml density bottle	2 No's

CE19311	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	3	2	1	1	2	1	3	3	1	3	3	3	2
CO 2	3	3	3	2	1	1	2	1	3	3	1	3	3	3	2
CO 3	3	3	3	2	1	1	2	1	3	3	1	3	3	3	2
CO 4	3	3	3	2	1	1	2	1	3	3	1	3	3	3	2
CO 5	3	3	3	2	1	1	2	1	3	3	1	3	3	3	2
Average	**3**	**3**	**3**	**2**	**1**	**1**	**2**	**1**	**3**	**3**	**1**	**3**	**3**	**3**	**2**

Subject Code	Subject Name (Practical Course)	Category	L	T	P	C
CE19312	**STRENGTH OF MATERIALS LABORATORY**	**PC**	**0**	**0**	**4**	**2**
Objectives:						

	To conduct experiments on the materials to assess their mechanical properties.
List of Experiments	
1	Tension test on mild steel rod.
2	Double shear test on metal.
3	Compression test on wood.
4	Torsion test on mild steel rod.
5	Impact test on metal specimen (Izod and Charpy).
6	Hardness test on metals (Rockwell and Brinell Hardness Tests).
7	Deflection test on metal beams (Simply Supported and Cantilever)
8	Deflection test on carriage spring
9	Compression test on helical spring
10	Tension test on helical spring
	Total Contact : 60
Course Outcomes:	
On completion of the course, the students will be able to	
	Characterize the behaviour of mild steel rod on tensile and shear testing, wood on compression testing.
	Assess the behaviour of mild steel specimen subjected to Torsion and Impact loading.
	Interpret the Hardness numbers of different metals.
	Examine the deflection of Beams and Springs subjected to Bending.
	Evaluate the stiffness of the Springs under Tensile and Compressive loadings.
References :	
1	Strength of Materials Laboratory Manual, Anna University, Chennai - 600 025.
2	IS1786-2008 (Fourth Revision, Reaffirmed 2013), 'High strength deformed bars and wires for concrete reinforcement – Specification, 2008.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

Sl. No.	Description of Equipment	Quantity
1.	UTM of minimum 400 kN capacity	1
2.	Torsion testing machine	1
3.	Izod impact testing machine	1
4.	Hardness testing machine Rockwell Brinell	1 each
5.	Beam deflection test apparatus	1
6.	Extensometer	1
7.	Compressometer	1
8.	Dial gauges	Few

CE19312	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	2	2	1	1	1	1	3	3	2	3	3	3	2
CO 2	3	3	2	2	1	1	1	1	3	3	2	3	3	3	2
CO 3	3	3	2	2	1	1	1	1	3	3	2	3	3	3	2
CO 4	3	3	2	2	1	1	1	1	3	3	2	3	3	3	2
CO 5	3	3	2	2	1	1	1	1	3	3	2	3	3	3	2
Average	**3**	**3**	**2**	**2**	**1**	**1**	**1**	**1**	**3**	**3**	**2**	**3**	**3**	**3**	**2**

Subject Code	Subject Name (Theory Course)	Category	L	T	P	C
GE19301	LIFE SCIENCE FOR ENGINEERS	BS	3	0	0	3

Objectives:

- Broad objective of this course is to give an introduction of life science to engineering students. The course helps students to familiarize with human physiology, life style diseases and their Management and basic diagnostic aspects.

UNIT I	**OVERVIEW OF CELLS AND TISSUES**	**9**
	Introduction to Bacteria, virus, fungi and animal cells. Organization of cells into tissues and organs. Functions of vital organs.	
UNIT II	**HEALTH AND NUTRITION**	**9**
	Balanced diet, Importance of RDA, BMR, and diet related diseases. Role of antioxidants PUFA, DHA, Essential amino acids, Essential fatty acids in diet. Water and its significance for human health. Physical and Mental health – Significance of exercise and yoga.	
UNIT III	**UNHEALTHY PRACTICES AND THEIR IMPACT ON HEALTH**	**9**
	Drug induced toxicity, Unhealthy practices - Drug abuse/Narcotics/Smoking/Alcohol/Self-medication/Undue usage of electronic gadgets.	
UNIT IV	**COMMON DISEASES AND LIFESTYLE DISORDERS**	**9**
	Prevention and management of food, water and airborne illness (Common cold, dehydration, food poisoning etc). Lifestyle disorders – obesity, diabetes, stroke, heart attack, ulcer, renal calculi, cancer, AIDS, hepatitis- prevention and management.	
UNIT V	**DIAGNOSTIC TESTS AND THEIR RELEVENCE**	**9**
	Normal range of biochemical parameters, significance of organ function tests, organ donation.	

Course outcomes:

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

- Classify the living organisms and relate the functions of vital organs.
- Demonstrate the importance of balanced diet and plan methods for healthy living.
- Analyse the hazards of unhealthy practices and take preventive measures.
- Categorise the various life style disorders and recommend ways to manage the common diseases.
- Evaluate and interpret biochemical parameters and their significance.

Text books:

1. Diseases of human body , Carol D Tamparo, Marcia A Lewis , Marcia A, Lewis ,EdD, RN, CMA- AC, F.A Davis Company, 2011.
2. Textbook of Medical Biochemistry ,Chatterjea ; Rana Shinde.

Reference Books:

1. Biology for Engineers, Arthur.T.,Johnson, CRC Press, Taylor and Francis, 2011.
2. Cell Biology and Genetics, Cecie Starr, Ralph Taggart, Christine Evers and Lisa Starr, Cengage Learning, 2008.
3. https://nptel.ac.in/courses/122103039/

GE19301	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	1	2	2	2	3	1	1	1	2	1	3	3	1	2

CO 2	3	1	2	2	2	3	1	1	1	2	1	3	3	1	2
CO 3	3	1	2	2	2	3	1	3	1	2	1	3	3	1	2
CO 4	3	1	2	2	2	3	1	1	1	2	1	3	3	1	2
CO 5	3	1	2	2	3	3	1	1	1	2	1	3	3	1	2
Average	**3**	**1**	**2**	**2**	**2.2**	**3**	**1**	**1.4**	**1**	**2**	**1**	**3**	**3**	**1**	**2**

IV SEMESTER

Subject Code	Subject Name	Category	L	T	P	C
MA19451	**NUMERICAL METHODS** **Common to IV sem. B.E. Aeronautical Engineering, Civil Engineering and B.Tech. Chemical Engineering**	**BS**	**3**	**1**	**0**	**4**

Objectives:

- To provide the necessary basic concepts of a few numerical methods.
- To provide procedures for solving numerically different kinds of problems occurring in the field of Engineering and Technology.

UNIT-I	**SOLUTION OF EQUATIONS**	**12**

Solution of algebraic and transcendental equations - Fixed point iteration method – Newton Raphson method- Solution of linear system of equations - Gauss elimination method – Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel.

UNIT-II	**INTERPOLATION**	**12**

Interpolation with equal intervals - Newton's forward and backward difference formulae - Interpolation with unequal intervals – Newton's divided difference interpolation - Lagrange's interpolation – Cubic Splines

UNIT-III	**NUMERICAL DIFFERENTIATION AND INTEGRATION**	**12**

Approximation of derivatives using interpolation polynomials - Numerical integration using Trapezoidal, Simpson's 1/3 rule and Simpson's 3/8 rule – Romberg's method - Two point and three point Gaussian quadrature formulae – Evaluation of double integrals by Trapezoidal rule.

UNIT-IV	**INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS**	**12**

Single Step methods: Taylor's series method - Euler's method - Modified Euler's method – Fourth order Runge - Kutta method for solving first order equations - Multi step methods: Milne's and Adams- Bash forth predictor corrector methods for solving first order equations.

UNIT-V	**BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS**	**12**

Finite difference method for solving second order differential equations - Finite difference techniques for the solution of two dimensional Laplace and Poisson equations on rectangular domain – One dimensional heat flow equation by implicit and explicit methods – One Dimensional Wave Equation by Explicit method.

Total Contact Hours	**:**	**60**

Course Outcomes:

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

- solve algebraic equations that arise during the study of Engineering problems.
- use various interpolation techniques for solving problems in Engineering.
- use numerical methods to solve problems involving numerical differentiation and integration.
- solve initial value problems numerically that arise in Science and Engineering.
- solve boundary value problems that encounter in different fields of Engineering study.

Text Book(s):	
1	Kandasamy P., Thilagavathy K., and Gunavathy,S., 'Numerical Methods', Chand and Co., 2007.
2	Grewal B.S., and Grewal. J.S.,"Numerical methods in Engineering and Science",Khanna Publishers, 9th Edition, New Delhi, 2007.
3	Sastry S.S, "Introductory Methods of Numerical Analysis", Prentice- Hall of India PVT. LTD., 4th edition, New Delhi, 2006.
Reference Book(s) / Web links:	
1	Veerarajan T., Ramachandran T., 'Numerical Methods with Programs in C and C++' Tata McGraw Hill., 2007.
2	Jain M.K., Iyengar, S.R., and Jain, R.K., 'Numerical Methods for Scientific and Engineering Computation', New Age Publishers. 6th edition, 2007.
3	Chapra S.C., and Canale. R.P, "Numerical Methods for Engineers", 7th Edition, McGrawHill, New Delhi, 2015.
4	Brian Bradie "A friendly introduction to Numerical analysis", Pearson Education, Asia, New Delhi, 2007.
5	Sankara Rao K., "Numerical methods for Scientists and Engineers", Prentice Hall of IndiaPrivate, 3rd Edition, New Delhi, 2007.

MA19451	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	2	3	1	-	-	-	-	-	-	2	2	1	-
CO 2	3	3	2	3	1	-	-	-	-	-	-	2	2	1	-
CO 3	3	3	2	3	1	-	-	-	-	-	-	2	2	1	-
CO 4	3	3	2	3	1	-	-	-	-	-	-	2	2	1	-
CO 5	3	3	2	3	1	-	-	-	-	-	-	2	2	1	-
Average	**3**	**3**	**2**	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**1**	**-**

Subject Code	Subject Name (Theory Course)	Category	L	T	P	C
CE19401	**STRENGTH OF MATERIALS II**	**PC**	**2**	**1**	**0**	**3**

Objectives:

- To determine deflection of beams and trusses using Energy principles.
- To illustrate the bending moment and shear force of indeterminate beams.
- To evaluate the failure of columns and stresses in thick cylinders
- To determine the principal stress and principal strain using theories of failures.
- To assess the unsymmetrical bending in beam sections and stresses in curved beams.

UNIT-I	ENERGY PRINCIPLES	9

Strain energy – strain energy due to axial load (gradual, sudden and impact loads), shear, flexure and torsion – Castigliano's theorems I & II- Principle of virtual work – application of energy theorems for computing deflections in beams and trusses- Maxwell's reciprocal theorems.

UNIT-II	INDETERMINATE BEAMS	9

Analysis of propped cantilever and fixed beams-fixed end moments and reactions – theorem of three moments – analysis of continuous beams – shear force and bending moment diagrams.

UNIT-III	COLUMNS AND CYLINDER	9

Euler's theory of long columns – critical loads for prismatic columns with different end conditions; Rankine's - Gordon's formula for eccentrically loaded columns – Eccentrically loaded short columns – middle third rule – core of the section – Thick cylinders – Compound cylinders.		
UNIT-IV	**STATE OF STRESS IN 3D AND THEORIES OF FAILURE**	**9**
Determination of principal stresses and principal planes in three dimensions – Volumetric strain – Theories of failure – Principal stress - Principal strain – shear stress – Strain energy and distortion energy theories – application in analysis of stress, load carrying capacity.		
UNIT-V	**ADVANCED TOPICS**	**9**
Unsymmetrical bending of beams of symmetrical and unsymmetrical sections – Shear Centre - curved beams – Winkler Bach formula**.**		

	Total Contact Hours	**:**	**45**

Course Outcomes:

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

□	Determine deflection of beams and trusses using Energy principles.
□	Illustrate the bending moment and shear force in indeterminate beams.
□	Evaluate the failure of columns and stresses in thick cylinders
□	Determine the principal stress and principal strain using various theories of failures.
□	Assess the unsymmetrical bending in beam sections and stresses in curved beams.

Text Book (s):

1	Rajput R.K. "Strength of Materials (Mechanics of Solids)", S.Chand& company Ltd., New Delhi, 2010.
2	Egor P Popov, "Engineering Mechanics of Solids", 2nd edition, PHI Learning Pvt. Ltd., New Delhi, 2012.

Reference Book (s) / Web links:

1	Kazimi S.M.A, "Solid Mechanics", Tata McGraw-Hill Publishing Co., New Delhi, 2003.
2	William A .Nash, "Theory and Problems of Strength of Materials", Schaum's Outline Series, Tata McGraw Hill Publishing Company, 2007.
3	PunmiaB.C."Theory of Structures" (SMTS) Vol I&II, Laxmi Publishing Pvt Ltd, New Delhi 2004.
4	Rattan.S.S., "Strength of Materials", Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2011.
5	R.K.Bansal "Strength of Materials", Lakshmi Publications Pvt Ltd, New Delhi, 2018

CE19401	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO 1	3	3	1	1	1	1	1	1	2	1	2	3	3	1	1
CO 2	3	3	2	1	1	1	1	1	2	1	2	3	3	1	1
CO 3	3	3	2	1	1	1	1	1	2	1	2	3	3	1	1
CO 4	3	3	1	2	1	1	1	1	2	1	2	3	3	1	1
CO 5	3	3	2	3	1	1	1	1	2	1	2	3	3	1	1
Average	**3**	**3**	**1.6**	**1.6**	**1**	**1**	**1**	**1**	**2**	**1**	**2**	**3**	**3**	**1**	**1**

Subject Code	**Subject Name (Theory Course)**	**Category**	**L**	**T**	**P**	**C**
CE19402	**APPLIED HYDRAULIC ENGINEERING**	**PC**	**3**	**0**	**0**	**3**

Objectives:

□	To acquire knowledge on open channel flow and its characteristics.
□	To analyse the gradually varied flow and its profiles.

□	To analyse the rapidly varying flow.
□	To illustrate the performance of Centrifugal and Reciprocating Pumps.
□	To illustrate the characteristics of Impulse and Reaction Turbines.

UNIT-I	**OPEN CHANNEL AND UNIFORM FLOWS**	**9**

Definition, Differences between pipe flow and open channel flow - Types of Flow - Properties of Open Channel - Velocity distribution in open channel - Steady uniform flow: Chezy's equation, Manning's equation - Best hydraulic sections for Uniform flow – Wide open channel.

UNIT-II	**GRADUALLY VARIED FLOW**	**9**

Specific energy and Specific force - Critical flow, Subcritical and Super Critical flow-Dynamic equations of gradually varied flows – Classification of flow profiles –Profile determination by Direct step method and Standard step method.

UNIT-III	**RAPIDLY VARIED FLOW**	**9**

Application of the momentum equation for RVF - Hydraulic jumps - Types - Energy dissipation – Positive and Negative surges.

UNIT-IV	**PUMPS**	**9**

Impact of Jet on flat, curved plates, Stationary and Moving – Classification of Pumps - Centrifugal pumps – Work done - Minimum speed to start the pump - NPSH - Multistage pumps – Characteristics curve - Reciprocating pumps - Negative slip - Indicator diagrams and its variations – Air vessels - Savings in work done.

UNIT-V	**TURBINES**	**9**

Classification of Turbines – Pelton wheel – Francis turbine – Kaplan turbine - Draft tube and cavitation - Specific speed – Characteristic Curves of Turbines

Total Contact Hours	**:**	**45**

Course Outcomes:

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

□	Acquire knowledge on open channel flow and its characteristics.
□	Analyse the gradually varied flow and its profiles.
□	Analyse the rapidly varying flow.
□	Determine the performance of Centrifugal and Reciprocating Pumps.
□	Compute the characteristics of Impulse and Reaction Turbines.

Text Book(s):

1	P. N. Chandramouli, "Applied Hydraulic Engineering", Yes Dee Publishing, Chennai, 2017.
2	Dr.Modi P.N and Dr. S.M. Seth "Hydraulics and Fluid Mechanics including Hydraulic Machines", Standard Book House New Delhi, 2009.

Reference Book(s) / Web links:

1	K. Subramanya, "Flow in open channels", Tata McGraw Hill, New Delhi, 2000.
2	M. Hanif Chaudhry, "Open Channel Flow", Second Edition, Springer, 2007.
3	Rajesh Srivastava, "Flow through open channels", Oxford University Press, New Delhi, 2008.
4	Dr.A.K.Jain "Fluid Mechanics" (Including Hydraulic Machines), Khanna Publishers, Twelfth Edition, 2016.
5	Dr.R.K.Bansal "Fluid Mechanics and Hydraulic Machines",Laxmi Publications,2005.

CE19402	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	3	2	1	2	2	2	2	1	2	3	3	3	2
CO 2	3	3	3	2	1	2	2	2	2	1	2	3	3	3	2
CO 3	3	3	3	2	1	2	2	2	2	1	2	3	3	3	2

CO 4	3	3	3	2	1	2	2	2	2	1	2	3	3	3	2
CO 5	3	3	3	2	1	2	2	2	2	1	2	3	3	3	2
Average	**3**	**3**	**3**	**2**	**1**	**2**	**2**	**2**	**2**	**1**	**2**	**3**	**3**	**3**	**2**

Subject Code	**Subject Name (Theory Course)**	**Category**	**L**	**T**	**P**	**C**
CE19403	**SURVEYING**	**PC**	**3**	**0**	**0**	**3**

Objectives:

- To acquire knowledge on the classification and basic principles of plane surveying.
- To acquaint with tacheometric surveying, trigonometric levelling and its significance.
- To assimilate the concepts of control surveying and errors occurred in the observations.
- To apply the knowledge of advanced surveying techniques in the field.
- To apply the working principle of modern surveying equipments like total station and GPS.

UNIT-I **FUNDAMENTALS OF CONVENTIONAL SURVEYING AND LEVELLING** **9**

Classifications and basic principles of surveying - Methods of ranging - Chain traversing - Obstacles- Tape corrections - Compass - Types of Compass- Basic Principles- Bearing – Types - True Bearing - Magnetic Bearing- Local Attraction – Magnetic declination – Dip- Levelling- Principles and theory of Levelling – Datum- Bench Marks – Temporary and Permanent Adjustments- Methods of Levelling- Booking – Reduction - Sources of errors in Levelling- Curvature and refraction - Contouring - Digital Planimeter - Uses.

UNIT-II **THEODOLITE AND TACHEOMETRIC SURVEYING** **9**

Horizontal and vertical angle measurements - Temporary and permanent adjustments - Heights and distances - Tacheometer - Stadia Constants - Anallactic Lens - Tacheometry surveying - Tangential and Stadia - Trigonometric levelling.

UNIT-III **CONTROL SURVEYING AND ADJUSTMENT** **9**

Horizontal and vertical control – Methods – specifications – triangulation- baseline – satellite stations – reduction to centre– single and reciprocal observations – traversing –Sources of errors- precautions and corrections – classification of errors – true and most probable values- weighed observations – method of equal shifts –principle of least squares - normal equation – correlates- level nets- adjustment of simple triangulation networks.

UNIT-IV **ADVANCED TOPICS IN SURVEYING** **9**

Hydrographic Surveying – Tides – MSL – Sounding methods – Three point problem –Sextants and station pointer –Fundamentals of Photogrammetry and Remote sensing – Astronomical terms and definitions.

UNIT-V **MODERN SURVEYING** **9**

Total Station : Advantages - Fundamental quantities measured - Parts and accessories - working principle - On board calculations - Field procedure - Errors and Good practices in using Total Station.

GPS Surveying : Different segments - space, control and user segments - satellite configuration-signal structure - Orbit determination and representation - Anti Spoofing and Selective Availability - Task of control segment - Hand Held and Geodetic receivers - data processing - Traversing and triangulation.

Total Contact Hours : 45

Course Outcomes:

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

- Conversant to use conventional surveying instruments such as chain, compass and levelling.
- Comprehend theodolite and tacheometer surveying and its significance in corresponding

	applications.
□	Develop skills in selecting suitable control stations and adjustments to be made for the errors occurring in the observations.
□	Acquainted in advanced surveying topics like hydrographic, astronomical and photogrammetric surveying.
□	Apply the working principle of modern surveying equipments like total station and GPS.
Text Book(s):	
1	T.P.Kanetkar and S.V.Kulkarni, Surveying and Levelling, Parts 1 & 2, Pune Vidyarthi Griha Prakashan, Pune, 2010.
2	Dr.B.C.Punmia, Ashok K.Jain and Arun K Jain , Surveying Vol. I & II, Lakshmi Publications Pvt Ltd,New Delhi, 2015.
Reference Book(s) / Web links:	
1	Alfred Leick, "GPS satellite surveying", John Wiley & Sons Inc., 4th Edition, 2015.
2	Guochang Xu, "GPS Theory, Algorithms and Applications", Springer – Berlin, 2010.
3	Satheesh Gopi, R Sathishkumar, N. Madhu, "Advanced Surveying, Total Station GPS and Remote Sensing" Pearson education, 2007.
4	Roy S.K., "Fundamentals of Surveying", 2nd Edition, Prentice Hall of India, 2011.
5	James M. Anderson and Edward M. Mikhail, "Surveying, Theory and Practice", 7th Edition, McGraw Hill, 2012.
6	Bannister and S. Raymond, "Surveying", 7th Edition, Longman 2004.
7	Arora K.R.,"SurveyingVol I & II", Standard Book house, 16th Edition 2013.

CE19403	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	2	3	1	1	-	3	1	1	1	1	2	1	2
CO 2	3	3	2	3	1	1	-	3	1	1	1	1	2	1	2
CO 3	3	3	2	3	1	1	-	3	1	1	1	1	2	1	2
CO 4	3	2	3	3	3	1	1	3	1	1	1	1	2	1	2
CO 5	3	2	3	3	3	1	1	3	1	1	1	2	2	1	2
Average	**3**	**2.6**	**2.4**	**3**	**1.8**	**1**	**1**	**3**	**1**	**1**	**1**	**1.2**	**2**	**1**	**2**

Subject Code	Subject Name (Practical Course)	Category	L	T	P	C
CE19411	**SURVEYING LABORATORY**	**PC**	**0**	**0**	**4**	**2**
Objectives:						
□	To learn about the surveying instruments used for linear measurements.					
□	To gain knowledge on Levelling in the field.					
□	To compute the distances and height using theodolite surveying.					
□	To determine the distances and heights of a position using tacheometric surveying.					
□	To assimilate modern survey techniques like Total Station and GPS.					
List of Experiments						
Chain Survey						
1.	Study of chains and its accessories, Aligning, Ranging, Chaining and Marking Perpendicular offset.					
2.	Chaining & Ranging.					
3.	Setting out works – Foundation marking using tapes single Room.					
Levelling						

4.	Study of levels and levelling staff
5.	Fly levelling using Dumpy level &Tilting level.
Theodolite	
6.	Study of Theodolite
7.	Measurements of horizontal angles by reiteration.
8.	Measurements of horizontal angles by repetition.
9.	Measurements of vertical angles & height of an object with base accessible.
10.	Determination of elevation of an object using single plane method when base is inaccessible.
Tacheometry	
11.	Determination of Tacheometric Constants.
12.	Heights and distances by Stadia Tacheometry.
13.	Heights and distances by Tangential Tacheometry.
Modern Surveying – Total Station & GPS	
14.	Study of Total Station.
15.	Measuring Horizontal and vertical angles using Total Station
16.	Determination of distance and difference in elevation between two inaccessible points using Total station.
17.	Study of GPS
18.	Co-ordinates and elevation measurement using GPS
19.	Area of building using GPS
Total Contact Hours	**: 60**

Course Outcomes:

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

- Implement the procedure of Chain Survey to find different distances and areas.
- Determine the reduced level of points using levelling instruments.
- Locate the position of the object after finding the distance and heights using theodolite.
- Apply the concepts of tacheometer surveying to find the height and distance of given object.
- Implement the modern survey techniques using Total Station equipment and GPS.

Reference Books(s) / Web links:

1	Dr.B.C.Punmia, Ashok K.Jain and Arun K Jain , Surveying Vol. I & II, Lakshmi Publications Pvt Ltd,New Delhi, 2005.
2	Alfred Leick, “GPS satellite surveying”, John Wiley & Sons Inc., 3rd Edition, 2004.
3	Bannister and S. Raymond, "Surveying", 7th Edition, Longman 2004. 3. Laurila, S.H. "Electronic Surveying in Practice", John Wiley and Sons Inc, 1993

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.No.	Description of Equipment	Quantity
1.	Total Station	3 No’s
2.	Theodolites	At least 1 for every 5 students
3.	Dumpy level / Filling level	At least 1 for every 5 students
4.	Pocket stereoscope	1 No
5.	Ranging rods	1 for a set of 5 students
6.	Levelling staff	
7.	Cross staff	
8.	Chains	
9.	Tapes	

10.	Arrows	
11.	Prismatic Compass	10 no's
12.	Surveyor Compass	2 no's
13.	GPS	3 no's

CE19411	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	2	2	2	3	1	1	1	3	2	1	3	3	2	1
CO 2	3	2	2	2	3	1	1	1	3	2	1	3	3	2	1
CO 3	3	2	2	2	3	1	1	1	3	2	1	3	3	2	1
CO 4	3	2	2	2	3	1	1	1	3	2	1	3	3	2	1
CO 5	3	2	2	2	3	1	1	1	3	2	1	3	3	2	1
Average	**3**	**2**	**2**	**2**	**3**	**1**	**1**	**1**	**3**	**2**	**1**	**3**	**3**	**2**	**1**

Subject Code	**Subject Name (Practical Course)**	**L**	**T**	**P**	**C**
CE19412	**HYDRAULIC ENGINEERING LABORATORY**	**0**	**0**	**4**	**2**

Objectives:

- To acquire knowledge on the flow measurement apparatus.
- To measure the losses that occur in the pipe flow.
- To operate the pumps and to study its characteristics.
- To operate the turbines and to study its characteristics.
- To understand the principle of buoyancy and Meta-centric height determination.

List of Experiments

A.	**Flow Measurement**
1.	Determination of coefficient of discharge of Rotameter.
2.	Determination of coefficient of discharge of Venturimeter/Orificemeter.
3.	Bernoulli's Experiment.
B.	**Losses in Pipes**
4.	Determination of friction factor in pipes.
5.	Determination of min or losses.
C.	**Pumps**
6.	Characteristics of Centrifugal pumps.
7.	Characteristics of Gear pump.
8.	Characteristics of Submersible pump.
9.	Characteristics of Reciprocating pump.
D.	**Turbines**
10.	Characteristics of Pelton wheel turbine.
11.	Characteristics of Francis turbine and Kaplan turbine.
E.	**Determination of Metacentric height**
12.	Determination of Metacentric height of floating bodies.

Total Contact Hours : 60

Course Outcomes:

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

- Apply Bernoulli equation for calibration of flow measuring devices.
- Measure friction factor in pipes and compare with Moody diagram.
- Determine the performance characteristics of pumps.

□	Determine the performance characteristics of turbines.
□	Implement the principle of buoyancy in floating objects.
Reference Books(s) / Web links:	
1	SarbjitSingh."Experiments in Fluid Mechanics", Prentice Hall of India Pvt. Ltd, Learning Private Limited, Delhi, 2009.
2	Hydraulic Laboratory Manual", Centre for Water Resources, Anna University, 2004.
3	Modi P.N. and Seth S.M., "Hydraulics and Fluid Mechanics", Standard Book House, New Delhi, 2000.
4	Subramanya K. "Flow in open channels", Tata McGraw Hill Publishing.Company, 2001.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.No	Description of Equipment	Quantity
1	Rotometer	1
2	Venturimeter/Orificemeter	1
3	Bernoulli's Experiment	1
4	Centrifugal Pump	1
5	Gear Pump	1
6	Submersible pump	1
7	Reciprocating Pump	1
8	Pelton Wheel turbine	1
9	Francis turbine	1
10	kaplon turbine	1
11	Determination of Metacentric height of floating bodies	1
12	Determination of friction factor in pipes	1
13	Determination of minor losses.	1

CE19412	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	2	2	1	1	1	1	3	3	2	3	3	3	2
CO 2	3	3	2	2	1	1	1	1	3	3	2	3	3	3	2
CO 3	3	3	2	2	1	1	1	1	3	3	2	3	3	3	2
CO 4	3	3	2	2	1	1	1	1	3	3	2	3	3	3	2
CO 5	3	3	2	2	1	1	1	1	3	3	2	3	3	3	2
Average	**3**	**3**	**2**	**2**	**1**	**1**	**1**	**1**	**3**	**3**	**2**	**3**	**3**	**3**	**2**

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
MC19301	**ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE (Non Credit Course)**	**MC**	**3**	**0**	**0**	**0**
Objectives:						
□	This course aims at imparting basic principles of thought process, reasoning and inference Sustainability is the core of Indian traditional knowledge system connecting society and nature Holistic life style of yogic science and wisdom are important in modern society with rapid technological advancements and societal disruptions. The course mainly focuses on introduction to Indian knowledge system, Indian perspective of modern science, basic principles of Yoga and holistic healthcare system, Indian philosophical, linguistic and artistic traditions.					

Pedagogy: Problem based learning, group discussions, collaborative mini projects.

UNIT-I	**Introduction To Indian Knowledge System:** Basic structure of the Indian Knowledge System –Veda – Upaveda - Ayurveda, Dhanurveda- Gandharvaveda, Sthapathyaveda and Arthasasthra. Vedanga (Six forms of Veda) – Shiksha, Kalpa, Nirukta, Vyakarana, Jyothisha and Chandas- Four Shasthras - Dharmashastra, Mimamsa, Purana and Tharkashastra.	**6**
UNIT-II	Modern Science And Yoga: Modern Science and the Indian Knowledge System – a comparison - Merits and demerits of Modern Science and the Indian Knowledge System - the science of Yoga-different styles of Yoga – types of Yogaasana, Pranayam, Mudras, Meditation techniques and their health benefits – Yoga and holistic healthcare – Case studies.	**6**
UNIT-III	Indian Philosophical Tradition: Sarvadharshan/Sadhdharshan – Six systems (dharshans) of Indian philosophy - Nyaya, Vaisheshika, Sankhya, Yoga, Mimamsa, Vedanta-Other systems- Chavarka, Jain (Jainism), Boudh (Buddhism) – Case Studies.	**6**
UNIT-IV	Indian Linguistic Tradition: Introduction to Linguistics in ancient India – history – Phonetics and Phonology – Morphology –Syntax and Semantics-Case Studies.	**6**
UNIT-V	Indian Artistic Tradition: Introduction to traditional Indian art forms – Chitrakala (Painting), Murthikala / Shilpakala (Sculptures), Vaasthukala, Sthaapathya kala (Architecture), Sangeeth (Music), Nruthya (Dance) and Sahithya (Literature) – Case Studies.	**6**
	Total Contact Hours : 30	

Course Outcomes:	
□	At the end of the course, students will be able to appreciate the importance of traditional Indian knowledge system, Yoga and other Indian traditions that are important in a modern society with technological advancements and lifestyle changes.
Text Book (s):	
1	V. Sivaramakrishnan (Ed.), *Cultural Heritage of India-course material*, Bharatiya Vidya Bhavan, Mumbai. 5th Edition, 2014.
2	Swami Jitatmanand, *Modern Physics and Vedant*, Bharatiya Vidya Bhavan.
3	Swami Jitatmanand, *Holistic Science and Vedant*, Bharatiya Vidya Bhavan.
4	Fritzof Capra, Tao of Physics.
5	Fritzof Capra, The Wave of life.
Reference Book (s) / Web links:	
1	VN Jha (Eng. Trans.), *Tarkasangraha of Annam Bhatta*, International Chinmay Foundation, Velliarnad, Arnakulam.
2	Yoga Sutra of Patanjali, Ramakrishna Mission, Kolkata.
3	GN Jha (Eng. Trans.), Ed. RN Jha, Yoga-darshanam with Vyasa Bhashya,Vidyanidhi Prakashan, Delhi 2016.
4	RN Jha, Science of Consciousness Psychotherapy and Yoga Practices, Vidyanidhi Prakashan, Delhi 2016.

MC19301	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	-	-	-	-	-	1	1	3	2	-	-	1	-	-	-
CO 2	-	-	-	-	-	1	1	3	2	-	-	1	-	-	-

CO 3	-	-	-	-	-	1	1	3	2	-	-	1	-	-	-
CO 4	-	-	-	-	-	1	1	3	2	-	-	1	-	-	-
CO 5	-	-	-	-	-	1	1	3	2	-	-	1	-	-	-
Average	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**3**	**2**	**-**	**-**	**1**	**-**	**-**	**-**

Subject Code	**Subject Name (Practical course)**	**Category**	**L**	**T**	**P**	**C**
GE19421	**SOFT SKILLS I**	**EEC**	**0**	**0**	**2**	**1**

Objectives:

- To help students break out of shyness.
- To build confidence.
- To enhance English communication skills.
- To encourage students' creative thinking to help them frame their own opinions.

Learning and Teaching Strategy:

The program is completely student centric where the focus is on activities led by students which include role plays, discussions, debates other games as well. These activities would be supplemented by interactive use of technology and brief trainer input.

Week	**Activity Name**	**Description**	**Objective**
1	Introduction	The trainer and the college facilitator talk to the students about the course and in turn the students introduce themselves.	To set expectations about the course and the students are made aware of the rules and regulations involved in this program
2	If I ruled the world	This is a quick and useful game by getting students to form a circle and provide their point of view. Each student then repeats what the other has said and comes up with their own opinion.	The aim of this activity is to for students to get to know each other and also develop their listening skills as well as learning how to agree and disagree politely.
3	Picture Narrating	This activity is based on several sequential pictures. Students are asked to tell the story taking place in the sequential pictures by paying attention to the criteria provided by the teacher as a rubric. Rubrics can include the vocabulary or structures they need to use while narrating.	The aim of this activity is to make the students develop creative way of thinking.
4	Brainstorming	On a given topic, students can produce ideas in a limited time. Depending on the context, either individual or group brainstorming is effective and learners generate ideas quickly and freely. The good characteristics of brainstorming are that the students are not criticized for their ideas so students will be open to sharing	The activity aims at making the students speak freely without the fear of being criticized. It also encourages students to come up with their own opinions.

		new ideas.	
5	Debate	Is competition necessary in regards to the learning process?	The aim of this activity is to develop the students ability to debate and think out of the box
6	Short Talks	Here the students are given topics for which they take one minute to prepare and two minutes to speak. They can write down points but can't read them out they can only use it as a reference.	The activity aims at breaking the students' shyness and encouraging them to standup in front of the class and speak. It also aims at creating awareness that they are restricted for time so they only speak points that are relevant and important.
7	Debate	Will posting students' grades on bulletin boards publicly motivate them to perform better or is it humiliating?	This activity aims at enhancing the students unbiased thought process when it comes to exams and grades as well as develop their skills to debate
8	The Art of diplomacy	The facilitator proceeds to share multiple concepts of conversation and helps the participants to identify the various methods of being diplomatic and how do deal with misinformation.	The aim of the lesson is to provide an opportunity for the participants to learn about body language and choosing the appropriate words for conversation.
9	Debate	Are humans too dependent on computers?	The aim of this activity is to test the students debating skills and thought process with a topic that affects everybody in daily life.
10	Story Completion	The teacher starts to tell a story but after 2 sentences he/she asks students to work in groups to create the rest of the story which includes the plot and the ending.	This activity aims at building their narrating skills as well as their creativity and ability to work in a team.

11	Role play debate	Students scrutinize different points of view or perspectives related to an issue. For example, a debate about the question "Should students be required to wear uniforms at school?" might yield a range of opinions. Those might include views expressed by a student (or perhaps two students – one representing each side of the issue), a parent, a school principal, a police officer, a teacher, the owner of a clothing store, and others.	The aim of this activity is to get students to speak based on other people's perspective instead of their own. The students take the role of various characters and debate accordingly.
12	I Couldn't Disagree More	This is a game where students practice rebuttal techniques where one student provides a thought or an idea and the other students starts with the phrase I couldn't disagree more and continues with his opinion	The aim of this activity is to improve general communication skills and confidence.
	Feedback	At the end of the session in the final week (12) the trainer would provide feedback to the students on best practices for future benefits	The aim is to do both give feedback to students as well as obtain feedback on the course from them.
		Total Contact Hours	**: 30**

Course Outcomes:

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

- Be more confident
- Speak in front of a large audience.
- Be better creative thinkers.
- Be spontaneous.
- Know the importance of communicating in English.

GE19421	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	-	-	-	-	-	-	-	-	1	3	-	1	-	-	-
CO 2	1	-	-	-	-	-	1	-	1	3	1	1	-	-	-
CO 3	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO 4	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO 5	-	-	-	-	-	-	-	-	-	3	-	-	-	-	1
Average	0.2	0	0	0	0.4	0	0.2	0	0.4	3	0.2	0.4	0	0	0.2

SEMESTER V

Subject Code	Subject Name (Theory Course)	Category	L	T	P	C
CE19501	DESIGN OF REINFORCED CONCRETE ELEMENTS	PC	3	1	0	4

Objectives:

□	To analyze and design singly reinforced and doubly reinforced beams by working stress method and limit state method as per Codal provision.
□	To analyze and design flanged beams and beams subjected to bending, shear and torsion as per limit state method.
□	To design all types of slabs for different boundary conditions and design the doglegged staircase as per Codal provision.
□	To design the columns for different types of location and loading condition as per Codal provision.
□	To design the types of footing and masonry wall for loading as per Codal provision.

UNIT-I	**INTRODUCTION**	**12**

Objective of structural design-Steps in RCC Structural Design Process- Type of Loads on Structures and Load combinations- Code of practices and Specifications - Concept of Working Stress Method, Ultimate Load Design and Limit State Design Methods for RCC –Properties of Concrete and Reinforcing Steel - Analysis and Design of Singly reinforced Rectangular beams by working stress method - Limit State philosophy as detailed in IS code - Advantages of Limit State Method over other methods - Analysis and design of singly and doubly reinforced rectangular beams by Limit State Method.

UNIT-II	**DESIGN OF BEAMS**	**12**

Analysis and design of Flanged beams – Use of design aids for Flexure - Behaviour of RC members in Shear, Bond and Anchorage - Design requirements as per IS code - Behaviour of rectangular RC beams in shear and torsion - Design of RC members for combined Bending, Shear and Tension.

UNIT-III	**DESIGN OF SLABS AND STAIRCASE**	**12**

Analysis and design of cantilever, one way simply supported and continuous slabs and supporting beams-Two way slab- Design of simply supported and continuous slabs using IS Code coefficients- Types of Staircases – Design of dog-legged Staircase.

UNIT-IV	**DESIGN OF COLUMNS**	**12**

Types of columns –Axially Loaded columns – Design of short Rectangular, Square and Circular Columns –Design of Slender columns- Design for Uniaxial and Biaxial bending using Design aids.

UNIT-V	**DESIGN OF FOOTINGS**	**12**

Concepts of Proportioning footings and foundations based on soil properties-Design of wall footing – Design of axially and eccentrically loaded Square, Rectangular pad and sloped footings – Design of Combined Rectangular footing for two columns only.

Total Contact Hours	**:**	**60**

Course Outcomes:

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

□	Analyze and design singly reinforced and doubly reinforced beams by working stress method and limit state method as per Codal provision.
□	Analyze and design flanged beams and beams subjected to bending, shear and torsion as per limit state method.
□	Design all types of slabs for different boundary conditions and design the doglegged staircase as per Codal provision.
□	Design the columns for different types of location and loading condition as per Codal provision.
□	Design the types of footing and masonry wall for loading as per Codal provision.

Text Book (s):	
1	Subramanian,N.,“ Design of Reinforced Concrete Structures”,Oxford University Press, New Delhi, 2014.
2	Ramamrutham S.,“ Design of Reinforced Concrete Structures”Dhanpat rai,New Delhi,2011.
Reference Book (s) / Web links:	
1	Dr.Ramachandra, “ Limit state Design of Concrete Structures “ Standard Book House, New Delhi.
2	Krishnaraju.N “Design of Reinforced Concrete Structurres “, CBS Publishers & Distributors Pvt. Ltd., New Delhi.
3	Punmia.B.C., Ashok Kumar Jain, Arun Kumar Jain, “Limit State Design of Reinforced Concrete”, Laxmi Publication Pvt. Ltd., New Delhi, 2007.
4	Dayaratnam.P., Limit State Design of Reinforced Concrete Structures, Oxford, IBH Publishing Company Pvt. Ltd., 2008.
5	Varghese, P.C., “Limit State Design of Reinforced Concrete”, Prentice Hall of India, Pvt. Ltd., New Delhi, 2002.
6	Edward G. Nawy, Reinforced Concrete – A fundamental Approach, 6th Edition, Prentice Hall, 2008.
7	Unnikrishna Pillai and Devdass Menon, Reinforced Concrete Design, Tata McGraw Hill Publishing Company Ltd., 2005.
8	Gambhir.M.L., "Fundamentals of Reinforced Concrete Design", Prentice Hall of India Private Limited, New Delhi, 2006.
9	Online courses - http://www.nptel.iitm.ac.in/
10	American Concrete Institute-https://www.concrete.org/
11	Online Software-http://simplifieddesignofconcretestructures.weebly.com/beam-design.html
Code Book(s):	
1	IS 456:2000 Plain and Reinforced Concrete – Code of Practice.
2	IS 875(1-5):1987 Code of Practice for Design Loads for Buildings and Structures.
3	SP 16:1980 Design Aids for Reinforced Concrete to IS 456:1978.
4	SP 34:1987 Handbook of concrete reinforcement and detailing.
5	Handbook for Limit State Design of Reinforced Concrete Structures – Roorkee.

CE19501	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO 1	3	3	3	3	2	2	1	2	1	1	1	3	3	3	1
CO 2	3	3	3	3	2	2	1	2	1	1	1	3	3	3	1
CO 3	3	3	3	3	2	2	1	2	1	1	1	3	3	3	1
CO 4	3	3	3	3	2	2	1	2	1	1	1	3	3	3	1
CO 5	3	3	3	3	2	2	1	2	1	1	1	3	3	3	1
Average	**3**	**3**	**3**	**3**	**2**	**2**	**1**	**2**	**1**	**1**	**1**	**3**	**3**	**3**	**1**

Subject Code	**Subject Name (Theory course)**	**Category**	**L**	**T**	**P**	**C**
CE19502	**TRAFFIC AND HIGHWAY ENGINEERING**	**PC**	**3**	**0**	**0**	**3**
Objectives:						
☐	To procure knowledge on the principles and standards adopted in Planning and Design of Traffic system.					
☐	To get acquainted with the different types of traffic surveys with applications in studies and					

	forecasting.
□	To recognize the significance of highway planning and road development plan in India.
□	To achieve acquaintance on application of Science and Engineering fundamentals in designing the components for an efficient Highway.
□	To select appropriate methods for construction, evaluation and maintenance of roadways.

UNIT-I	**TRAFFIC ENGINEERING**	**8**

Significance and scope, Characteristics of Vehicles and Road Users, –Traffic Stream Characteristics– Components of Traffic Engineering – Road, Traffic and Land Use Characteristics.

UNIT-II	**TRAFFIC SURVEYS AND ANALYSIS**	**9**

Surveys and Analysis - Volume, Capacity, Speed and Delays, Origin and Destination, Parking, Pedestrian Studies, Accident Studies and Safety Level of Services- Problems.

UNIT-III	**HIGHWAY ENGINEERING**	**9**

History of road development in India – Classification of highways – Institutions for Highway planning, design and construction at different levels – factors influencing highway alignment –Typical cross sections of Urban and Rural roads.

UNIT-IV	**DESIGN OF HIGHWAY ELEMENTS**	**10**

Cross sectional elements – Horizontal curves, super elevation, transition curves, widening of curves – Sight distances – Vertical curves, gradients– pavement components and their role - Design practice for flexible and rigid pavements (IRC methods only).

UNIT-V	**HIGHWAY CONSTRUCTION AND MAINTENANCE**	**9**

Highway construction materials, properties, testing methods – Construction practice of flexible and concrete pavement- Highway drainage–Evaluation and Maintenance of pavements.

	Total Contact Hours	**:**	**45**

Course Outcomes:

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

□	Recognize the traffic characteristics and its various models describing the relationship among traffic stream parameters.
□	Comprehend the knowledge on traffic surveys and studies such as 'Volume Count', 'Speed and delay', 'Origin and destination', 'Parking', 'Pedestrian' and 'Accident surveys'.
□	Plan a highway according to the principles and standards adopted in various intuitions in India.
□	Design the geometric features of road network and components of pavement.
□	Test the highway materials and Construction practice methods and know its properties and able to perform pavement evaluation and management.

Text Book (s):

1	L.R. Kadiyali, Traffic Engineering and Transport planning, Khanna Publishers, New Delhi, (2011).
2	Subramanian K.P., Highways, Railways, Airport and Harbour Engineering,Scitech Publications (India), Chennai, 2010.

Reference Book (s) / Web links:

1	S K Khannaand Justo.C.E.G. Highway Engineering, Nem Chand & Bros Publishers, 2014.
2	S K Khanna, Justo.C.E.G and Veeraragavan. A, Highway Materials and Pavement Testing Nem Chand & Bros Publishers, 2013.
3	C.Venkatramaiah., Transportation Engineering-Highway Engineering, Universities Press `(India) Private Limited, Hyderabad, 2015.
4	Subhash C Saxena, Textbook of Highway and Traffic Engineering. CBS Publishers, 2017.
5	R.Srinivasa Kumar., Textbook of Highway Engineering Universities Press (India) Private Limited, Hyderabad, 2011.

Code Book(s):

1	IRC-37- 2018 Indian Road Congress (IRC), Guidelines for the Flexible pavements design**.**

2	IRC-58-2018 Indian Road Congress (IRC), Guidelines for the Plain jointed rigid pavements-design-Highways.
3	Indian Road Congress (IRC), Guidelines and Special Publications of Planning and Design.

CE19502	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	3	2	1	3	1	1	1	1	1	3	1	3	3
CO 2	2	1	1	1	3	1	1	1	1	1	1	3	3	3	2
CO 3	2	2	2	2	1	1	1	1	1	1	1	1	3	3	2
CO 4	2	2	2	2	1	1	1	1	1	1	1	1	2	1	3
CO 5	2	1	2	1	1	1	1	1	1	1	1	1	1	2	3
Average	**2.2**	**1.8**	**2**	**1.6**	**1.4**	**4.4**	**1**	**1**	**1**	**1**	**1**	**1.8**	**2**	**2.4**	**2.6**

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
CE19503	**STRUCTURAL ANALYSIS I**	**PC**	**2**	**1**	**0**	**3**

Objectives:

- To analyze indeterminate beams and frames using Strain Energy Method.
- To analyze indeterminate beams and frames using Slope Deflection Method.
- To analyze indeterminate beams and frames using Moment Distribution Method.
- To analyze indeterminate beams and frames using Flexibility Method.
- To analyze indeterminate beams and frames using Stiffness Method.

UNIT-I **STRAIN ENERGY METHOD** **9**

Introduction to Force and Displacement methods. Determination of Static and Kinematic Indeterminacies – Strain Energy - Analysis of continuous beams, plane frames and indeterminate plane trusses by strain energy method (upto two degree of redundancy).

UNIT-II **SLOPE DEFLECTION METHOD** **9**

Slope deflection equations – Equilibrium conditions - Analysis of continuous beams and rigid frames – Rigid frames with inclined members - Support settlements- symmetric frames with symmetric and skew-symmetric loadings.

UNIT-III **MOMENT DISTRIBUTION METHOD** **9**

Stiffness and carry over factors – Distribution and carryover of moments - Analysis of continuous Beams- Plane rigid frames with and without sway – Support settlement - symmetric frames with symmetric and skew-symmetric loadings.

UNIT-IV **FLEXIBLITY METHOD** **9**

Primary structures - Compatibility conditions – Formation of flexibility - Analysis of indeterminate pin-jointed plane frames, continuous beams and rigid jointed plane frames by direct flexibility approach.

UNIT-V **STIFFNESS METHOD** **9**

Restrained structure – Formation of stiffness - Equilibrium conditions - Analysis of Continuous Beams, Pin-jointed plane frames and rigid frames by direct stiffness method.

Total Contact Hours : 45

Course Outcomes:

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

- Analyze and illustrate the bending moment & shear force for indeterminate structures using strain energy method.

□	Analyze and illustrate the bending moment & shear force for indeterminate structures using Slope Deflection Method.
□	Analyze and illustrate the bending moment & shear force for indeterminate structures using Moment Distribution Method.
□	Analyze and illustrate the bending moment & shear force for indeterminate structures using Flexibility Method.
□	Analyze and illustrate the bending moment & shear force for indeterminate structures using Stiffness Method.
Text Book(s):	
1	Dr. Punmia B.C, Ashok Kumar Jain & Dr. Arun Kumar Jain, "Theory of Structures", Laxmi Publications, New Delhi, 2017.
2	a) Bhavikatti,S.S, "Structural Analysis-I", Vikas Publishing House Pvt.Ltd., New Delhi, 2010. b) Bhavikatti S.S, "Structural Analysis –II", Vikas Publishing House Pvt. Ltd., New Delhi, 2013.
Reference Book(s) / Web links:	
1	Gambhir. M.L., "Fundamentals of Structural Mechanics and Analysis", PHI Learning Pvt .Ltd., 2011.
2	Reddy.C.S, "Basic Structural Analysis", The McGraw Hill companies, 2010.
3	Negi L.S and Jangid R.S, "Structural Analysis", Tata McGraw Hill Publishing Co.Ltd.2004.
4	Pandit G.S.and Gupta S.P., "Structural Analysis – A Matrix Approach", The McGraw Hill companies, 2008.
5	https://nptel.ac.in/courses/105/105/105105166/
6	https://nptel.ac.in/courses/105/101/105101086/

CE19503	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	2	3	1	2	1	1	2	1	-	2	3	3	1
CO 2	3	3	2	3	1	2	1	1	2	1	-	2	3	3	1
CO 3	3	3	2	3	1	2	1	1	2	1	-	2	3	3	1
CO 4	3	3	2	3	1	2	1	1	2	1	-	2	3	3	1
CO 5	3	3	2	3	1	2	1	1	2	1	-	2	3	3	1
Average	**3**	**3**	**2**	**3**	**1**	**2**	**1**	**1**	**2**	**1**	**-**	**2**	**3**	**3**	**1**

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
CE19504	**SOIL MECHANICS**	**PC**	**2**	**1**	**0**	**3**
Objectives:						
□	To acquire knowledge about soil classification based on the index properties of soil.					
□	To evaluate effective stress in soil and to understand capillary, permeability, seepage occurring in soil.					
□	To estimate stress distribution within soil and also know soil behavior under compression.					
□	To evaluate shear strength parameters of soil using different laboratory tests.					
□	To analyze slope stability using different methods and also know the different slope protection measures.					
UNIT-I	**SOIL CLASSIFICATION AND COMPACTION**					**9**

History – formation and types of soil – composition - Soil index properties – clay mineralogy– description – Classification – BIS – USCS – phase relationship – Compaction – theory – laboratory and field Compaction method – factors influencing compaction.		
UNIT-II	**EFFECTIVE STRESS AND PERMEABILITY**	**9**
Soil - water – Effective stress concepts in soils – Capillary phenomena – Permeability – Darcy's law – Determination of Permeability – Laboratory methods (Constant head and falling head methods) and field measurement - pumping out test in unconfined and confined aquifer – Factors influencing permeability of soil – Seepage - Two dimensional flow – Laplace equation – Introduction to flow nets – Simple problems.		
UNIT-III	**STRESS DISTRIBUTION AND SETTLEMENT**	**9**
Stress distribution in homogeneous and isotropic medium – Boussinesq's theory – (Point load, circular load, strip load, rectangular load) - Use of Newmark's influence chart – Components of settlement — Immediate and consolidation settlement – Factors influencing settlement – Terzaghi's one dimensional consolidation theory – Computation of rate of settlement. –- √t and log t methods, e-log p relationship - Computation of consolidation settlement - N.C clays and O.C clays.		
UNIT-IV	**SHEAR STRENGTH**	**9**
Shear strength of cohesive and cohesionless soils – Mohr-Coulomb failure theory – shear strength - Direct shear, Triaxial compression, UCC and Vane shear tests – Pore pressure parameters – Factors influencing shear strength of soil.		
UNIT-V	**SLOPE STABILITY**	**9**
Slope failures – Types and causes - Infinite slopes and finite slopes – Total stress analysis for saturated clay – Friction circle method –Taylor's stability number – Fellenius method of slices – Location of critical slope surface in cohesive and c - ϕ soil – Slope protection measures.		
	Total Contact Hours :	**45**

Course Outcomes:

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

□	Analyze and compute the different index properties of soil and classify the soil according to IS classification system.
□	Assess the soil condition in the presence of water and evaluate the effective stresses, permeability and seepage within soil.
□	Compute the increase in vertical pressure using stress distribution concepts and estimate the consolidation parameters and settlement of compressible soils.
□	Evaluate the shear strength parameters of soil by various laboratory tests and drainage conditions.
□	Analyze the slope stability using different methods and propose measures to mitigate slope failures.

Text Book (s):

1	Murthy, V.N.S., "Text book of Soil Mechanics and Foundation Engineering", CBS Publishers Distribution Ltd., New Delhi. 2014.
2	Punmia, B.C., "Soil Mechanics and Foundations", Laxmi Publications Pvt. Ltd. New Delhi, 16th Edition, 2017.

Reference Book (s) / Web links:

1	McCarthy, D.F., "Essentials of Soil Mechanics and Foundations: Basic Geotechnics". Prentice-Hall, 2006.
2	Coduto, D.P., "Geotechnical Engineering – Principles and Practices", Prentice Hall of India Pvt. Ltd. New Delhi, 2010.
3	Braja M Das, "Principles of Geotechnical Engineering", Cengage Learning India Private Limited, 8th Edition, 2014.
4	Palanikumar.M, "Soil Mechanics", Prentice Hall of India Pvt. Ltd, Learning Private Limited Delhi, 2013.
5	Craig.R.F., "Soil Mechanics", E & FN Spon, London and New York, 2012.

6	Venkatramaiah.C., "Geotechnical Engineering", New Age International Pvt. Ltd., New Delhi, 2017.
7	Arora, K.R., "Soil Mechanics and Foundation Engineering", Standard Publishers and Distributors, New Delhi, 7th Edition, 2017(Reprint).
8	Gopal Ranjan, A S R Rao, "Basic and Applied Soil Mechanics" New Age International Publication, 3rd Edition, 2016.
9	https://nptel.ac.in/courses/105/105/105105168/
10	https://people.eng.unimelb.edu.au/stsy/geomechanics_text/Ch5_Flow.pdf
11	http://www.gpcet.ac.in/wp-content/uploads/2017/04/UNIT-5.pdf

CE19504	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	2	2	1	1	1	1	1	1	1	1	3	2	2
CO 2	3	3	2	2	1	1	1	1	1	1	1	1	3	2	2
CO 3	3	3	2	2	1	1	1	1	1	1	1	1	3	2	2
CO 4	3	3	2	2	1	1	1	1	1	1	1	1	3	2	2
CO 5	3	3	3	2	1	1	2	1	1	1	1	1	3	2	2
Average	**3**	**3**	**2.2**	**2**	**1**	**1**	**1.2**	**1**	**1**	**1**	**1**	**1**	**3**	**2**	**2**

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
CE19505	**WATER SUPPLY ENGINEERING**	**PC**	**3**	**0**	**0**	**3**

Objectives:

- To estimate water demand, population forecasting & water quality characteristics and to be familiar with water quality standards.
- To design of flow through pipes and acquire knowledge in laying, jointing and testing of pipes, appurtenances and pumps.
- To design water treatment plant units like flash mixers, clariflocculators, pulsator clarifier and sand filters.
- To familiarize about advanced water treatment methods like water softening, desalination, RO plant, demineralization, adsorption, ion exchange, defluoridation and iron & manganese removal.
- To determine the requirements of water distribution, design of service reservoirs, water distribution networks, house service connection and pipe fittings & fixtures.

UNIT-I	**SOURCES OF WATER**	**9**

Public water supply system – Planning, Objectives, Design period, Population forecasting; Water demand – Sources of water and their characteristics, Surface and Groundwater – Impounding Reservoir – Development and selection of source – Source Water quality – Characterization – Significance – Drinking Water quality standards.

UNIT-II	**CONVEYANCE FROM THE SOURCE**	**9**

Water supply – intake structures – Functions, Pipes and conduits for water – Selection of Pipe materials – Hydraulics of flow in pipes – Transmission main design – Laying, jointing and testing of pipes – appurtenances – Types and capacity of pumps – Selection of pumps.

UNIT-III	**WATER TREATMENT**	**11**

Objectives – Unit operations and processes – Principles, functions and design of water treatment plant units, aerators of flash mixers, Coagulation and flocculation – Clariflocculator - Plate and tube settlers - Pulsator clarifier - sand filters - Disinfection - Residue Management –Construction, Operation and Maintenance aspects.

UNIT-IV	ADVANCED WATER TREATMENT	8
Water softening – Desalination - R.O. Plant – demineralization – Adsorption - Ion exchange– Membrane Systems – RO Reject Management - Iron and Manganese removal - Defluoridation – Removal of Arsenic - Construction and Operation & Maintenance aspects – Recent advances.		
UNIT-V	**WATER DISTRIBUTION AND SUPPLY**	**8**
Requirements of water distribution – Components – Service reservoirs– Functions – Network design – Economics – Analysis of distribution networks - Computer applications – Leak detection. Principles of design of water supply in buildings – House service connection – Fixtures and fittings, systems of plumbing and types of plumbing.		
	Total Contact Hours : 45	

Course Outcomes:

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

- Estimate water demand, population forecasting & water quality characteristics and to be familiar with water quality standards.
- Design of flow through pipes and acquire knowledge in laying, jointing and testing of pipes, appurtenances and pumps.
- Design of water treatment plant units like flash mixers, clariflocculators, pulsator clarifier and sand filters.
- Acquire knowledge on advanced water treatment methods like water softening, desalination, RO plant, demineralization, adsorption, ion exchange, defluoridation and iron & manganese removal.
- Design service reservoirs, water distribution networks and be familiar with house service connection and pipe fittings & fixtures.

Text Book (s):

1. Garg, S.K. Environmental Engineering, Vol.I Khanna Publishers, New Delhi, 2010.
2. Punmia, B.C.,Ashok Jain and Arun Jain, Water Supply Engineering, Laxmi Publications (P) Ltd., New Delhi, 2010.

Reference Book(s) / Web links:

1. Syed R. Qasim and Edward M. Motley Guang Zhu, Water Works Engineering Planning, Design and Operation, Prentice Hall of India Learning Private Limited, New Delhi, 2009.
2. Peavy, Rowe, Tchobanoglous, "Environmental Engineering", McGraw Hill Publishers, New Delhi, 1995.
3. Birdie G.S and Birdie J.S "Water Supply and Sanitary Engineering" Dhatpat Rai Publishing Company New Delhi, 7th edition 2004.
4. Gilbert M. Masters , " Introduction to Environmental Engineering and Science", third Edition, 2008.
5. Chatterjee A.K. Water Supply, Waste Disposal and Environmental Engineering, 8th ed., New Delhi, Khanna Publisher. 2010.
6. Modi, P.N., Water Supply Engineering, Vol.I Standard Book House, New Delhi, 2010.
7. https://nptel.ac.in/courses/105/105/105105201/

Code Book(s):

1. IS10500:2012 Water Quality Standards ,New Delhi 2012.
2. Manual on Water Supply and Treatment, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 1999.

CE19505	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3

CO 1	3	3	3	2	1	3	3	1	1	1	1	3	3	2	1
CO 2	3	3	3	2	1	3	3	1	1	1	1	3	3	2	1
CO 3	3	3	3	2	1	3	3	1	1	1	1	3	3	2	1
CO 4	3	3	3	1	1	3	3	1	1	1	1	3	3	2	1
CO 5	3	3	3	2	1	3	3	1	1	1	1	3	3	2	1
Average	3	**3**	**3**	**1.8**	**1**	**3**	**3**	**1**	**1**	**1**	**1**	**3**	**3**	**2**	**1**

Subject Code	**Subject Name (Practical course)**	**Category**	**L**	**T**	**P**	**C**
CE19511	**SOIL MECHANICS LABORATORY**	**PC**	**0**	**0**	**2**	**1**

Objectives:

- To classify the soil based on the index properties of soil.
- To evaluate the in-situ density & compaction characteristics of soil.
- To determine the permeability of soil.
- To estimate the shear strength parameters of soil.
- To evaluate the soil strength based on the CBR test.

List of Experiments

1	**DETERMINATION OF INDEX PROPERTIES**	**10**
a.	Specific gravity of soil solids.	
b.	Grain size distribution – Sieve analysis.	
c.	Grain size distribution - Hydrometer analysis.	
d.	Liquid limit, Plastic limit and shrinkage limit tests.	
e.	Differential free swell test.	
2	**DETERMINATION OF INSITU DENSITY AND COMPACTION CHARACTERISTICS**	**5**
a.	Field density Test (Sand replacement method and core cutter method).	
b.	Determination of moisture – density relationship using standard Proctor compaction test.	
c.	Determination of relative density (Demonstration only).	
3	**DETERMINATION OF ENGINEERING PROPERTIES**	**15**
a.	Permeability determination (constant head and falling head methods).	
b.	One dimensional consolidation test (Determination of Co-efficient of consolidation only).	
c.	Direct shear test in cohesionless soil.	
d.	Unconfined compression test on cohesive soil.	
e.	Laboratory vane shear test on cohesive soil.	
f.	Tri-axial compression test (Demonstration only).	
g.	California Bearing Ratio Test.	
	Total Contact Hours : 30	

Course Outcomes:

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

- Classify the soil based on the index properties of soil.
- Evaluate the in-situ density & compaction characteristics of soil.
- Determine the permeability of soil.
- Estimate the shear strength parameters of soil.
- Evaluate the soil strength based on the CBR test.

Reference Book(s) / Web links:

1	"Soil Engineering Laboratory Instruction Manual" published by Engineering College Cooperative Society, Anna University, Chennai, 2010.
2	Lambe T.W., "Soil Testing for Engineers", John Wiley and Sons, New York, 1951. Digitized 2008.
3	Saibaba Reddy, E.Ramasastri, K. "Measurement of Engineering Properties of Soils" New Age International (P) Limited Publishers, New Delhi, 2002.
4	https://nptel.ac.in/courses/105/101/105101160/
5	http://smfe-iiith.vlabs.ac.in/
Code Book(s):	
1	IS Code of Practice (2720) Relevant Parts, as amended from time to time, Bureau of Indian Standards, New Delhi.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

Sl.No.	Description of Equipment	Quantity
1.	Sieves	2 sets
2.	Hydrometer	2 sets
3.	Liquid and Plastic limit apparatus	2 sets
4.	Shrinkage limit apparatus	3 sets
5.	Proctor Compaction apparatus	2 sets
6.	California Bearing Ratio (CBR) test device	1
7.	Direct Shear apparatus	1
8.	Thermometer	2
9.	Sand replacement method accessories and core cutter method accessories	2
10.	Tri-axial Shear apparatus	1
11.	Three Gang Consolidation test device	1
12.	Relative Density apparatus	1
13.	Van Shear apparatus	1
14.	Weighing machine – 20kg capacity	1 No
15.	Weighing machine – 1kg capacity	3 No's

CE19511	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	1	1	2	1	1	1	2	3	1	1	2	3	2	2
CO 2	3	1	1	2	1	1	1	2	3	1	1	2	3	2	2
CO 3	3	1	1	2	1	1	1	2	3	1	1	2	3	2	2
CO 4	3	1	1	2	1	1	1	2	3	1	1	2	3	2	2
CO 5	3	1	1	2	1	1	1	2	3	1	1	2	3	2	2
Average	**3**	**1**	**1**	**2**	**1**	**1**	**1**	**2**	**3**	**1**	**1**	**2**	**3**	**2**	**2**

Subject Code	Subject Name (Practical course)	Category	L	T	P	C

CE19512	SURVEY CAMP*	PC	0	0	2	1

Groups of not more than six members in a group will carry out each exercise in survey camp. The camp must involve work on a large area of not less than 40 acres outside the campus (Survey camp should not be conducted inside the campus). At the end of the camp, each student shall have mapped and contoured the area. The camp record shall include all original field observations, calculations and plots.

Objectives:

- To conduct survey by traversing and contouring in the field.
- To mark the location of building by offsets.
- To determine the Sun Rise/ Sun Set time and Azimuth.
- To traverse the area using Total Station and GPS.
- To set a simple/compound/reverse/transition curve in the field.

List of Experiments

1.	Traverse using Total station.
2.	Contouring – Radial and Block.
4.	Longitudinal and Cross Sectional Levelling of Road and Canal/Bund.
5.	Offset of Buildings and Plotting the Location.
6.	Estimation of Sun Rise/ Sun Set time using Sun Observations
7.	Determination of Azimuth by Ex-Meridian observation.
8.	Traversing using GPS.
9.	Curve setting by deflection angle method.
10.	Triangulation and Trilateration.

Course Outcomes:

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

- Traverse and Contour the field.
- Mark the building and its location.
- Determine the Sun Rise/ Sun Set time and Azimuth in the field.
- Traverse the area using Total Station and GPS.
- Set a simple/compound/reverse/transition curve in the field.

Reference Book(s) / Web links:

1	Alfred Leick, “GPS satellite surveying”, John Wiley & Sons Inc., 4th Edition, 2015.
2	Arora K.R.,"SurveyingVol I & II", Standard Book house, 16th Edition 2013.
3	Dr.B.C.Punmia, Ashok K.Jain and Arun K Jain, Surveying Vol. I & II, Lakshmi Publications Pvt Ltd,New Delhi, 2015.
4	Guochang Xu, “GPS Theory, Algorithms and Applications”, Springer – Berlin, 2010.
5	James M. Anderson and Edward M. Mikhail, "Surveying, Theory and Practice", 7th Edition, McGraw Hill, 2012.
6	Roy S.K., "Fundamentals of Surveying", 2nd Edition, Prentice Hall of India, 2011.
7	Satheesh Gopi, R Sathishkumar, N. Madhu, “Advanced Surveying, Total Station GPS and Remote Sensing” Pearson education, 2007.

(* Two weeks at the end of Fourth Semester)

CE19512	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	2	2	2	3	1	1	1	3	2	1	3	3	2	1
CO 2	3	2	2	2	3	1	1	1	3	2	1	3	3	2	1
CO 3	3	2	2	2	3	1	1	1	3	2	1	3	3	2	1

CO 4	3	2	2	2	3	1	1	1	3	2	1	3	3	2	1
CO 5	3	2	2	2	3	1	1	1	3	2	1	3	3	2	1
Average	**3**	**2**	**2**	**2**	**3**	**1**	**1**	**1**	**3**	**2**	**1**	**3**	**3**	**2**	**1**

Subject Code	**Subject Name (Practical Course)**	**Category**	**L**	**T**	**P**	**C**
GE19521	**SOFT SKILLS II**	**EEC**	**0**	**0**	**2**	**1**

Objectives:

- To help students break out of shyness.
- To build confidence.
- To enhance English communication skills.
- To encourage students' creative thinking to help them frame their own opinions.

Learning and Teaching Strategy:

The program is completely student centric where the focus is on activities led by students which include role plays, discussions, debates other games as well. These activities would be supplemented by interactive use of technology and brief trainer input.

Week	**Activity Name**	**Description**	**Objective**
1	The News hour	Students are made to read news articles from the English newspapers. The students also have to find words and their meaning from the article they have not come across before and share it with the group. They then use these words in sentences of their own	The aim of this activity is not only to get the students to read the newspaper but also aims at enhancing the students' vocabulary.
2	Court Case	The facilitator provides the participants the premise of a story and proceeds to convert the story into a court case. The students are required, department-wise to debate and provide their points to win the case for their clients.	The aim of the lesson is to encourage creative and out-of-the -box thinking to ensure a good debate and defense skills.
3	The ultimate weekend	The students design activities they are going to do over the weekend and they have to invite their classmates to join in the activity. The students move around the class and talk to other students and invite them.	The aim of this activity is to develop the art of conversation among students. It also aims at practicing the grammatical structures of "going to" "have to" and asking questions.
4	The Four Corners	This is a debate game that uses four corners of the classroom to get students moving. The following is written on the 4 corners of the room "Strongly Agree, Somewhat Agree, Somewhat Disagree and Strongly Disagree". The topics are then given to the class and students move to the corner that they feel best explains their opinions	This activity aims at getting students to come up with their own opinions and stand by it instead of being overshadowed by others and forcing themselves to change based on others opinions.

5	Debate	Boarding school or day school? Which is more beneficial for a student?	The aim of this activity is to encourage students to draw up feasible points on the advantages and benefits of both. And enhance their debating ability
6	Grand Master	The facilitator starts the session by keeping an individual in mind, upon which the students guess it only through "Yes or No" questions. Post few trials the students are given same opportunity to do the same with the crowd.	The aim of the lesson is designed to teach the art of questioning. It also helps to enhance the students' speaking and listening skills.
7	Debate	Does violence on the TV and Video games influence children negatively?	This activity aims at encouraging the students to debate on real life scenarios that most students spend a lot of time on.
8	Turn Tables	This is a speaking activity where the students need to speak for and against the given topics when the facilitator shouts out 'Turn Table'.	The aim of this activity is to make the participants become spontaneous and have good presence of mind.
9	Debate	Do marks define the capabilities of a student?	This debate activity aims at allowing the students to argue on this worrisome adage of marks.
10	Fiction AD	The Participants are asked to create an Ad for a challenging topic only using fictional characters.	The activity aims at developing their creativity and presentation skills.
11	Debate	Are social networking sites effective, or are they just a sophisticated means for stalking people?	This activity aims at refining the students debating skills on a very real life situation
12	Talent Hunt	Talent Hunt is a fun activity where the students are selected at random and supported to present any of their own skills.	The aim of this activity is designed to evoke their inner talents and break the shyness and the fear of participating in front of a crowd
	Feedback	At the end of the session in the final week (12) the trainer would provide feedback to the students on best practices for future benefits.	The aim is to do both give feedback to students as well as obtain feedback on the course from them.
			Total Contact Hours : 60

Course Outcomes:

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

- Be more confident.
- Speak in front of a large audience without hesitation.
- Think creatively.
- Speak impromptu.
- Communicate in English.

GE19521	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3

CO 1	-	-	-	-	-	-	-	-	2	3	1	1	-	-	1
CO 2	-	-	-	-	-	-	-	-	2	3	2	-	-	-	1
CO 3	-	1	-	-	-	-	-	-	2	3	1	1	-	1	2
CO 4	-	-	-	-	-	-	-	-	2	3	-	-	-	-	1
CO 5	-	1	-	-	-	-	-	-	2	3	1	1	-	-	3
Average	0	1	0	0	0	0	0	0	2	3	1.25	1	0	1	1.6

SEMESTER VI

Subject Code	**Subject Name (Theory course)**	**Category**	**L**	**T**	**P**	**C**
CE19601	**DESIGN OF STEEL STRUCTURES**	**PC**	**3**	**1**	**0**	**4**

Objectives:

- To apprehend the design philosophy of steel structures and failure modes of steel structural connections.
- To design the tension members.
- To design the compression members.
- To design laterally supported and unsupported beams, built-up beams and plate girders
- To design industrial roofs truss, gantry girders, continuous beams and portal frames using plastic design approach.

UNIT-I	**INTRODUCTION TO STRUCTURAL STEEL AND DESIGN OF CONNECTIONS**	**12**

General – Working Stress Method - Types of Steel -Properties of structural steel - I.S. rolled sections - Concept of Limit State Design - Design of Simple and eccentric Bolted and welded connections by LSM - Types of failure and efficiency of joint – prying action - Introduction to HSFG bolts.

UNIT-II	**TENSION MEMBERS**	**12**

Types of sections – Net area – Net effective sections for angles and Tee in tension-Behaviour and Design of simple and built-up members subjected to tension - Shear lag effect- Design of lug angles - tension splice.

UNIT-III	**COMPRESSION MEMBERS**	**12**

Behaviour of short and long columns - Euler's column theory-Design of simple and built-up compression members with lacings and battens - Design of column bases - slab base and gusseted base.

UNIT-IV	**BEAMS**	**12**

Design of laterally supported and unsupported beams - Design of built-up beams - Design of plate Girders.

UNIT-V	**INDUSTRIAL STRUCTURES AND PLASTIC DESIGN**	**12**

Design of roof trusses – loads on trusses – purlin design using angle and channel sections – truss design, Design of joints and end bearings– Gantry girders–Design Considerations - Introduction to pre-engineered buildings - Design of continuous beams and portal frames using plastic design approach.

	Total Contact Hours	**:**	**60**

Course Outcomes:

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

- Perceive the design philosophy of steel structures and predict the design strength of bolted and welded connections.
- Design the most suitable section for tension members based on design criteria.
- Design the most suitable section for compression members based on design considerations.
- Analyze and design steel beams by applying the codal requirements.

□	Compute the design loads on industrial roofs truss, gantry girders, continuous beams and portal frames using plastic design approach.
Text Book (s):	
1	Duggal S.K., Limit State Design of Steel Structures, Tata McGraw Hill, Publishing Co. Ltd., New Delhi, 2014.
2	Bhavikatti S.S, Design of Steel Structures: By Limit State Method as Per IS: 800 - 2007, IK International Publishing House, New Delhi, 2017.
Reference Book (s) / Web links:	
1	Subramanian.N, Design of Steel Structures, Oxford University Press, New Delhi, 2016.
2	Gambhir M L, Fundamentals of Structural Steel Design, McGraw Hill Education India Pvt Limited, 2013.
3	Narayanan.R.et.al., Teaching Resource on Structural steel Design, INSDAG, Ministry of Steel Publishing, 2000.
4	Sarwar Alam Raz, Structural Design in Steel, New Age International Publishers, 2014.
5	Jack C. McCormac and Stephen F Csernak, Structural Steel Design, Pearson Education Limited, 2013.
6	https://nptel.ac.in/courses/105/105/105105162/
7	https://nptel.ac.in/courses/105/106/105106112/
8	https://nptel.ac.in/courses/105/106/105106113/
Code Book(s):	
1	IS 800:2007, General Construction in Steel-Code of Practice, (Third Revision), Bureau of Indian Standards, New Delhi, 2007.
2	SP 6 (1) Hand book on structural steel sections.
3	IS: 875 (Part 3) : 2015, Design Loads (Other than Earthquake) for Buildings and Structure – Code of Practice Part 3 Wind Loads (Third Revision), Bureau of Indian Standards, New Delhi, 2015.

CE19601	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	3	2	1	1	1	1	-	1	1	1	2	2	2
CO 2	3	3	3	2	1	2	1	1	1	1	2	1	3	2	3
CO 3	3	3	3	2	1	2	1	1	1	1	2	1	3	2	3
CO 4	3	3	3	2	1	2	1	1	1	1	2	1	3	2	3
CO 5	3	3	3	3	1	3	2	1	1	1	2	2	2	2	3
Average	**3**	**3**	**3**	**2.2**	**1**	**2**	**1.2**	**1**	**1**	**1**	**1.8**	**1.2**	**2.6**	**2**	**2.8**

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
CE19602	**STRUCTURAL ANALYSIS II**	**PC**	**2**	**1**	**0**	**3**
Objectives:						
□	To illustrate influence line for determinate beams and trusses.					
□	To illustrate influence line for indeterminate beams using Muller-Breslau principle.					
□	To determine the plastic moment and collapse load for various beams and frames using plastic analysis.					
□	To analyze various structural forms of arches for different support conditions.					
□	To analyze suspension cables bridges and stiffening girders.					

UNIT-I	INFLUENCE LINES FOR DETERMINATE BEAMS	9
Influence lines for reactions in statically determinate beams – Influence lines for shear force and bending moment – Calculation of critical stress resultants due to concentrated and distributed moving loads - absolute maximum bending moment - influence lines for member forces in pin jointed frames.		
UNIT-II	**INFLUENCE LINES FOR INDETERMINATE BEAMS**	**9**
Muller Breslau's principle – Influence line for Shearing force, Bending Moment and support reaction components of propped cantilever, fixed beams and continuous beams (Redundancy restricted to one).		
UNIT-III	**PLASTIC ANALYSIS**	**9**
Plastic theory - Statically indeterminate structures – Plastic moment of resistance – Plastic modulus – Shape factor – Load factor – Plastic hinge and mechanism – Collapse Load - Static and kinematic methods– Upper and lower bound theorems - Plastic analysis of indeterminate beams and frames.		
UNIT-IV	**ARCHES**	**9**
Arches - Types of arches – Analysis of three hinged, two hinged and fixed arches - Parabolic and circular arches – Settlement and temperature effects.		
UNIT-V	**CABLES AND SUSPENSION BRIDGES**	**9**
Equilibrium of cables – length of cable – Anchorage of suspension cables- Analysis of forces in the cable – stiffening girders - cables with three hinged stiffening girders – Influence lines for three hinged stiffening girders.		
	Total Contact Hours :	**45**

Course Outcomes:

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

- Illustrate influence line for determinate beams and trusses.
- Illustrate influence line for indeterminate beams using Muller-Breslau principle.
- Determine the plastic moment and collapse load for various beams and frames using plastic analysis.
- Analyze various structural forms of arches for different support conditions.
- Analyze suspension cables bridges and stiffening girders.

Text Book (s):

1	Dr. Punmia B.C, Ashok Kumar Jain & Dr. Arun Kumar Jain, "Theory of Structures", Laxmi Publications, New Delhi, 2017.
2	a) Bhavikatti,S.S, "Structural Analysis-I", Vikas Publishing House Pvt.Ltd., New Delhi, 2010. b) Bhavikatti S.S, "Structural Analysis –II", Vikas Publishing House Pvt. Ltd., New Delhi, 2013.

Reference Book (s) / Web links:

1	Gambhir. M.L., "Fundamentals of Structural Mechanics and Analysis", PHI Learning Pvt .Ltd., 2011.
2	Reddy.C.S, "Basic Structural Analysis", The McGraw Hill companies, 2010.
3	Negi L.S and Jangid R.S, "Structural Analysis", Tata McGraw Hill Publishing Co.Ltd.2004.
4	Vazrani.V.N And Ratwani,M.M, Analysis of Structures, Vol.II, Khanna Publisers,2015.
5	https://nptel.ac.in/courses/105/105/105105166/
6	https://nptel.ac.in/courses/105/101/105101086/

CE19602	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	2	3	1	2	1	1	2	1	-	2	3	3	1

CO 2	3	3	2	3	1	2	1	1	2	1	-	2	3	3	1
CO 3	3	3	2	3	1	2	1	1	2	1	-	2	3	3	1
CO 4	3	3	2	3	1	2	1	1	2	1	-	2	3	3	1
CO 5	3	3	2	3	1	2	1	1	2	1	-	2	3	3	1
Average	**3**	**3**	**2**	**3**	**1**	**2**	**1**	**1**	**2**	**1**	**-**	**2**	**3**	**3**	**1**

Subject Code	**Subject Name (Theory course)**	**Category**	**L**	**T**	**P**	**C**
CE19603	**FOUNDATION ENGINEERING**	**PC**	**3**	**0**	**0**	**3**

Objectives:

- To select the type of foundation based on the soil condition inferred from different methods of subsoil exploration.
- To estimate the bearing capacity of soil and also the settlement of foundation.
- To proportion different types of shallow footings.
- To design pile foundation and also calculate the settlement of pile group.
- To analyze the stability of retaining walls using different methods.

UNIT-I	**SITE INVESTIGATION AND SELECTION OF FOUNDATION**	**9**

Scope and objectives – Methods of exploration – Auguring and boring – Wash boring and rotary drilling – Depth and spacing of bore holes – Soil samples – Representative and undisturbed – Sampling methods – Split spoon sampler, Thin wall sampler, Stationary piston sampler – Penetration tests (SPT and SCPT) – Data interpretation - Strength parameters - Bore log report and Selection of foundation.

UNIT-II	**SHALLOW FOUNDATION**	**9**

Location and depth of foundation – Codal provisions – Bearing capacity of shallow foundation on homogeneous deposits – Terzaghi's formula and BIS formula – Factors affecting bearing capacity – Bearing capacity from in-situ tests (SPT, SCPT and plate load test) – Allowable bearing pressure – Seismic considerations in bearing capacity evaluation. Determination of Settlement of foundations on granular and clay deposits – Total and differential settlement – Allowable settlements – Codal provision – Methods of minimizing total and differential settlements.

UNIT-III	**FOOTINGS AND RAFTS**	**9**

Types of Isolated footing, Combined footing, Mat foundation – Contact pressure and settlement distribution – Proportioning of foundations for conventional rigid behaviour – Minimum thickness for rigid behaviour – Applications – Compensated foundation – Codal provision.

UNIT-IV	**PILE FOUNDATION**	**9**

Types of piles and their functions – Factors influencing the selection of pile – Load carrying capacity of single pile in granular and cohesive soil – Static formula – Dynamic formulae (Engineering news and Hileys) – Capacity from insitu tests (SPT and SCPT) – Negative skin friction – Uplift capacity- Group capacity by different methods (Feld's rule, Converse – Labarra formula and block failure criterion) – Settlement of pile groups – Interpretation of pile load test (routine test only), Under reamed piles – Capacity under compression and uplift – Cohesive – expansive – non expansive – Cohesionless soils – Codal provisions.

UNIT-V	**RETAINING WALLS**	**9**

Plastic equilibrium in soils – Active and passive states – Rankine's theory – Cohesionless and cohesive soil – Coulomb's wedge theory – Condition for critical failure plane – Earth pressure on retaining walls of simple configurations – Culmann's Graphical method – Pressure on the wall due to line load – Stability analysis of retaining walls – Codal provisions.

	Total Contact Hours	**:**	**45**

Course Outcomes:	
On completion of the course, the students will be able to	
□	Get familiarized with different subsoil exploration methods and decide the foundation based on the soil condition.
□	Estimate the bearing capacity of soil and also the settlement of foundation.
□	Proportion different types of shallow footings.
□	Estimate load carrying capacity of pile and also calculate the settlement of pile group.
□	Analyze the stability of retaining walls using different methods.
Text Book (s):	
1	Murthy, V.N.S., "Text book of Soil Mechanics and Foundation Engineering", CBS Publishers Distribution Ltd., New Delhi. 2014.
2	Punmia, B.C., "Soil Mechanics and Foundations", Laxmi Publications Pvt. Ltd. New Delhi, 16th Edition 2017.
Reference Book (s) / Web links:	
1	Arora, K.R., "Soil Mechanics and Foundation Engineering", Standard Publishers and Distributors, New Delhi, 7th Edition, 2017 (Reprint).
2	Gopal Ranjan, A S R Rao, "Basic and Applied Soil Mechanics" New Age International Publication, 3rd Edition, 2016.
3	Braja M Das, "Principles of Foundation Engineering" (Eigth edition), Cengage Learning 2014.
4	Kaniraj, S.R. "Design aids in Soil Mechanics and Foundation Engineering", Tata McGraw Hill publishing company Ltd., New Delhi, 2014.
5	Venkatramaiah.C., "Geotechnical Engineering", New Age International Pvt. Ltd., New Delhi, 2017.
6	Joseph E bowles, "Foundation Analysis and design", McGraw Hill Education, 5th Edition, 28th August 2015.
7	https://nptel.ac.in/courses/105/105/105105176/
8	https://www.clemson.edu/cecas/departments/ce/pdf/CE4210_%20Sample_Course%20Notes_2016.pdf
9	http://environment.uwe.ac.uk/geocal/foundations/founbear.htm
10	https://www.nitsri.ac.in/Department/Civil%20Engineering/CGE-202_7_Pile_Foundation_Design_A_Student_Guide.pdf
11	https://pdhonline.com/courses/c155/c155content.pdf
Code Book(s):	
1	IS Code 6403: 1981 (Reaffirmed 1997) "Bearing capacity of shallow foundation", Bureau of Indian Standards, New Delhi.
2	IS Code 8009 (Part 1):1976 (Reaffirmed 1998) "Shallow foundations subjected to symmetrical static vertical loads", Bureau of Indian Standards, New Delhi.
3	IS Code 8009 (Part 2):1980 (Reaffirmed 1995) "Deep foundations subjected to symmetrical static vertical loading", Bureau of Indian Standards, New Delhi.
4	IS Code 2911 (Part 1): 1979 (Reaffirmed 1997) "Concrete Piles" Bureau of Indian Standards, New Delhi.
5	IS Code 2911 (Part 2): 1979 (Reaffirmed 1997) "Timber Piles", Bureau of Indian Standards, New Delhi.
6	IS Code 2911 (Part 3): 1979 (Reaffirmed 1997) "Under Reamed Piles", Bureau of Indian Standards, New Delhi.
7	IS Code 2911 (Part 4): 1979 (Reaffirmed 1997) "Load Test on Piles", Bureau of Indian Standards, New Delhi.

8	IS Code 1904: 1986 (Reaffirmed 1995) "Design and Construction of Foundations in Soils", Bureau of Indian Standards, New Delhi.
9	IS Code 2131: 1981 (Reaffirmed 1997) "Method for Standard Penetration test for Soils", Bureau of Indian Standards, New Delhi.
10	IS Code 2132: 1986 (Reaffirmed 1997) "Code of Practice for thin – walled tube sampling for soils", Bureau of Indian Standards, New Delhi.
11	IS Code 1892 (1979): Code of Practice for subsurface Investigation for Foundations. Bureau of Indian Standards, New Delhi.
12	IS Code 14458 (Part 1): 1998 "Retaining Wall for Hill Area – Guidelines, Selection of Type of Wall" , Bureau of Indian Standards, New Delhi.
13	IS Code 14458 (Part 2): 1998 "Retaining Wall for Hill Area – Guidelines, Design of Retaining/Breast Walls" , Bureau of Indian Standards, New Delhi.
14	IS Code 14458 (Part 3) : 1998 "Retaining Wall for Hill Area – Guidelines, Construction Of Dry Stone Walls", Bureau of Indian Standards, New Delhi.

CE19603	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO 1	2	2	2	2	1	1	1	1	1	1	1	2	3	2	3
CO 2	3	2	2	2	1	1	1	2	1	1	1	2	3	2	3
CO 3	2	2	2	2	1	1	1	1	1	1	1	2	3	2	3
CO 4	2	2	2	2	1	1	1	1	1	1	1	2	3	2	3
CO 5	2	2	2	2	1	1	1	1	1	1	1	2	3	2	3
Average	**2.2**	**2**	**2**	**2**	**1**	**1**	**1**	**1.2**	**1**	**1**	**1**	**2**	**3**	**2**	**3**

Subject Code	**Subject Name (Theory course)**	**Category**	**L**	**T**	**P**	**C**
CE19604	**WASTE WATER ENGINEERING**	**PC**	**3**	**0**	**0**	**3**

Objectives:

- To estimate sanitary sewage flow, storm water flow & design the sewer and to acquire knowledge on sewer materials, sewer appurtenances, corrosion and its preventive measures.
- To design the primary treatment units and to know its construction, operation and maintenance aspects.
- To design the secondary treatment units and to know its construction, operation and maintenance aspects.
- To acquire knowledge on the disposal of sewage using various methods without affecting the environment.
- To design the sludge treatment units like digesters, thickeners and their ultimate disposal without affecting the environment.

UNIT-I	**PLANNING AND DESIGN OF SEWERAGE SYSTEM**	**9**

Characteristics and composition of sewage - population equivalent -Sanitary sewage flow estimation – Sewer materials – Hydraulics of flow in sanitary sewers – Sewer design – Storm drainage-Storm runoff estimation – sewer appurtenances – corrosion in sewers – prevention and control – sewage pumping-drainage in buildings-plumbing systems for drainage.

UNIT-II	**PRIMARY TREATMENT OF SEWAGE**	**9**

Objectives – Unit Operations and Processes – Selection of treatment processes - Onsite sanitation - Septic tank- Grey water harvesting – Primary treatment – Principles, functions and design of sewage treatment units - screens - grit chamber-primary sedimentation tanks – Construction, Operation and Maintenance aspects.		
UNIT-III	**SECONDARY TREATMENT OF SEWAGE**	**9**
Objectives – Selection of Treatment Methods – Principles, Functions, - Activated Sludge Process and Extended aeration systems -Trickling filters– Sequencing Batch Reactor(SBR) – Membrane Bioreactor - UASB – Waste Stabilization Ponds – Other treatment methods -Reclamation and Reuse of sewage - Recent Advances in Sewage Treatment – Construction, Operation and Maintenance aspects.		
UNIT-IV	**DISPOSAL OF SEWAGE**	**9**
Standards for– Disposal - Methods – dilution – Mass balance principle - Self purification of river-Oxygen sag curve – deoxygenation and reaeration - Streeter–Phelps model - Land disposal – Sewage farming – sodium hazards - Soil dispersion system.		
UNIT-V	**SLUDGE TREATMENT AND DISPOSAL**	**9**
Objectives - Sludge characterization – Thickening - Design of gravity thickener- Sludge digestion - Standard rate and High rate digester design- Biogas recovery - Sludge Conditioning and Dewatering – Sludge drying beds - ultimate residue disposal - recent advances.		
	Total Contact Hours : 45	

Course Outcomes:	
On completion of the course, the students will be able to	
□	Estimate sanitary sewage flow, storm water flow & design the sewer and have acquired knowledge on sewer materials, sewer appurtenances, corrosion and its preventive measures.
□	Design the primary treatment units and to manage its operation and maintenance.
□	Design the secondary treatment units and to manage its operation and maintenance.
□	Acquire knowledge on the disposal of sewage using various methods without affecting the environment.
□	Design the sludge treatment units like digesters, thickeners and their ultimate disposal without affecting the environment.
Text Book (s):	
1	Garg, S.K., Environmental Engineering Vol. II, Khanna Publishers, New Delhi, 2015.
2	Punmia, B.C., Jain, A.K., and Jain.A.K., Environmental Engineering, Vol.II, Laxmi Publications, 2010.
Reference Book (s):	
1	Manual on Sewerage and Sewage Treatment Systems Part A,B and C, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 2013.
2	Duggal K.N., "Elements of Environmental Engineering" S.Chand and Co. Ltd., New Delhi, 2014.
3	Dr.P.N.Modi "Sewage Treatment & Disposal and Wastewater Engineering", Standard book house, Rajsons Publication Pvt. Ltd., New Delhi., 2015.
4	Metcalf and Eddy- Wastewater Engineering–Treatment and Reuse, Tata Mc.Graw-Hill Company, New Delhi, 2010.
5	Gray N.F, "Water Technology", Elsevier India Pvt. Ltd., New Delhi, 2006.
Web links:	
1	https://nptel.ac.in/courses/105/105/105105048/
2	https://nptel.ac.in/courses/105/105/105105178/
3	https://nptel.ac.in/courses/105/106/105106119/

CE19604	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3

CO 1	3	3	3	2	1	3	3	2	1	1	1	2	3	2	1
CO 2	3	3	3	2	1	3	3	2	1	1	1	2	3	2	1
CO 3	3	3	3	2	1	3	3	2	1	1	1	2	3	2	1
CO 4	3	3	3	2	1	3	3	2	1	1	1	2	3	2	1
CO 5	3	3	3	2	1	3	3	2	1	1	1	2	3	2	1
Average	**3**	**3**	**3**	**2**	**1**	**3**	**3**	**2**	**1**	**1**	**1**	**2**	**3**	**2**	**1**

Subject Code	**Subject Name (Practical course)**	**Category**	**L**	**T**	**P**	**C**
CE19611	**INDUSTRIAL INTERNSHIP***	**EEC**	**0**	**0**	**2**	**1**

Objectives:

- To enhance the knowledge of the students in professional engineering practice sought through industrial training on different current technologies.
- To expose students to real work life situations and to equip them with abreast of new technology that intensify their job acumen.
- To employ the students in structural industrial projects and strengthen the practical skills of the students.
- To develop significant commitment in the students' profession and specialization.

STRATEGY:

The students individually undertake training in reputed civil engineering companies for the specified duration. At the end of the training, a report on the work done will be prepared and presented. The students will be evaluated through a viva-voce examination by a team of internal staff.

Course Outcomes:

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

- Apply prior acquired knowledge in a real-life environment.
- Integrate classroom theory with workplace practice.
- Acquire knowledge from the industry professionals who have assortment of knowledge in working in live-projects.
- Work on a research project or undertake work experience under the guidance of industry and academic supervision.
- Extend the knowledge through research and development in the chosen fields of specialization.

(* Two weeks at the end of Fifth Semester)

Subject Code	**Subject Name (Practical course)**	**Category**	**L**	**T**	**P**	**C**
CE19612	**WATER AND WASTE WATER ANALYSIS LABORATORY**	**PC**	**0**	**0**	**2**	**1**

Objectives:

- To determine the physical characteristics of water and wastewater.
- To determine the chemical characteristics of water and wastewater.
- To quantify dosage requirement for coagulation and chlorination process.
- To determine the mineral content in water.
- To determine the biological characteristics of water and wastewater.

List of Experiments:

1. Determination of pH, Turbidity and conductivity.
2. Determination of Hardness.

3. Determination of Alkalinity and Acidity.	
4. Determination of Chlorides.	
5. Determination of Phosphates and Sulphates.	
6. Determination of iron and fluoride.	
7. Determination of Optimum Coagulant dosage.	
8. Determination of residual chlorine and available chlorine in bleaching powder.	
9. Determination of Oil and Grease.	
10. Determination of suspended, settleable, volatile and fixed solids.	
11. Determination Dissolved Oxygen and BOD for the given sample.	
12. Determination of COD for given sample.	
13. Determination of SVI of Biological sludge and microscopic examination.	
14. Determination of MPN index of given water sample.	
Course Outcomes:	
On completion of the course, the students will be able to	
□	Determine the physical characteristics of water and wastewater and infer its environmental significance.
□	Determine the chemical characteristics of water and wastewater and infer its environmental significance.
□	Quantify the optimum dosage for coagulation and chlorination process.
□	Determine the mineral content in water and derive meaningful inferences.
□	Determine the biological characteristics of water and wastewater and infer its environmental significance.
References:	
1	Standards Methods for the Examination of Water and Wastewater: 17th Edition, WPCF, APHA and AWWA, USA, 1989.
2	IS 3025: 1986 Methods of sampling and test (physical and chemical) for water and wastewater.
Web link of Virtual Labs:	
1	https://ee1-nitk.vlabs.ac.in/
2	https://ee2-nitk.vlabs.ac.in/

List of Experiments:

1. Determination of pH, Turbidity and conductivity
2. Determination of Hardness
3. Determination of Alkalinity and Acidity
4. Determination of Chlorides
5. Determination of Phosphates and Sulphates
6. Determination of iron and fluoride
7. Determination of Optimum Coagulant dosage
8. Determination of residual chlorine and available chlorine in bleaching powder
9. Determination of Oil, and Grease
10. Determination of suspended, settleable, volatile and fixed solids
11. Determination Dissolved Oxygen and BOD for the given sample
12. Determination of COD for given sample
13. Determination of SVI of Biological sludge and microscopic examination
14. Determination of MPN index of given water sample

CE19612	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	1	1	2	1	1	3	2	3	1	1	2	3	1	1

CO 2	3	1	1	2	1	1	3	2	3	1	1	2	3	1	1
CO 3	3	1	1	2	1	1	3	2	3	1	1	2	3	1	1
CO 4	3	1	1	2	1	1	3	2	3	1	1	2	3	1	1
CO 5	3	1	1	2	1	1	3	2	3	1	1	2	3	1	1
Average	**3**	**1**	**1**	**2**	**1**	**1**	**3**	**2**	**3**	**1**	**1**	**2**	**3**	**1**	**1**

Subject Code	**Subject Name (Practical course)**	**Category**	**L**	**T**	**P**	**C**
CE19613	**INNOVATION AND DESIGN THINKING FOR CIVIL ENGINEERS**	**EEC**	**0**	**0**	**4**	**2**

Objectives : This course enables students to

- Have a special focus on skill development through active engagement in real world problems.

Total Contact Hours	**:**	**30**

STRATEGY:

The students may be grouped into 2 to 4 and work under a project supervisor. The student has to identify a problem based on design thinking strategy in an area of interest in Civil Engineering domain. A project report to be submitted by the students after completing the work to the satisfaction, which will be reviewed and evaluated for internal assessment by a Committee constituted by the Head of the Department. The student will be evaluated based on the internal reviews, report preparation and the viva voce examination.

Course Outcomes:

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

- Generate and develop design ideas through different technique.
- conceive, organize, lead, implement, and evaluate successful projects in any Civil Engineering discipline.

Text Book (s):

1. John.R.Karsnitz, Stephen O'Brien and John P. Hutchinson, "Engineering Design", Cengage learning (International edition) Second Edition, 2013.

Reference Book (s) / Web links:

1. Yousef Haik and Tamer M.Shahin, "Engineering Design Process", Cengage Learning, Second Edition, 2011.

Subject Code	Subject Name (Practical Course)	Category	L	T	P	C
CE19614	HIGHWAY ENGINEERING LABORATORY	PC	0	0	2	1

Objectives:

- To familiarize with procedures of testing the pavement aggregate.
- To conduct all standardized tests to assess the quality of bitumen.
- To characterize the optimum binder content using marshall method.
- To determine the consistency and properties of bitumen.
- To develop an understanding on the determination of Binder Content in bituminous mixes.

List of Experiments

I	**TEST ON AGGREGATE**
1	Specific gravity determination of the coarse aggregate sample.
2	Determination of abrasion value of the coarse aggregate sample.
3	Determination of water absorption capacity of the coarse aggregate sample.
III	**TEST ON BITUMEN**
4	Specific gravity determination of the bitumen/asphalt sample.
5	Determination of consistency of the bituminous material.
6	Viscosity determination of bituminous binder.
7	Determination of softening point of the asphalt/bitumen sample
8	Determination of optimum binder content by Marshall method
9	Determination of ductility value of the bitumen sample
10	Estimation of loss of bitumen on heating
V	**TEST ON BITUMEN MIXES**
11	Determination of stripping value of the bituminous mix Demonstration
12	Determination of bitumen content in the bituminous mix by cold solvent extraction method

Total Contact : 30

Course Outcomes:

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

- Characterize pavement aggregate through relevant test.
- Ascertain the quality of bitumen.
- Determine the optimum binder content using marshall method.
- Evaluate the consistency and properties of bitumen.
- Determine the bitumen content in the bituminous mixes.

Code Book(s):

1	IS 1208 -1978 Edition 2.1 (2004-10): Methods for Testing Tar and Bituminous Materials: (First Revision).
2	Methods of test for aggregates, IS 2386 – 1963 Bureau of Indian Standards.
3	Mix Design Methods Asphalt Institute Manual Series No. 2, Sixth Edition, 1997, Lexington, KY, USA.
4	Coarse and Fine Aggregate for Concrete - Specification (Third Revision) - IS 383: 2016.
5	Standard Test Method for Marshall Stability and Flow of Asphalt Mixtures. - ASTM D6927

Reference Book (s) / Web links:

1	Highway Materials and Pavement Testing, Nem Chand and Bros., Roorkee, Revised Fifth Edition, 2009
2	N. L. Arora, A Textbook of Transportation Engineering, New India Publication, 1997
3	L. R. Kadiyali, Transportation Engineering, Khanna Publishing, 2016.
4	http://vlabs.iitb.ac.in/vlabs-dev/labs/nitk_labs/Transportation_Engineering_Lab/index.html

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

Sl. No.	Description of Equipment	Quantity
1.	Marshall Stability Test Apparatus - (Motorized, 50kN capacity, single speed)	1
2.	Laboratory California Bearing Ratio Test Apparatus - (Motorized; Three speed type; 50kN capacity)	1
3.	Tar Viscometer	1
4.	Ductility Testing Machine	1
5.	Abrasion Testing Machine	1
6.	Universal Penetrometer	1
7.	Ring and Ball Apparatus	2
8.	Centrifuge Extractor	1

CE19614	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	1	3	2	1	1	1	1	3	3	1	3	3	3	2
CO 2	3	1	3	2	1	1	1	1	3	3	1	3	3	3	2
CO 3	3	1	3	2	1	1	1	1	3	3	1	3	3	3	2
CO 4	3	1	3	2	1	1	1	1	3	3	1	3	3	3	2
CO 5	3	1	3	2	1	1	1	1	3	3	1	3	3	3	2
Average	**3**	**1**	**3**	**2**	**1**	**1**	**1**	**1**	**3**	**3**	**1**	**3**	**3**	**3**	**2**

Subject Code	Subject Name (Practical course)	Category	L	T	P	C
GE19621	**PROBLEM SOLVING TECHNIQUES**	**EEC**	**0**	**0**	**2**	**1**

Objectives:

- To improve the numerical ability.
- To improve problem-solving skills.

S.NO	TOPICS
1	Numbers system.
2	Reading comprehension.
3	Data arrangements and Blood relations.
4	Time and Work.
5	Sentence correction.
6	Coding & Decoding, Series, Analogy, Odd man out and Visual reasoning.
7	Percentages, Simple interest and Compound interest.
8	Sentence completion and Para-jumbles.

9	Profit and Loss, Partnerships and Averages.
10	Permutation, Combination and Probability.
11	Data interpretation and Data sufficiency.
12	Logarithms, Progressions, Geometry and Quadratic equations.
	Total Contact Hours : 30

Course Outcomes:

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

- Have mental alertness.
- Have numerical ability.
- Solve quantitative aptitude problems with more confident.

SEMESTER VII

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
CE19701	ESTIMATION AND QUANTITY SURVEYING	PC	3	0	0	3

Objectives:

- To Acquire thorough knowledge about the components of structures and arriving the quantities.
- To estimate the rate for various items of works in the structures.
- To understand the types of specifications and develop the report preparation for various structures.
- To apply knowledge on preparing contracts and arbitration.
- To assess the valuation of building and land.

UNIT-I QUANTITY ESTIMATION **9**

Philosophy – Purpose – Methods of estimation – Types of estimates – Approximate estimates – Detailed estimate – Estimation of quantities for buildings, bituminous and cement concrete roads, septic tank, soak pit, retaining walls – culverts (additional practice in class room using computer softwares).

UNIT-II RATE ANALYSIS AND COSTING **9**

Standard Data – Observed Data – Schedule of rates – Market rates – Standard Data for Man Hours and Machineries for common civil works – Rate Analysis for all Building works, canals, and Roads– Cost Estimates (additional practice in class room using Computer softwares) - (Analysis of rates for the item of work asked, the data regarding labour, rates of labour and rates of material to be given in the Examination Question Paper).

UNIT-III SPECIFICATIONS, REPORTS AND TENDERS **9**

Specifications – Detailed and general specifications (NRM 2) – Constructions – Sources – Types of specifications – Principles for report preparation – report on estimate of residential building – Culvert – Roads – TTT Act 2000 – Tender notices – types – tender procedures – Drafting model tenders , E-tendering-Digital signature certificates - Encrypting - Decrypting – Reverse auctions.

UNIT-IV CONTRACTS **9**

Contract – Types of contracts – Formation of contract – Contract conditions – Contract for labour, material, design, construction – Drafting of contract documents based on IBRD / MoRTH Standard bidding documents – Construction contracts – Contract problems – Arbitration and legal requirements - Construction disputes and resolution methods (FIDIC contract terms).

UNIT-V VALUATION **9**

Definitions – Various types of valuations – Valuation methods - Necessity – Capitalised value – Depreciation – Escalation – Valuation of land – Buildings – Calculation of Standard rent – Mortgage – Lease.

Total Contact Hours : 45

Course Outcomes:

On completion of the course, the students will be able to	
□	Arrive quantities of item work for various elements of structures.
□	Estimate the rate for various items of works in the structures.
□	Understand the types of specifications and develop the report preparation for various structures.
□	Apply knowledge on preparing contracts and arbitration.
□	Assess the valuation of building and land.
Text Book (s):	
1	B.N Dutta 'Estimating and Costing in Civil Engineering', UBS Publishers & Distributors (P) Ltd, 2016.
2	B.S.Patil, 'Civil Engineering Contracts and Estimates', University Press, 2006.
3	D.N. Banerjee, 'Principles and Practices of Valuation', V Edition, Eastern Law House, 2015.
Reference Book (s) / Web links:	
1	Hand Book of Consolidated Data – 8/2000, Vol.1, TNPWD.
2	Tamil Nadu Transparencies in Tenders Act, 1998.
3	Arbitration and Conciliation Act, 1996.
4	Standard Bid Evaluation Form, Procurement of Good or Works, The World Bank, April 1996.
5	Standard Data Book for Analysis and Rates, IRC, New Delhi, 2003.

CE19701	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	2	3	2	3	2	1	2	3	2	3	3	3	3	3
CO 2	3	2	3	2	3	2	1	2	3	2	3	3	3	3	3
CO 3	2	1	2	1	-	2	1	2	3	3	3	3	3	3	2
CO 4	2	1	2	1	-	2	1	3	3	3	3	3	3	3	2
CO 5	3	2	3	2	2	2	1	2	3	2	3	3	3	3	3
Average	**2.6**	**1.6**	**2.6**	**1.6**	**2.67**	**2**	**1**	**2.2**	**3**	**2.4**	**3**	**3**	**3**	**3**	**2.6**

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
CE19702	**WATER RESOURCES AND IRRIGATION ENGINEERING**	**PC**	**3**	**0**	**0**	**3**

Objectives:	
□	To understand the concept of water resources, planning and development.
□	To understand the concept of water resources planning, water use, water quality and water budget.
□	To estimate the irrigation water required for crop and its efficiencies.
□	To impart knowledge on canal irrigation system, canal regulations and its theories.
□	To acquire knowledge on various irrigation methods, water distribution and Participatory irrigation management.

UNIT-I	**WATER RESOURCES**	**9**

Water resources survey – Water resources of India and Tamilnadu – Description of water resources planning – Estimation of water requirements for irrigation and drinking- Single and multipurpose reservoir – Multi objective - Fixation of Storage capacity -Strategies for reservoir operation – Design flood-levees and flood walls.

UNIT-II	**WATER RESOURCE MANAGEMENT**	**9**
Economics of water resources planning – National Water Policy – Consumptive and non-consumptive water use - Water quality – Scope and aims of master plan - Concept of basin as a unit for development - Water budget- Conjunctive use of surface and ground water.		
UNIT-III	**IRRIGATION ENGINEERING**	**9**
Need – Merits and Demerits – Duty, Delta and Base period – Irrigation efficiencies – Crops and Seasons - Crop water Requirement – Estimation of Consumptive use of water.		
UNIT-IV	**CANAL IRRIGATION**	**9**
Types of Impounding structures: Gravity dam – Diversion Head works - Canal drop – Cross drainage works – Canal regulations – Canal outlets – Canal lining - Kennady's and Lacey's Regime theory.		
UNIT-V	**IRRIGATION METHODS AND MANAGEMENT**	**9**
Lift irrigation – Tank irrigation – Well irrigation – Irrigation methods: Surface and Sub-Surface and Micro Irrigation - Merits and demerits – Irrigation scheduling – Water distribution – Participatory irrigation management with a case study.		
	Total Contact Hours : 45	

Course Outcomes:	
On completion of the course, the students will be able to	
□	Describe with the concept of water resources, planning, and development.
□	Apply the concept of water resources planning, water use, water quality and water budget.
□	Get familiarized with the crop water requirements and its efficiencies.
□	Get familiarized with the canal irrigation system, canal regulations and its theories.
□	Acquire knowledge on various irrigation methods, water distribution and Participatory irrigation management.
Text Book (s):	
1	Linsley R.K. and Franzini J.B, "Water Resources Engineering", McGraw-Hill Inc, 2000.
2	Punmia B.C., et. al; Irrigation and water power Engineering, Laxmi Publications, 16th Edition, New Delhi, 2009.
Reference Book (s) / Web links:	
1	Garg S. K., "Irrigation Engineering and Hydraulic structures", Khanna Publishers, 23rd Revised Edition, New Delhi, 2009.
2	Duggal, K.N. and Soni, J.P., "Elements of Water Resources Engineering",New Age International Publishers, 2005.
3	Chaturvedi M.C., "Water Resources Systems Planning and Management", Tata McGraw- Hill Inc., New Delhi, 1997.
4	Michael A.M., Irrigation Theory and Practice, 2nd Edition, Vikas Publishing House Pvt. Ltd., Noida, Up, 2008.
5	Dilip Kumar Majumdar, "Irrigation Water Management", Prentice-Hall of India, New Delhi, 2008.
6	Asawa, G.L., "Irrigation Engineering", NewAge International Publishers, New Delhi, 2000.
7	https://nptel.ac.in/courses/105/105/105105110/

CE19702	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**

CO 1	2	-	1	1	1	2	2	2	1	1	1	3	1	1	2
CO 2	2	-	1	-	1	2	2	2	1	1	1	3	1	1	2
CO 3	2	2	2	3	2	3	2	2	1	1	1	3	1	3	2
CO 4	2	3	2	3	2	3	2	2	1	1	1	3	1	3	2
CO 5	2	-	1	-	1	2	2	2	1	1	1	3	1	2	2
Average	**2**	**2.5**	**1.8**	**2.3**	**1.4**	**2.4**	**2**	**2**	**1**	**1**	**1**	**3**	**1**	**2**	**2**

Subject Code	**Subject Name (Practical course)**	**Category**	**L**	**T**	**P**	**C**
CE19711	**COMPUTER AIDED DESIGN AND DRAFTING LABORATORY**	**PC**	**0**	**0**	**4**	**2**

Objectives:

- To design, analysis and detailing of cantilever and counterfort retaining wall by using AutoCAD and STAAD Pro.
- To gain the concepts of design and analysis of Tee beam bridge by using STAAD Pro.
- To acquire knowledge to the Design, analysis and detailing of water tanks by using AutoCAD and STAAD Pro.
- To acquire knowledge to understand the plate girder bridge design and analysis by using STAAD Pro.
- To design, analysis of Multi Storey Building by using STAAD Pro.

LIST OF EXPERIMENTS:

1. Design and drawing of RCC cantilever and counter fort type retaining walls with reinforcement details.
2. Design of solid slab and RCC Tee beam bridges for IRC loading and reinforcement details.
3. Design and drafting of circular and rectangular RCC water tanks.
4. Design of plate Girder Bridge - Truss Girder bridges – Detailed Drawings including connections.
5. Design and analysis of Multi Storey Building using Staad.pro.

Total Contact Hours	**:**	**60**

Course Outcomes:

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

- Design and Detail cantilever and counterfort retaining wall.
- Analyze & Design RCC Tee beam bridge by using STAAD Pro.
- Design and detail the water tanks.
- Design the plate girder bridge.
- Analyze & Design multi storey building by using Staad.pro.

Text Book (s):

1. Krishnaraju,N. “Structural Design & Drawing, Universities Press, 2009.
2. Punmia, B.C., Ashok Kumar Jain, Arun Kumar Jain, “Comprehensive Design of Steel Structures, Laxmi Publications Pvt. Ltd., 2003.

Reference Book (s) / Web links:

1. Krishnamurthy, D., “Structural Design & Drawing – Vol. II and III, CBS Publishers, 2010.
2. Shah V L and Veena Gore, “Limit State Design of Steel Structures” IS800-2007, Structure Publications, 2009.
3. Staad.,pro V8i select series 4, Technical reference manual, Bentley,2012.

Code Book (s):

1	IS 456:2000 Plain and Reinforced Concrete – Code of Practice.
2	IS 800 :2007, General Construction In Steel – Code of Practice, (Third Revision), Bureau of Indian Standards, New Delhi, 2007.

EXAMINATION DURATION: 3 HOURS
LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS

Sl.No.	Description of Equipment	Quantity
1.	Models of Structures	1 each
2.	Computers Pentium IV	30 No's
3.	Analysis and Design Software - Minimum 5 use License	1 No

CE19711	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	3	3	3	2	2	1	1	1	-	2	3	2	1
CO 2	3	3	3	3	3	2	2	1	1	1	-	2	3	2	1
CO 3	3	3	3	3	3	2	2	1	1	1	-	2	3	2	1
CO 4	3	3	3	3	3	2	2	1	1	1	-	2	3	2	1
CO 5	3	3	3	3	3	2	2	1	1	1	-	2	3	2	1
Average	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**1**	**1**	**1**	**-**	**2**	**3**	**2**	**1**

Subject Code	Subject Name	Category	L	T	P	C
CE19712	**CREATIVE AND INNOVATIVE PROJECT**	**EEC**	**0**	**0**	**6**	**3**

Objectives:

- To use the knowledge acquired in Civil Engineering to do a mini project, which allows the students to come up with designs, fabrication or algorithms and programs expressing their ideas in a novel way.

STRATEGY

The student has to identify a topic of interest on consultation with Faculty/Supervisor. Review the literature and gather information pertaining to the chosen topic. State the objectives and develop a methodology to achieve the objectives. Carryout the design / fabrication or develop computer code. Demonstrate the novelty of the project through the results and outputs.

Total Contact Hours	**:**	**60**

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

- Identify the strategies for effective planning and plan the structure or facility for the topic identified.
- Identify the loading conditions and the design parameters for which the structure has to be designed.
- Apply the theoretical concepts in the actual design and analyse the real time structures.
- Analyse the cost estimate of the structure and give a detailed drawing of the designed structural components.
- Prepare the project report with all the relevant data and present the technical aspect of the workdone.

Subject Code	Subject Name	Category	L	T	P	C

CE19713	COMPREHENSION IN CIVIL ENGINEERING	EEC	0	0	2	1

Objectives:

- To encourage the students to comprehend the knowledge acquired from the first Semester to Sixth Semester of B.E Degree Course through periodic exercises.

Total Contact Hours	**:**	**30**

METHOD OF EVALUATION:

The students will be assessed 100% internally through weekly test and an end semester examination with objective type questions in Civil Engineering domain.

OUTCOMES:

At the end of this course, students are: Able to apply the fundamental knowledge gained for solving the engineering problems. Able to apply the knowledge gained to write the competitive exams Able to apply the knowledge gained to face technical interviews.

SEMESTER VIII

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
CE19801	CONSTRUCTION ECONOMICS AND PROJECT MANAGEMENT	PC	3	0	0	3

Objectives:

- To understand the basic terms and concepts of Economics and its importance.
- To gain knowledge about Economics in the field of Construction.
- To procure knowledge on project management and its features.
- To get acquainted with the various types of Project management in construction.
- To acquire knowledge about the planning and scheduling process in project management.

UNIT I	BASIC ECONOMICS	8

Definition of economics – nature and scope of economic science – nature and scope of managerial economics – basic terms and concepts – goods – utility – value – wealth – factors of production – land – its peculiarities – labour –economies of large and small scale – consumption – wants – its characteristics and classification – law of diminishing marginal utility – relation between economic decision and technical decision.

UNIT II	ECONOMICS IN CIVIL ENGINEERING	8

Role of civil engineering in industrial development - Advances in civil engineering and engineering economics - Support matters of economy as related to engineering - Market demand and supply-choice of technology and quality control and quality production - Audit in economic,
Law of returns governing production.

UNIT III	PROJECT MANAGEMENT	9

Project Management – Concept of a Project – Characteristic features - tools and techniques for project management – role of project managers. Development of project plan and objectives – programming – scheduling – project organization – organization and project team – role of communication in project management – controlling systems.

UNIT IV	TYPES OF PROJECT MANAGEMENT	10

Project Scope Management - Project Time Management - Project Cost Management - Project Resource Management - Project Quality Management - Project Risk Management – Project Procurement Management – Project safety management – Personnel management.

UNIT V	WORKING SYSTEMS	10

Working systems – Characteristics – class of systems – design of systems – work break down system (WBS) – project execution plan – project procedure manual –sub systems of project management-monitoring of projects- networks - Gantt Chart - CPM – PERT – Line of Balance – Use of Advanced Scheduling Techniques-Scheduling with uncertain durations-Crashing and time/cost tradeoffs – Introduction to application software. (Primavera and MS Projects).			
	Total Contact Hours	**:**	**45**

Course Outcomes:	
On completion of the course, the students will be able to	
□	Understand with basic terms and concepts of Economics and its importance.
□	Acquire knowledge on the application of Economics in the field of Construction.
□	Acquaint the features of the project management.
□	Get familiarized with various types of Project managements in construction.
□	Get aware of the planning and scheduling process in project management.

Text Book (s):	
1	Construction Economics: A new Approach by Danny Myers, Taylor and Francis Publisher, 2004.
2	Prasanna Chandra, "Project Planning, Analysis, Selection, Implementation and review", Tata Mcgraw Hill ,2009.

Reference Book (s) / Web links:	
1	The Construction Industry Aspects of its Economics and Management, Singapore University Press, 1990.
2	Warneer Z, Hirsch, "Urban Economics", Macmillan, New York, 2003.
3	Chitkara.K.K, "Construction Project Management", Tata McGraw Hill.2008.
4	Frederick E. Gould, "Construction Project Management", Went worth Institute of Technology, Vary E. Joyce, Massachusetts Institute of Technology, 2000.
5	Choudhury, S "Project Management", Tata McGraw-Hill Publishing company New Delhi 2008.
6	Sengutha .B, Guha .H, "Construction Management and Planning", Tata Mc Graw Hill, 2001.
7	Dewett K.K. & Varma J.D., Elementary Economic Theory, S Chand & Co., 2006.
8	Sharma JC "Construction Management and Accounts" Satya Prakashan, NewDelhi.

CE19801	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO 1	2	2	-	-	-	1	1	2	-	-	3	2	1	-	1
CO 2	3	3	-	-	-	1	1	2	-	-	3	3	2	-	1
CO 3	2	2	-	-	-	-	-	2	3	3	3	3	2	-	3
CO 4	-	-	-	-	-	-	-	-	3	3	3	3	1	-	2
CO 5	3	3	1	1	1	-	-	2	2	2	2	3	3	2	3
Average	**2.5**	**2.5**	**1**	**1**	**1**	**1**	**1**	**2**	**2.7**	**2.7**	**2.8**	**2.8**	**1.8**	**2**	**2**

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**C**
CE19811	**PROJECT**	**EEC**	**0**	**0**	**12**	**6**

Objectives:	
□	To develop the ability to interpret a specific problem.
□	To formulate a proper methodology.

□	To precede the work right from its identification and literature review till the successful solution of the same.
□	To infer the various results and conclude the result.
□	To prepare project reports and to face reviews and viva voce.

STRATEGY

The student works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction. The student will be evaluated based on the report and the viva voce examination by a team of examiners including one external examiner.

	Total Contact Hours	**:**	**200**

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

□	Pursue any challenging practical problems and find solution to the topic defined.
□	Recognize the materials and technologies to be used to achieve the necessary characteristics.
□	Formulate a methodology to conduct the work.
□	Demonstrate the formulated methodology through studies on model/prototype and laboratory testing.
□	Deduce important references and report the technical aspect of the work performed.

PROFESSIONAL ELECTIVES

SEMESTER VI

PROFESSIONAL ELECTIVE – I

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
CE19P61	**REMOTE SENSING AND GEOGRAPHIC INFORMATION SYSTEM**	**PE**	**3**	**0**	**0**	**3**

Objectives:

□	To propagate about the physics and principles of remote sensing.
□	To provide exposure about the various remote sensing platforms.
□	To acquire knowledge about the optical sensors.
□	To comprehend the fundamentals of Geographical Information System.
□	To acquaint with the concepts of data analysis and its application.

UNIT-I	**PHYSICS OF REMOTE SENSING**	**9**

Remote Sensing - Definition - Components - Electro Magnetic Spectrum – Basic wave theory – Particle theory – Stefan Boltzmann law – Wien's-Displacement Law - Radiometric quantities - Effects of Atmosphere-Scattering – Different types –Absorption-Atmospheric window- Energy interaction with surface features – Spectral reflectance of vegetation, soil and water –atmospheric influence on spectral response patterns- multi concept in Remote sensing.

UNIT-II	**PLATFORMS**	**9**

Orbit elements – Types of orbits – Motions of planets and satellites – Launch of space vehicle – Orbit perturbations and maneuvers – escape velocity - Types and characteristics of different remote sensing platforms – sun synchronous and geo synchronous satellites.

UNIT-III	**OPTICAL SENSORS**	**9**

Classification of remote sensors – selection of sensor parameters - resolution concept - Spectral, Radiometric and temporal resolution – Quality of images in optical systems – imaging mode – photographic camera – opto-mechanical scanners – push broom and whiskbroom cameras – Panchromatic, multi spectral , hyperspectral scanners – geometric characteristics of scanner imagery - Earth resource satellites operating with optical sensors- Landsat, SPOT, IRS, WorldView.

UNIT-IV	FUNDAMENTALS OF GIS			9
Introduction to GIS - Basic spatial concepts - Coordinate Systems - GIS and Information Systems – Definitions – History of GIS - Components of a GIS – Hardware, Software, Data, People, Methods – Proprietary and open source Software - Types of data – Spatial, Attribute data- types of attributes – scales/ levels of measurements.				
UNIT-V	**DATA ANALYSIS & APPLICATIONS**			**9**
Vector Data Analysis tools - Data Analysis tools - Network Analysis - Digital Elevation models - 3D data collection and utilization- Natural Resource Management - Engineering - Navigation - Vehicle tracking and fleet management - Marketing and Business applications - Case studies.				
	Total Contact Hours	**:**	**45**	

Course Outcomes:	
	On completion of the course, the students will be able to
☐	Recognize the physics of Remote sensing and to identify the principles.
☐	Know about the various platforms and orbits used for launching remote sensing satellites.
☐	Differentiate the types and configuration of various satellites and sensors.
☐	Recognize the importance of the basics of Geographical Information System.
☐	Perform data analysis techniques using GIS for various applications of Civil Engineering.

Text Book (s):	
1	Lillesand T.M., and Kiefer,R.W. Remote Sensing and Image interpretation, Seventh edition of John Wiley & Sons-2015, ISBN : 978-1-118-91947-7.
2	Bhatta B, Remote Sensing and GIS, Edition: 2021, Oxford Press, ISBN: 9780199496648, 9780199496648.
Reference Book(s) / Web links:	
1	Charles Elachi and Jakob J. van Zyl , Introduction To The Physics and Techniques of Remote Sensing , Wiley Series in Remote Sensing and Image Processing, 2006.
2	Paul Curran P.J. Principles of Remote Sensing, ELBS; 1995
3	Sabins, F.F.Jr, Remote Sensing Principles and Image interpretation, W.H.Freeman & Co,1978.
4	Verbyla, David, Satellite Remote Sensing of Natural Resources. CRC Press, 1995.
5	Lo.C.P., Albert K.W. Yeung, Concepts and Techniques of Geographic Information Systems, Prentice-Hall India Publishers, 2006.
6	John A.Richards, Springer – Verlag, Remote Sensing Digital Image Analysis, 2005, ISBN: 3540251286.
7	George Joseph, Fundamentals of Remote Sensing, Second Edition, Universities Press (India) Pvt Ltd, Hyderabad, 2005, ISBN: 8173715351, 9788173715358
8	Ian Heywood, Sarah Cornelius, Steve Carver, Srinivasa Raju, An Introduction Geographical Information Systems, Pearson Education, 2nd Edition,2007.
9	Kang – Tsung Chang, Introduction to Geographic Information Systems, McGraw Hill Publishing, 2nd Edition, 2011.
10	https://mgimond.github.io/Spatial/introGIS.html
11	https://www.arcgis.com/apps/Cascade/index.html?appid=691851921fdd4216846d0a481af7fc0e
12	https://appliedsciences.nasa.gov/sites/default/files/EO4IM_Session_2.pdf

CE19P61	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	1	3	1	2	1	3	3	2	1	1	2	1	1
CO 2	3	3	1	3	1	2	1	3	3	2	1	1	2	1	1
CO 3	3	3	1	2	2	2	1	3	3	2	1	1	2	2	1
CO 4	3	2	3	2	3	2	2	3	3	3	1	1	2	1	1
CO 5	3	2	3	2	3	2	1	3	3	2	1	2	2	2	1
Average	**3**	**2.6**	**1.8**	**2.4**	**2**	**2**	**1.2**	**3**	**3**	**2.2**	**1**	**1.2**	**2**	**1.4**	**1**

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
CE19P62	CONCRETE TECHNOLOGY	PE	3	0	0	3

Objectives:

- To acquire knowledge on properties and tests of constituent materials in concrete.
- To understand the different types of admixtures and their effects on concrete properties.
- To design the concrete mix ratio for various design strength as per IS code.
- To evaluate the strength and properties of fresh and hardened concrete.
- To know the applications and properties of special concretes.

UNIT-I CONSTITUENT MATERIALS **9**

Cement-Different types-Chemical composition and Properties -Tests on cement-IS Specifications-Aggregates-Classification-Mechanical properties and tests as per BIS grading requirements-Water-Quality of water for use in concrete.

UNIT-II CHEMICAL AND MINERAL ADMIXTURES **9**

Chemical Admixtures-Accelerators-Retarders- Plasticizers- Corrosion inhibitors-Shrinkage compensators, air entraining agents, Alkali Silica reactivity inhibitors. Mineral Admixtures like Fly Ash, Silica Fume, Ground Granulated Blast Furnace Slag, Rice husk ash, Bagasse ash and Metakaolin -Their effects on concrete properties.

UNIT-III PROPORTIONING OF CONCRETE MIX **9**

Principles of Mix Proportioning-Properties of concrete related to Mix Design-Physical properties of materials required for Mix Design - Design Mix and Nominal Mix-BIS Method of Mix Design - Mix Design Examples.

UNIT-IV FRESH AND HARDENED PROPERTIES OF CONCRETE **9**

Workability-Tests for workability of normal concrete and self-compacting concrete-Slump Test and Compacting factor Test-Segregation and Bleeding-Determination of Compressive and Flexural strength as per BIS - Properties of Hardened concrete-Determination of Compressive and Flexural strength-Stress-strain curve for concrete-Determination of Young's Modulus – Accelerated curing methods.

UNIT-V SPECIAL CONCRETES **9**

Light weight concretes - High strength concrete - Fiber reinforced concrete – Ferro cement - Ready mix concrete - SIFCON- Shotcrete – Polymer concrete - High performance concrete- Geopolymer Concrete – Self Compacting concrete – Vacuum concreting – Mix design for HPC (ACI method) and SCC (Okamura method).

Total Contact Hours : 45

Course Outcomes:

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

- Determine the chemical and physical properties of the concrete constituents
- Choose the appropriate chemical and mineral admixtures for acquiring the desirable concrete properties.
- Design the concrete mix proportion for various design strength as per the IS codal provisions.
- Conduct various tests to determine the fresh and hardened concrete properties.
- Select the type of concrete based on the requirement for a particular application.

Text Book (s):

1. Gambir, M.L; "Concrete Technology", 3rd Edition, Tata McGraw Hill Publishing Co Ltd, New Delhi, 2007.
2. ShettyM.S, "Concrete Technology", S.Chand and Company Ltd, New Delhi, 2003.

Reference Book (s) / Web links:	
1	Santhakumar,A.R; "Concrete Technology" , Oxford University Press, New Delhi, 2007
2	Neville, A.M; "Properties of Concrete", Pitman Publishing Limited, London, 1995.
3	Gupta.B.L., Amit Gupta, "Concrete Technology", Jain Book Agency, 2010.
4	http://www.theconcreteportal.com/rheology.html
5	http://nptel.ac.in/courses/105102012/
Code Book(s):	
1	IS10262-2019 Recommended Guidelines for Concrete Mix Design, Bureau of Indian Standards, New Delhi.

CE19P62	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	-	-	-	-	1	1	1	1	1	1	2	3	-	1
CO 2	3	-	-	-	-	1	1	1	1	1	1	2	3	-	1
CO 3	3	3	3	2	2	2	2	2	1	1	1	2	3	2	1
CO 4	3	-	-	-	-	1	1	1	1	1	1	2	3	-	1
CO 5	3	-	-	-	-	1	1	1	1	1	1	2	3	-	1
Average	**3**	**3**	**3**	**2**	**2**	**1.2**	**1.2**	**1.2**	**1**	**1**	**1**	**2**	**3**	**2**	**1**

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
CE19P63	**ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT**	**PE**	**3**	**0**	**0**	**3**

Objectives:

- To impart the knowledge and skills to identify and access the environmental impacts.
- To examine the assessment of impact on various environmental assessment components.
- To plan for the mitigation of adverse impact and to monitor the same.
- To assess the economic value of environmental impact through cost benefit analysis.
- To relate the monitoring and assessment methods with various case studies.

UNIT-I	INTRODUCTION	9

Impacts of Development on Environment – Rio Principles of Sustainable Development- Environmental Impact Assessment (EIA) – Objectives – Historical development – EIA Types – EIA in project cycle –EIA Notification and Legal Framework–Stakeholders and their Role in EIA– Selection & Registration Criteria for EIA Consultants.

UNIT-II	ENVIRONMENTAL ASSESSMENT	9

Screening and Scoping in EIA – Drafting of Terms of Reference, Baseline monitoring, Prediction and Assessment of Impact on land, water, air, noise and energy, flora and fauna - Matrices – Networks – Checklist Methods - Mathematical models for Impact prediction – Analysis of alternatives.

UNIT-III	ENVIRONMENTAL MANAGEMENT PLAN	9

Plan for mitigation of adverse impact on water, air and land, water, energy, flora and fauna – Environmental Monitoring Plan – EIA Report Preparation – Review of EIA Reports – Public Hearing- Environmental Clearance Post Project Monitoring.

UNIT-IV	SOCIO ECONOMIC ASSESSMENT	9

Baseline monitoring of Socio economic environment – Identification of Project Affected Personal – Rehabilitation and Resettlement Plan- Economic valuation of Environmental impacts – Cost benefit

Analysis.		
UNIT-V	**CASE STUDIES**	**9**
EIA case studies pertaining to Infrastructure Projects – Real Estate Development - Roads and Bridges – Mass Rapid Transport Systems - Ports and Harbour – Airports - Dams and Irrigation projects - Power plants – CETP's- Waste Processing and Disposal facilities – Mining Projects.		
	Total Contact Hours : 45	

Course Outcomes:	
On completion of the course, the students will be able to	
□	Acquire knowledge and skills to identify and assess the environmental impacts.
□	Examine the assessment of impact on various environmental assessment components.
□	Plan for the mitigation of adverse impact and to monitor the same.
□	Assess the economic value of environmental impact through cost benefit analysis.
□	Relate the monitoring and assessment methods with various case studies.
Text Book (s):	
1	Canter, R.L, "Environmental impact Assessment ", 2nd Edition, McGraw Hill Inc, New Delhi,1995.
2	Lohani, B., J.W. Evans, H. Ludwig, R.R. Everitt, Richard A. Carpenter, and S.L. Tu, "Environmental Impact Assessment for Developing Countries in Asia", Volume 1 – Overview Asian Development Bank, 1997.
Reference Book (s) / Web links:	
1	Becker H. A., Frank Vanclay,"The International handbook of social impact assessment conceptual and methodological advances, Edward Elgar Publishing,2003.
2	Barry Sadler and Mary McCabe, "Environmental Impact Assessment Training Resource Manual", United Nations Environment Programme, 2002.
3	Judith Petts, "Handbook of Environmental Impact Assessment Vol. I and II", Blackwell Science New York, 1999.
4	Lawrence, D.P., Environmental Impact Assessment – Practical Solutions to recurrent problems, Wiley-Interscience, New Jersey, 2003.
5	World Bank – Source Book on EIA.
6	Peter Morris, RikiTherivel "Methods of Environmental Impact Assessment", Routledge Publishers, 2009.
7	https://nptel.ac.in/courses/120/108/120108004/
Code Book(s):	
1	Ministry of Environment and Forests EIA Notification and Sectoral Guides, Government of India, New Delhi, 2010.

CE19P63	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	1	1	1	-	2	3	1	1	1	1	2	2	-	1
CO 2	3	2	2	2	-	2	3	1	1	1	1	2	3	1	2
CO 3	2	1	1	1	-	2	3	1	1	1	1	2	3	-	2
CO 4	2	1	1	1	-	3	3	1	1	1	1	2	3	-	2
CO 5	2	1	1	1	-	1	3	1	1	1	1	2	2	-	1
Average	**2.2**	**1.2**	**1.2**	**1.2**	**-**	**2.0**	**3**	**1**	**1**	**1**	**1**	**2**	**2.6**	**0.2**	**1.6**

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
CE19P64	ADVANCED SURVEYING	PE	3	0	0	3

Objectives:

- To acquire knowledge on the astronomical surveying and determination of time, latitude and longitude.
- To obtain knowledge on the aerial surveying, photogrammetry and photo interpretation.
- To gain knowledge on the applications of total station in surveying.
- To acquire knowledge on the GPS concept in surveying and its data processing applications.
- To visualize the various other methods of surveying for curve setting, hydrographic survey and tunneling.

UNIT-I	ASTRONOMICAL SURVEYING	9

Astronomical terms and definition – Motion of sun and stars – Celestial co-ordinate System - Time system - Nautical Alamance – Apparent attitude and corrections – Field observations and determinations of time, longitude, latitude and azimuth by attitude and Hour angle method.

UNIT-II	AERIAL SURVEYING	9

Terrestrial Photogrammetry – Terrestrial stereo photogrammetry – Aerial photogrammetry – overlaps – scale of photographs – Vertical and titled photographs distortion in aerial photographs – stereoscopic vision - photo interpretation – Applications.

UNIT-III	TOTAL STATION SURVEYING	9

Classification – basic measuring and working principles of an Electro – optical and Microwave total station - sources of errors in Electro – optical and Microwave total station – Care and Maintenance of total station – trilateration – Applications.

UNIT-IV	GPS SURVEYING	9

Basic concepts – Space, Control and User segments – Satellite configuration – Signal structure – Orbit determination and representation – Anti spoofing and selective availability – hand held and geodetic receivers – Field work procedure – Data processing Applications.

UNIT-V	MISCELLANEOUS	9

Reconnaissance – Route surveys for highways, railways and waterways – simple, compound, reverse, transition and vertical curve – setting out methods - hydrographic surveying – tides – MSL – Sounding methods – measurement of current and discharge – Tunnel alignment and setting out – Settlement and Deformation studies.

Total Contact Hours	:	45

Course Outcomes:

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

- Get familiarized on the astronomical surveying and determination of time, latitude and longitude.
- Get familiarized on the aerial surveying, photogrammetry and photo interpretation.
- Use the knowledge acquired on the applications of total station in surveying.
- Get familiarized on the GPS concept in surveying and its data processing applications.
- Carry out the various other methods of surveying for curve setting, hydrographic survey and tunneling.

Text Book (s):

1. James M. Anderson and Edward M. Mikhail, “Surveying, Theory and Practice”, 7th Edition, McGraw Hill, 2001.
2. Bannister and S. Raymond, “Surveying”, 7th Edition, Longman 2004.

Reference Book (s) / Web links:

1	Alfred Leick, GPS satellite surveying, John Wiley & Sons Inc., 3rd Edition, 2004.
2	Laurila, S.H. Electronic Surveying in Practice, John Wiley and Sons Inc, 1993.
3	Roy S.K., "Fundamentals of Surveying", 2nd Edition, Prentice Hall of India, 2004.
4	Arora K.R. "Surveying Vol I & II", Standard Book House, 10th Edition 2008.
5	Guocheng Xu, GPS Theory, Algorithms and Applications, Springer – Verlag, Berlin, 2003.
6	Seeber G, Satellite Geodesy, Water De Gruyter, Berlin, 1998.

CE19P64	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	1	3	1	1	1	3	3	2	1	1	2	-	1
CO 2	3	3	1	3	1	1	1	3	3	2	1	1	2	1	1
CO 3	3	3	1	2	2	1	1	3	3	2	1	1	2	2	1
CO 4	3	2	3	2	3	1	2	3	3	3	1	1	2	-	1
CO 5	3	2	3	2	3	1	1	3	3	2	1	2	2	2	1
Average	**3**	**2.6**	**1.8**	**2.4**	**2**	**1**	**1.2**	**3**	**3**	**2.2**	**1**	**1.2**	**2**	**1.7**	**1**

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
CE19P65	**NON DESTRUCTIVE TESTING OF MATERIALS**	**PE**	**3**	**0**	**0**	**3**

Objectives:

- To study and understand the various Non Destructive Evaluation and Testing methods, theory and their industrial applications.
- To acquire knowledge on various testing methods for detecting defects and for characterizing the material.
- To obtain knowledge on various test methods using liquid penetration and Magnetisation methods for surface defect detection and to know the techniques using principles of thermography and eddy current sensing elements.
- To acquire knowledge on the principles and uses of ultrasonic testing methods and acoustic emission testing methods.
- To develop an understanding on the principles, types and uses of radiography for NDT.

UNIT-I	**OVERVIEW OF NDT**	**9**

NDT Versus Mechanical testing, Overview of the Non Destructive Testing Methods for the detection of manufacturing defects as well as material characterisation. Relative merits and limitations, Various physical characteristics of materials and their applications in NDT., Visual inspection Unaided and aided.

UNIT-II	**SURFACE NDE METHODS**	**9**

Liquid Penetrant Testing – Principles, types and properties of liquid penetrants, developers, advanta and limitations of various methods, Testing Procedure, Interpretation of results. Magnetic Parti Testing- Theory of magnetism, inspection materials Magnetisation methods, Interpretation and evaluat of test indications, Principles and methods of demagnetization, Residual magnetism.

UNIT-III	**THERMOGRAPHY AND EDDY CURRENT TESTING(ET)**	**9**

Thermography- Principles, Contact and non contact inspection methods, Techniques for applying liq crystals, Advantages and limitation – infrared radiation and infrared detectors, Instrumentations methods, applications.Eddy Current Testing-Generation of eddy currents, Properties of eddy curre Eddy current sensing elements, Probes, Instrumentation, Types of arrangement, Applications, advantag Limitations, Interpretation/Evaluation.

UNIT-IV	ULTRASONIC TESTING (UT) AND ACOUSTIC EMISSION(AE)	9
Ultrasonic Testing-Principle, Transducers, transmission and pulse-echo method, straight beam and an beam, instrumentation, data representation, A/Scan, B-scan, C-scan. Phased Array Ultrasound, Time Flight Diffraction. Acoustic Emission Technique ¡VPrinciple, AE parameters, Applications.		
UNIT-V	**RADIOGRAPHY(RT)**	**9**
Principle, interaction of X-Ray with matter, imaging, film and film less techniques, types and use of fil and screens, geometric factors, Inverse square, law, characteristics of films – graininess, density, spe contrast, characteristic curves, Penetrameters, Exposure charts, Radiographic equivalence. Fluorosco Xero-Radiography, Computed Radiography, Computed Tomography.		
	Total Contact Hours : 45	

Course Outcomes:

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

- Detect the manufacturing defects and characterize the materials.
- Diagnose the surface defects using liquid penetration and magnetization methods.
- Get familiarized with the principles of thermography and eddy current sensing elements and their use in NDT.
- Get familiarized with the techniques and use of ultrasonic and acoustic emission testing methods.
- Get familiarized with various radiographic techniques and use them for NDT.

Text Book (s):

1. Baldev Raj, T.Jayakumar, M.Thavasimuthu “Practical Non-Destructive Testing¨, Narosa Publish House, 2009.
2. Ravi Prakash, ¡§Non-Destructive Testing Techniques¡¨, 1st revised edition, New Age Internatio Publishers, 2010.

Reference Book (s) / Web links:

1. ASM Metals Handbook,¡¨Non-Destructive Evaluation and Quality Control¡¨, American Society of Metals, Metals Park, Ohio, USA, 200, Volume-17.
2. Paul E Mix, ¡§Introduction to Non-destructive testing: a training guide¡¨, Wiley, 2nd Edition New Jersey, 2005.
3. Charles, J. Hellier,¡§ Handbook of Nondestructive evaluation¡¨, McGraw Hill, New York 2001.
4. ASNT, American Society for Non Destructive Testing, Columbus, Ohio, NDT Handbook,Vol. 1, Leak Testing, Vol. 2, Liquid Penetrant Testing, Vol. 3, Infrared and Thermal Testing Vol. 4, Radiographic Testing, Vol. 5, Electromagnetic Testing, Vol. 6, Acoustic Emission Testing, Vol. 7, Ultrasonic Testing.

CE19P65	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	2	2	2	2	2	2	1	-	-	-	2	3	1	1
CO 2	3	2	2	2	2	2	2	1	-	-	-	2	3	1	1
CO 3	3	2	2	2	2	2	2	1	-	-	-	2	3	1	1
CO 4	3	2	2	2	2	2	2	1	-	-	-	2	3	1	1
CO 5	3	2	2	2	2	2	2	1	-	-	-	2	3	1	1
Average	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**1**				**2**	**3**	**1**	**1**

SEMESTER VI

PROFESSIONAL ELECTIVE – II

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
CE19P66	CONSTRUCTION EQUIPMENT	PE	3	0	0	3

Objectives:

- To understand the applications and selection of construction equipment and its management.
- To gain knowledge about various types of earthwork equipment used in construction activities.
- To learn the equipment used for various construction activities like Tunneling, Dredging and modern construction equipment.
- To get familiarize with the equipment used in concrete and asphalt plants.
- To acquire knowledge about construction material handling equipment.

UNIT I	CONSTRUCTION EQUIPMENT AND MANAGEMENT	9

Identification – Planning of equipment – Selection of Equipment - Equipment Management in Projects - Maintenance Management – Equipment cost – Operating cost – Cost Control of Equipment - Depreciation Analysis – Replacement of Equipment- Replacement Analysis – Safety Management.

UNIT II	EQUIPMENT FOR EARTHWORK	9

Fundamentals of Earth Work Operations - Earth Moving Operations - Types of Earth Work Equipment - Tractors, Motor Graders, Scrapers, Front end Waders – Dozer, Excavators, Rippers, Loaders, trucks and hauling equipment, Compacting Equipment, Finishing equipment.

UNIT III	OTHER CONSTRUCTION EQUIPMENT	9

Equipment for Dredging, Trenching, Drag-line and clamshells, Tunneling – Equipment for Drilling and Blasting - Pile driving Equipment - Erection Equipment - Crane, Mobile crane - Types of pumps used in Construction - Equipment for Dewatering and Grouting – Equipment for Demolition - Under water concreting equipment – Modern Construction Equipment.

UNIT IV	CONCRETE AND ASPHALT PLANTS	9

Aggregate production- Different Crushers – Feeders - Screening Equipment - Handling Equipment - Batching and Mixing Equipment - Pumping Equipment – Ready mix concrete equipment, Concrete pouring equipment. Asphalt Plant, Asphalt Pavers, Asphalt compacting Equipment.

UNIT V	MATERIALS HANDLING EQUIPMENT	9

Forklifts and related equipment - Portable Material Bins – Material Handling Conveyors – Material Handling Cranes- Industrial Trucks.

	Total Contact Hours	:	45

Course Outcomes:

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

- Get familiarized with planning, selection and management of Construction equipment.
- Understand the application of the equipment used for various earthwork operations.
- Acquire knowledge about the equipment used for various construction activities like Tunneling, Dredging, etc. and modern construction equipment.
- Identify the equipment used for Concrete and Asphalt plants.
- Get aware of the equipment for handling the Construction Materials.

Text Book (s):

1. Sharma S.C. Construction Equipment and Management, Khanna Publishers, New Delhi,1988.
2. Peurifoy, R.L., Ledbetter, W.B. and Schexnayder, C., Construction Planning, Equipment and Methods, McGraw Hill, Singapore, 2006.

Reference Book (s) / Web links:

1	Dr.Mahesh Varma, Construction Equipment and its planning and Application, metropolitan Book Company, New Delhi. 1983.
2	John.E.Schaufelberger, Construction Equipment management, Pearson Publishers, USA 1998.
3	Sidney M. Levy, Construction Data Book: Construction Materials and Equipment, McGrawHill Education-Europe, Second edition.
4	Leonard E.Bernold, Construction Equipment and Methods (planning, innovation and safety), Wiley India Pvt Ltd.
5	Deodhar, S.V. Construction Equipment and Job Planning, Khanna Publishers, New Delhi,1988.

CE19P66	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	2	3	1	2	-	3	3	2	3	3	3	1	2
CO 2	3	-	-	-	3	1	-	3	3	2	2	3	3	1	2
CO 3	3	-	-	-	3	1	-	3	3	2	2	3	3	1	2
CO 4	3	-	-	-	3	1	-	3	3	2	2	3	3	1	2
CO 5	2	-	-	-	3	1	-	3	3	2	2	3	3	1	2
Average	**2.8**	**3**	**2**	**3**	**2.6**	**1.2**	**-**	**3**	**3**	**2**	**2.2**	**3**	**3**	**1**	**2**

Subject Code	Subject Name (Theory Course)	Category	L	T	P	C
CE19P67	**RAILWAYS, AIRPORTS AND HARBOUR ENGINEERING**	**PE**	**3**	**0**	**0**	**3**

Objectives:

- To understand the concepts and elements in Planning, Design and construction of Railways.
- To Select appropriate methods for construction and maintenance of railway tracks and operation.
- To understand the concepts and elements in Planning and design the geometric features of runway and taxiway.
- To design airport layout and to know visuals aids and air traffic control system
- Understand the terminologies, infrastructures in Harbour Engineering and Coastal regulations.

UNIT-I	**RAILWAY PLANNING AND CONSTRUCTION**	**9**

Elements of permanent way – Rails, Sleepers, Ballast, rail fixtures and fastenings, Selection of gauges - Track Stress, coning of wheels, creep in rails, defects in rails – Route alignment surveys, conventional and modern methods--Geometric design of railway, gradient, super elevation, widening of gauge on curves-, Level Crossings.

UNIT-II	**RAILWAY TRACK CONSTRUCTION, MAINTENANCE AND OPERATION**	**9**

Points and Crossings - Design of Turnouts, Working Principle-Track Circuiting - Construction & Maintenance – Conventional, Modern methods and Materials, Lay outs of Railway Stations and Yards, Rolling Stock, Tractive Power, Track Resistance - Role of Indian Railways in National Development – Railways for Urban Transportation – LRT & MRTS.

UNIT-III	**AIRPORT PLANNING AND DESIGN**	**9**

Role of Air Transport, Components of Airports - Airport Planning – Air traffic potential, Site Selection, Design of Components - Runway Design -Wind rose Diagram (Problems), Geometric Design and Corrections for Gradients (Problems), Drainage - Taxiway Design – Geometric Design Elements, Airport Drainage.

UNIT-IV	AIRPORT LAYOUTS, VISUAL AIDS, AND AIR TRAFFIC CONTROL	9

Airport Zoning - Clear Zone, Approach Zone, Buffer Zone, Turning Zone, Clearance over Highways and Railways - Airport Layouts –Case studies of Airport Layouts - Airport Buildings – Primary functions, Planning Concept, Principles of Passenger Flow, Passenger Facilities - Visual Aids – Runway and Taxiway Markings, Runway and Taxiway Lightings.

UNIT-V	HARBOUR ENGINEERING	9

Definition of Basic Terms: Harbour, Port, Satellite Port, Docks, Waves and Tides – Planning and Design of Harbours: Requirements, Classification, Location and Design Principles – Harbour Layout and Terminal Facilities – Coastal Structures: Piers, Break waters, Wharves, Jetties, Quays, Spring Fenders, Dolphins and Floating Landing Stage – Inland Water Transport.

Course Outcomes:

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

- Have Knowledge on engineering survey, equipment's used in permanent way, its fixture and fastenings and the geometric design of railway.
- Familiarize with the track drainage and its maintenance, relaying of track and infrastructure for metro, Mono and underground railways.
- Familiarize with air transport characteristics, classification and criteria for airport site selection and geometric design of runway and taxiway.
- Have Knowledge on airport Zoning, Visuals Aids and runway and taxiway Markings and lighting.
- Familiarize with the requirements, classification, Location and Design Principles of harbour Layout and coastal structures.

Text Book (s):

1	Subramanian K.P., Highways, Railways, Airport and Harbour Engineering, Scitech Publications (India), Chennai, 2010.
2	C.Venkatramaiah., Transportation Engineering-Vol.2 Railways, Airports, Docks and Harbours, Bridges and Tunnels.,Universities Press (India) Private Limited, Hyderabad, 2015.

Reference Book (s) / Web links:

1	Saxena Subhash, C.and Satyapal Arora, ACourse in Railway Engineering, Dhanapat Rai and Sons, Delhi, 1998.
2	Vazirani.V.N and Chandola.S.P, "Transportation Engineering-Vol.II", Khanna Publishers, New Delhi, 2015.
3	Mundrey J S, Railway Track Engineering, McGraw Hill Education (India) Private Ltd, New Delhi, 2013.
4	Khanna.S.K. Arora.M.G and Jain.S.S, Airport Planning and Design, NemachandandBros, Roorkee, 1994.

CE19P67	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	3	3	3	2	3	3	3	1	1	3	3	2	2
CO 2	3	3	3	3	3	2	3	3	3	1	1	3	3	2	2
CO 3	3	3	3	3	3	2	3	3	3	1	1	3	3	2	2
CO 4	3	3	3	3	3	2	3	3	3	1	-	3	3	2	2
CO 5	3	3	3	3	3	2	3	3	3	1	-	3	3	2	2
Average	**3**	**3**	**3**	**3**	**3**	**2**	**3**	**3**	**3**	**1**	**0.6**	**3**	**3**	**2**	**2**

Subject Code	Subject Name (Theory Course)	Category	L	T	P	C
CE19P68	URBAN PLANNING AND DEVELOPMENT	PE	3	0	0	3

Objectives:

- To understand the history of town planning and its importance.
- To study the various steps involved in urban planning and to know the housing development schemes.
- To learn the planning and management of different infrastructure facilities in a city.
- To understand the importance of public transport and non-motorized transport for a sustainable city development.
- To introduce the concept of smart cities in India.

UNIT-I	INTRODUCTION	8

History of Town Planning - Definitions and Objectives of Planning - Examples of planned and unplanned cities - Definition of Human settlement, Urban area, Town, City, Urbanisation, Suburbanisation, Urban sprawl, Peri-urban areas, Central Business District (CBD), Classification of urban areas.

UNIT-II	PLANNING PROCESS	8

Base map preparation - survey techniques - Analytical methods - region classification - Demographic methods - population forecasting. Introduction of Remote sensing, GIS and GPS in urban planning context - Regional planning.

UNIT-III	HOUSING DEVELOPMENT	10

Planning and management of local streets, water supply, storm water drainage, municipal solid waste management systems- New possibilities for recycling-Environmental Quality - Sanitation - Physical and mental health challenges in urban and sub-urban areas - Vulnerable population - Conserving natural resources.

UNIT-IV	TRANSPORT AND MOBILITY	9

Costs of congestion - Public and Para-transit modes (taxis and autos) - Feeder systems for the use of public transport - Non-motorized transport facilities - cycling and walking infrastructure - Integrated public transport.

UNIT-V	SMART CITIES	10

Smart city developments across the world - Specific priorities for Smart Cities in India - Leveraging recent technologies in enhancing urban living: internet of things (IoT) - Recreation -Renewable energy - Green corridors, green space and green buildings - Safety and security of urban population.

	Total Contact Hours	:	45

Course Outcomes:

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

- Know the importance of proper urban planning for a healthy city
- Get familiarized with the steps involved in planning of a city using remote sensing and GIS
- Know the various housing development schemes and to Plan and manage different infrastructure facilities in a city
- Design public transport and non-motorized transport facilities for a city
- Understand the importance of smart city developments in India and abroad and its various elements

Text Book (s):

1. Peter Hall, Mark Tewdwr-Jones, Urban and Regional Planning. Taylor & Francis, (2010).

2	Goel, S.L Urban Development and Management, Deep and Deep publications, New Delhi 2002.
Reference Book (s) / Web links:	
1	Singh V.B, Revitalised Urban Administration in India, Kalpaz publication, Delhi, 2001
2	Thooyavan, K.R., Human Settlements – A Planning Guide to Beginners, M.A Publications, Chennai, 2005.
Code Book(s):	
1	Tamil Nadu Town and Country Planning Act 1971, Government of Tamil Nadu, Chennai.
2	CMDA, Second Master Plan for Chennai, Chennai 2008.

CE19P68	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO 1	2	2	-	-	-	1	1	2	-	-	3	2	1	-	1
CO 2	3	3	-	-	-	1	1	2	-	-	3	3	2	-	1
CO 3	2	2	-	-	-	-	-	2	3	3	3	3	2	-	3
CO 4	-	-	-	-	-	-	-	-	3	3	3	3	1	-	2
CO 5	3	3	1	1	1	-	-	2	2	2	2	3	3	2	3
Average	**2.5**	**2.5**	**1**	**1**	**1**	**1**	**1**	**2**	**2.7**	**2.7**	**2.8**	**2.8**	**1.8**	**2**	**2**

Subject Code	**Subject Name (Theory course)**	**Category**	**L**	**T**	**P**	**C**
CE19P69	**TRANSPORT AND ENVIRONMENT**	**PE**	**3**	**0**	**0**	**3**

Objectives:

- To acquire knowledge of transportation projects on the environment.
- To acquire knowledge on methods of impact analysis and their applications.
- To acquire knowledge in Environmental Laws on transportation projects and socio-economic impacts.
- To acquire knowledge on the mitigative measures adopted in the planning stage.
- To predict and assess the impact of transportation projects.

UNIT-I	**INTRODUCTION**	**9**

Environmental Inventory, Environmental Assessment, Environmental Impact Assessment (EIA), Environmental Impact of Transportation Projects, Need for EIA, EIA Guidelines for Transportation Project, Historical Development.

UNIT-II	**METHODOLOGIES**	**9**

Elements of EIA – Screening and Scoping – Methods of Impact Analysis – Applications – Appropriate methodology.

UNIT-III	**ENVIRONMENTAL IMPACT, PREDICTION AND ASSESSMENT**	**9**

Prediction and Assessment of Impact of Transportation Project at various stages on water, air, noise, land acquisition and resettlement, Socio economic impact, indigenous people, aesthetics, health and safety, energy studies, IRC guidelines.

UNIT-IV	**ENVIRONMENTAL MITIGATION AND MANAGEMENT PLAN**	**9**

Mitigation of the impact on Natural and Man-made Environment, Health, Water, Land, Noise, Air, Public participation, Environmental Management Plan, Energy Conservation, Methods to reduce Global Warming.

UNIT-V	**EIA CASE STUDIES**	**9**

EIA Case Studies on Highway, Railway, Airways and Waterways Projects.			
	Total Contact Hours	**:**	**45**

Course Outcomes:	
On completion of the course, the students will be able to	
□	Acquire knowledge of Transportation projects on the environment.
□	Acquire knowledge on methods of impact analysis and their applications.
□	Acquire knowledge of Environmental Laws on transportation projects and socio-economic impacts.
□	Acquire knowledge on the mitigative measures adopted in the planning stage.
□	Predict and assess the impact of transportation projects.
Text Book (s):	
1	Canter, R.L, "Environmental impact Assessment ", 2nd Edition, McGraw Hill Inc, New Delhi, 1995.
2	Indian Road Congress (IRC), Environmental Impact of Highway Projects, IRC, Delhi, 1998.
Reference Book (s) / Web links:	
1	John G.Rau and David, C.Hooten, Environmental Impact Analysis Handbook, McGraw Hill Book Company, 1995
2	James H.Banks, Introduction to Transportation Engineering, McGraw Hill Book Company, 2000
3	World Bank, A Handbook on Roads and Environment, Vol.I and II, Washington DC, 1997
4	Priya Ranjan Trivedi, International Encyclopaedia of Ecology and Environment – EIA, Indian Institute of Ecology and Environment, New Delhi, 1998
5	P. Meenakshi, Elements of Environmental Science and Engineering, Prentice Hall of India, New Delhi, 2006
6	Thirumurthy A.M., Introduction to Environmental Science and Management, Shroff Publishers, Bombay, 2005.

CE19P69	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO 1	2	2	-	-	-	1	1	2	-	-	3	2	1	-	1
CO 2	3	3	-	-	-	1	1	2	-	-	3	3	2	-	1
CO 3	2	2	-	-	-	-	-	2	3	3	3	3	2	-	3
CO 4	-	-	-	-	-	-	-	-	3	3	3	3	1	-	2
CO 5	3	3	1	1	1	-	-	2	2	2	2	3	3	2	3
Average	**2.5**	**2.5**	**1**	**1**	**1**	**1**	**1**	**2**	**2.7**	**2.7**	**2.8**	**2.8**	**1.8**	**2**	**2**

SEMESTER VII

PROFESSIONL ELECTIVE – III

Subject Code	**Subject Name (Theory course)**	**Category**	**L**	**T**	**P**	**C**
CE19P71	**PRESTRESSED CONCRETE STRUCTURES**	**PE**	**3**	**0**	**0**	**3**

Objectives:	
□	To understand the need for prestressed concrete and various methods of analysis of prestressed concrete structures.
□	To design the prestressed concrete beams for flexure and shear as per the IS code.

□	To evaluate the short &long term deflections and anchorage zone stress in prestressed concrete beams.
□	To design composite and continuous prestressed concrete beams.
□	To design various tension and compression prestressed concrete members and understand the concept of partial prestressing.

UNIT-I	**INTRODUCTION – THEORY AND BEHAVIOUR**	**9**

Basic concepts – Advantages and disadvantages – Materials required – Systems and methods of prestressing – Analysis of sections – Stress concept – Strength concept – Load balancing concept – Effect of loading on the tensile stresses in tendons —- Losses of prestress in post -tensioned and pre-tensioned members.

UNIT-II	**DESIGN FOR FLEXURE AND SHEAR**	**9**

Basic assumptions of flexural design – Permissible stresses in steel and concrete as per I.S.1343 Code – Different Types of sections - Design of sections ofType I and Type II post-tensioned and pre tensioned beams – Check for flexural capacity based on I.S. 1343 Code – Influence of Layout of cables in post-tensioned beams – Location of wires in pre-tensioned beams – Design for shear based on I.S. 1343 Code.

UNIT-III	**DEFLECTION AND DESIGN OF ANCHORAGE ZONE**	**9**

Factors influencing deflections – Short term deflections of uncracked members – Prediction of long term deflections due to creep and shrinkage – Check for serviceability limit states. Determination of anchorage zone stresses in post-tensioned beams – design of anchorage zone reinforcement.

UNIT-IV	**COMPOSITE BEAMS AND CONTINUOUS BEAMS**	**9**

Analysis and design of composite beams – Methods of achieving continuity in continuous beams – Analysis for secondary moments – Concordant cable and linear transformation – Calculation of stresses – Principles of design.

UNIT-V	**TENSION AND COMPRESSION MEMBERS**	**9**

Role of prestressing in members subjected to Tensile forces and compressive forces - Design of tension and compression members – Tanks, pipes and poles – Partial prestressing – Definition, methods of achieving partial prestressing, merits and demerits of partial prestressing.

	Total Contact Hours	**:**	**45**

Course Outcomes:

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

□	Understand the need for prestressed concrete and various methods of analysis of prestressed concrete structures.
□	Design the prestressed concrete beams for flexure and shear as per the IS code.
□	Evaluate the short & long term deflections and anchorage zone stress in prestressed concrete beams.
□	Design composite and continuous prestressed concrete beams.
□	Design various tension and compression prestressed concrete members and understand the concept of partial prestressing.

Text Book (s):

1	Krishna Raju N., "Prestressed concrete", 5th Edition, Tata McGraw Hill Company, New Delhi, 2012.
2	Rajagopalan.N, "Prestressed Concrete", Narosa Publishing House, 2002.

Reference Book (s) / Web links:

1	Pandit.G.S. and Gupta.S.P., "Prestressed Concrete", CBS Publishers and Distributers Pvt. Ltd, 2012.
2	Dayaratnam.P., "Prestressed Concrete Structures", Oxford and IBH, 2017.

3	Lin T.Y. and Ned.H.Burns, "Design of prestressed Concrete Structures", Third Edition, Wiley India Pvt. Ltd., New Delhi, 2013.
4	https://www.pci.org/
5	https://nptel.ac.in/courses/105/106/105106118/
Code Book(s):	
1	IS1343:2012, “Code of Practice for Prestressed Concrete”, Bureau of Indian Standards, New Delhi.

CE19P71	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	3	3	2	2	-	1	2	1	-	2	3	3	1
CO 2	3	3	3	3	2	2	-	1	2	1	-	2	3	3	1
CO 3	3	3	3	3	2	2	-	1	2	1	-	2	3	3	1
CO 4	3	3	3	3	2	2	-	1	2	1	-	2	3	3	1
CO 5	3	3	3	3	2	2	-	1	2	1	-	2	3	3	1
Average	**3**	**3**	**3**	**3**	**2**	**2**	**-**	**1**	**2**	**1**	**-**	**2**	**3**	**3**	**1**

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
CE19P72	**BRIDGE STRUCTURES**	**PE**	**3**	**0**	**0**	**3**

Objectives:

- To comprehend the various types of bridges, loads acting on road and railway bridges.
- To propose a suitable bridge type for a given project.
- To get familiarized with analysis and design of RC & PSC bridges.
- To understand the loading mechanism on steel bridges.
- To recommend suitable type of bearings, piers, abutments and foundation of bridges.

UNIT-I INTRODUCTION **9**

History of Bridges - Components of a Bridge and its definitions- Classification of Road Bridges - Selection of Site and Initial Decision Process - Survey and Alignment; Geotechnical Investigations and Interpretations. River Bridge: Selection of Bridge site and planning - Collection of Bridge design data - Hydrological calculation

Road Bridges - IRC codes - Standard Loading for Bridge Design - Influence lines for statically determinate structures - I.L. for statically indeterminate structures - Transverse distribution of Live loads among deck longitudinal - Load combinations for different working state and limit state designs

Railway Bridges: Loadings for Railway Bridges; Railroad data. Pre-design considerations; - Railroad vs. Highway bridges.

UNIT-II SUPERSTRUCTURE **9**

Selection of main bridge parameters, design methodologies -Choices of superstructure types; Orthotropic plate theory, load + techniques - Grillage analysis - Finite element analysis - Different types of superstructure (RCC and PSC); Longitudinal Analysis of Bridge.- Transverse Analysis of Bridge- Temperature Analysis-Distortional Analysis-Effects of Differential settlement of supports-Reinforced earth structures.

UNIT-III DESIGN OF RC AND PSC BRIDGES **9**

Design of slab bridges – Girder bridges – PSC bridges-design considerations.

UNIT-IV DESIGN OF STEEL BRIDGES **9**

Design of Truss Bridges – Design of Plate girder bridges.		
UNIT-V	**SUBSTRUCTURE, BEARINGS AND DECK JOINTS, PARAPETS AND RAILINGS**	**9**
Substructure - Pier; Abutment - Wing walls- Importance of Soil-Structure Interaction - Types of foundations - Open foundation- Pile foundation- Well foundation- Simply supported bridge- Continuous Bridge - Bearings and Deck Joints - Different types of bridge bearings and expansion joints - Parapets and Railings for Highway Bridges		
	Total Contact Hours : 45	

Course Outcomes:	
On completion of the course, the students will be able to	
□	Perceive the basic concepts in proportioning of bridge in terms of aesthetics, geographical location and functionality.
□	Choose a suitable bridge type for a given project taking into consideration the structural and economical aspects.
□	Design and detail RC & PSC bridges for different loadings.
□	Analyse and design steel truss and plate girder bridges.
□	Develop skills to prefer suitable type of bearings, piers, abutments and substructure.
Text Book (s):	
1	Johnson Victor D., Essentials of Bridge Engineering, 6th Edition, CBS Publishers & Distributors Pvt. Ltd., 2017.
2	Krishna Raju N., Design of Bridges, 5th Edition, Oxford and IBH publishing co., New Delhi, 2015.
Reference Book (s) / Web links:	
1	Praveen Nagarajan, Design of Concrete Bridges (As per Latest IRC Codes), Wiley, 2020.
2	Ponnuswamy S., Bridge Engineering, 3rd Edition, Tata McGraw-Hill, New Delhi, 2017.
3	Rajagopalan. N. “Bridge Superstructure”, Alpha Science International, 2006.
4	Jagadeesh.T.R. and Jayaram.M.A., “Design of Bridge Structures”, Prentice Hall of India Pvt. Ltd. 2009.
5	https://nptel.ac.in/courses/105/105/105105165/
Code Book(s):	
1	IRC: 5-2015, Standard Specifications and Code of Practice for Road Bridges, Section I – General Features of Design (Eight Revision), Indian Road Congress, 2015.
2	IRC: 6-2017, Standard Specifications and Code of Practice for Road Bridges, Section II – Loads and Load Combinations (Seventh Revision), Indian Road Congress, 2017.
3	IRC: 22-2015, Standard Specifications and Code of Practice for Road Bridges, Section VI – Composite Construction (Limit States Design) (Third Revision), Indian Road Congress, 2015.
4	IRC: 24-2010, Standard Specifications and Code of Practice for Road Bridges, Steel Road Bridges (Limit State Method) (Third Revision), Indian Road Congress, 2010.
5	IRC: 83-2015 (Part-I), Standard Specifications and Code of Practice for Road Bridges, Section IX Bearings, Part I: Roller & Rocker Bearings (Second Revision), Indian Road Congress, 2015.
6	IRC: 83-2015 (Part-II), Standard Specifications and Code of Practice for Road Bridges, Section IX Bearings (Elastomeric Bearings), Part II (First Revision), Indian Road Congress, 2015.
7	IRC: 83-2002 (Part-III), Standard Specifications and Code of Practice for Road Bridges, Section IX Bearings, Part III: POT, POT-CUM-PTFE, PIN and Metallic Guide Bearings, Indian Road Congress, 2002.
8	IRC: 83-2014 (Part IV), Standard Specifications and Code of Practice for Road Bridges, Section IX – Bearings (Spherical and Cylindrical), Indian Road Congress, 2014.
9	IRC: 112-2011, Code of Practice for Concrete Road Bridges. Indian Road Congress, 2011.

CE19P72	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	3	2	1	1	1	1	-	1	1	1	2	2	2
CO 2	3	3	3	2	1	2	1	1	1	1	2	1	3	2	3
CO 3	3	3	3	2	1	2	1	1	1	1	2	1	3	2	3
CO 4	3	3	3	2	1	2	1	1	1	1	2	1	3	2	3
CO 5	3	3	3	3	1	3	2	1	1	1	2	2	2	2	3
Average	**3.0**	**3.0**	**3.0**	**2.2**	**1.0**	**2.0**	**1.2**	**1.0**	**1.0**	**1.0**	**1.8**	**1.2**	**2.6**	**2.0**	**2.8**

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
CE19P73	**TALL STRUCTURES**	**PE**	**3**	**0**	**0**	**3**

Objectives:

- To impart knowledge on modern materials and design philosophy used in construction of tall buildings.
- To familiarize the loads acting on the tall structure.
- To assess the behavior of tall structures.
- To expertize in analysis of tall structures.
- To acquire knowledge on design of tall structures.

UNIT-I **DESIGN CRITERIA AND MATERIALS** **9**

Design Philosophy - Modern concepts – Materials used - High Performance Concrete, Fibre Reinforced Concrete, Light weight concrete, Self-Compacting Concrete, High strength steel, Composites.

UNIT-II **LOADING** **9**

Gravity Loading – Dead load, Live load – Live load reduction techniques, Impact load, Construction load, Sequential loading. Wind Loading – Static and Dynamic Approach, Analytical method, Wind Tunnel Experimental methods - Earthquake Loading – Equivalent lateral Load analysis, Dynamic Analysis, Combination of Loads.

UNIT-III **BEHAVIOUR OF STRUCTURAL SYSTEMS** **9**

Factors affecting the growth, height and structural form, Behaviour of Braced frames, Rigid Frames, in filled frames, Shear walls, Coupled Shear walls, Wall – Frames, Tubular and Outrigger – Hybrid systems.

UNIT-IV **ANALYSIS** **9**

Modeling for approximate analysis, accurate analysis and reduction techniques, Analysis of structures as an integral unit, Analysis for drift and twist - Computerized 3D analysis.

UNIT-V **DESIGN PARAMETERS** **9**

Design for differential movement, Creep and Shrinkage effects, Temperature Effects and Fire Resistance, Stability of Tall Structures - PΔ Effects, Buckling analysis of Tall Buildings.

Total Contact Hours : 45

Course Outcomes:

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

- Get familiarized with the design aspects and the various innovative materials which can be used for the construction of tall buildings.
- Comprehend the types of loading and load combination for analyzing tall structures.
- Identify various structural systems, their behavior and performance under different loading conditions.
- Analyze the structures as an integral unit for drift and twisting effects.
- Recognize the various design parameters considered while designing tall buildings.

Text Book (s):

1. Bryan Stafford Smith and Alex Coull, Tall Building Structures, Analysis and Design, John Wiley and Sons, Inc., 2011.

2	Taranath B.S, Structural Analysis and Design of Tall Buildings: Steel and Composite Construction, McGraw Hill, 2011.
Reference Book(s) / Web links:	
1	Lin T.Y. and Burry D.Stotes, Structural Concepts and Systems for Architects and Engineers, John Wiley, 1994.
2	Lynn S.Beedle, Advances in Tall Buildings, CBS Publishers and Distributors, Delhi, 1996
3	Wolfgang Schuler, High Rise Building Structures, John Wiley & Sons, New York, 1986.
4	Kolousek V, Pimer M, Fischer O and Naprstek J, Wind effects on Civil Engineering Structures. Elsevier Publications.1984.

CE19P73	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	2	2	2	2	2	2	1	1	1	1	3	3	2	2
CO 2	3	2	2	2	1	2	2	1	-	1	1	3	3	2	2
CO 3	3	2	2	2	2	2	2	1	1	1	1	3	3	2	2
CO 4	3	2	2	2	2	2	2	1	1	1	1	3	3	2	2
CO 5	3	3	3	3	2	2	2	1	1	1	1	3	3	2	2
Average	**3**	**2.2**	**2.2**	**2.2**	**1.8**	**2**	**2**	**1**	**0.8**	**1**	**1**	**3**	**3**	**2**	**2**

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
CE19P74	**COASTAL ENGINEERING**	**PE**	**3**	**0**	**0**	**3**

Objectives:

- To understand basic concepts of waves, wind, sea, swell, wave mechanics and measurements.
- To analyze the different properties of waves.
- To have an understanding of Tide analysis, prediction, seasonal fluctuations and wave properties.
- To assess and use appropriate coastal structure for shore protection.
- To acquaint the various modelling aspects in coastal engineering and mitigation measures for tsunami.

UNIT-I	**INTRODUCTION TO COASTAL ENGINEERING**	**9**

Introduction - wind and waves - Sea and Swell -Introduction to small amplitude wave theory - use of wave tables- Mechanics of water waves - Linear (Airy) wave theory – Wave measurement.

UNIT-II	**WAVE PROPERTIES AND ANALYSIS**	**9**

Introduction to non-linear waves and their properties - Waves in shallow waters -Hindcast wave generation models, wave shoaling; wave refraction; wave breaking; wave diffraction random and 3D waves- Short term wave analysis - wave spectra and its utilities - Long term wave analysis- Statistics analysis of grouped wave data.

UNIT-III	**TYPES AND WAVE TRANSFORMATION**	**9**

Tide analysis and prediction, storm surge, seiches and seasonal fluctuations - Long term water level fluctuations – Wave shoaling; wave refraction; wave breaking; wave diffraction.

UNIT-IV	**COASTAL STRUCTURES AND SHORE PROTECTION**	**9**

Risk analysis – design wave – Break waters – Shore protection – groins, seal walls, offshore breakwaters artificial nourishment.

UNIT-V	**MODELING IN COASTAL ENGINEERING**	**9**

Physical modeling in Coastal Engineering - Limitations and advantages - Role of physical modeling in coastal engineering - Numerical modeling - Modeling aspects - limitations - Tsunami mitigation measures.

Total Contact Hours	**:**	**45**

Course Outcomes:

	On completion of the course, the students will be able to
□	Understand the coastal features, wave theory and mechanics of water waves.
□	Analyze the waves based on its properties using 3-D waves and wave generation models.
□	Comprehend the sediment types, transportation types and movement of waves.
□	Design and apply the best possible sustainable coastal defense techniques with appropriate materials such as groins, sea walls, offshore breakwaters, etc.,
□	Model in coastal engineering and mitigate measures for tsunami.
Text Book (s):	
1	Kamphuis, J.W., Introduction to coastal engineering and management, 3rd Edition, June 2020.
2	Dean, R.G. and Dalrymple, R.A., Water wave mechanics for Engineers and Scientists, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1994.
Reference Book(s) / Web links:	
1	Mani, J. S. Coastal Hydrodynamics. PHI Learning Pvt. Ltd., 2012.
2	Ippen, A.T., Estuary and Coastline Hydrodynamics, McGraw-Hill, Inc., New York, 1978.
3	Sorenson, R.M., Basic Coastal Engineering, A Wiley-Interscience Pub. New York, 1978.
4	Coastal Engineering Manual, Vol. I-VI, Coastal Engineering Research Centre, Dept. of the Army, US Army Corps of Engineers, Washington DC, 2006.
5	https://www.ntslf.org/about-tides/tides-faq
6	https://onlinecourses.swayam2.ac.in/cec21_hs03/preview

CE19P74	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	2	1	3	1	1	1	2	3	1	1	2	2	2	3
CO 2	3	2	1	3	1	1	1	2	3	1	1	2	2	2	2
CO 3	3	2	1	3	1	1	1	2	3	1	1	2	3	3	3
CO 4	3	2	1	3	1	1	1	2	3	1	1	2	3	3	3
CO 5	3	2	1	3	1	1	1	2	3	1	1	2	1	2	2
Average	**3**	**2**	**1**	**3**	**1**	**1**	**1**	**2**	**3**	**1**	**1**	**2**	**2.2**	**2.4**	**2.6**

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
CE19P75	**GLOBAL CLIMATIC CHANGE**	**PE**	**3**	**0**	**0**	**3**
Objectives:						
□	To understand basic concepts of atmosphere, monsoon and climate change.					
□	To gain knowledge on global climate change causing man made processes.					
□	To know the national and international protocols on emission status and use of renewable energy.					
□	To create a sense of social, environmental impact and adaptation due to climate change.					
□	To inculcate the importance of conservation of natural resources.					
UNIT-I	**INTRODUCTION TO WEATHER AND CLIMATE**					**9**
Atmosphere – Climatology and Paleo climatology, Factors affecting global, regional and local climates, weather parameters. Tropical climate, Monsoons, Polar, Desert, Mid-latitude climates and their role in global climate change.						
UNIT-II	**ELEMENTS AND PROCESSES RELATED TO CLIMATE CHANGE**					**9**

Structure and driving forces of the earth - Global energy balance. Earth's carbon reservoirs- marine and terrestrial, Carbon cycles, Global Ocean Circulation, Southern oscillation (El-Nino and La- Nina), Greenhouse gases and global warming - Industrialization and urbanization, Representative Concentration Pathways.		
UNIT-III	**CLIMATE CHANGE MITIGATION**	**9**
Global and India emission status, Nationally Determined Contribution (NDC), International agreements and protocols, Future use of renewable energy, Carbon Capture and Carbon Sequestration.		
UNIT-IV	**CLIMATE CHANGE ADAPTATION**	**9**
Impacts and Vulnerability on Water, Agriculture, Forestry, Coastal and Health. Traditional knowledge to cope with climate change impacts – Community and ecological based adaptation, Climate Adaptation Fund and Insurance.		
UNIT-V	**CONSERVATION OF NATURAL RESOURCES**	**9**
Climate Change and Sustainable development, Water and Food Security, Need for Conservation of Natural Resources (Forestry and Coastal Eco-system), Climate Extreme events – heat wave, flood and droughts, Sea Level Rise and Ocean acidification and Natural based solution for conservation (NBS).		
	Total Contact Hours : 45	

Course Outcomes:	
On completion of the course, the students will be able to	
□	Understand the science and basic of weather and climate.
□	Apply the knowledge on natural and anthropogenic activities, which accelerate the climate change.
□	Comprehend the knowledge on various protocols and agreement that help to control and reduce climate change impacts.
□	Conversant to use the adaptive techniques to build the climate resilience society.
□	Understand the stress on natural based resources and to conserve it from natural calamities.
Text Book (s):	
1	Climate Change – The Science, Impacts and Solutions (2nd Edition) – A. Barrie Pittock, CSIRO Publishing, 2009.
2	Fundamentals of weather and climate (2nd Edition) – Robin Mcllveen, Oxford University Press, 2009.
Reference Book (s) / Web links:	
1	Climate change – Mitigation of Climate, IPCC, 2013.
2	Atmosphere Weather and Climate – K Siddartha, Kisalaya Publications Pvt. Ltd, 2013.
3	W. Neil Adger, Irene Lorenzoni and Karen L. O, Adapting to Climate Change: Thresholds, Values, Governance, Cambridge, 2009.
4	Vineet Kumar, Arjuna Srinidhi, Chandra Bhushan, Geetika Singh, Rising to the Call: Good Practices of Climate Change Adaptation in India, Centre For Science And Environment publisher, 2014.
5	Dan Gafta and John Akeroyd, Nature Conservation Concepts and Practice, Springer, 2006.
6	https://onlinecourses.swayam2.ac.in/cec21_hs03/preview
7	https://climate.nasa.gov/
8	https://www.globalchange.gov/climate-change
9	https://www.un.org/en/sections/issues-depth/climate-change/

CE19P75	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3

CO 1	3	3	3	3	2	2	1	3	1	1	1	3	3	3	2
CO 2	3	3	3	3	2	2	1	3	1	1	1	3	3	3	2
CO 3	3	3	3	3	2	2	1	3	1	1	1	3	3	3	2
CO 4	3	3	3	3	2	2	1	3	1	1	1	3	3	3	2
CO 5	3	3	3	3	2	2	1	3	1	1	1	3	3	3	2
Average	**3**	**3**	**3**	**3**	**2**	**2**	**1**	**3**	**1**	**1**	**1**	**3**	**3**	**3**	**2**

SEMESTER VII

PROFESSIONAL ELECTIVE – IV

Subject Code	Subject Name (Theory Course)	Category	L	T	P	C
CE19P76	**STRUCTURAL DYNAMICS AND EARTHQUAKE ENGINEERING**	**PE**	**3**	**0**	**0**	**3**

Objectives:

- To understand the concept of formulation of equations of motion of SDOF system for free and forced vibration of damped and undamped structures.
- To gain knowledge about basic principles of free and forced vibration both undamped and damped multiple degree of freedom systems.
- To get familiarized with the elements of engineering seismology.
- To acquire knowledge on the performance of structures under earthquake loading and evaluate earthquake forces as per IS: 1893 – 2002.
- To recognize the principles of Earthquake Resistant Design and detailing as per IS: 13920 – 1993.

UNIT-I **SINGLE DEGREE OF FREEDOM SYSTEM** **9**

Definition of degree of freedom – Idealization of structure as Single Degree of Freedom (SDOF) system – Formulation of equation of motion for various SDOF system – D' Alemberts Principles – Effect of damping – Free and forced vibration of damped and undamped structures – Response to harmonic forces and periodic forces.

UNIT-II **MULTI DEGREE OF FREEDOM SYSTEM** **9**

Formulation of equation of motion for multi degree of freedom (MDOF) system – Evaluation of natural frequencies and modes – Eigen values and Eigen vectors – Response to free and forced vibration of undamped and damped MDOF systems – Modal superposition methods.

UNIT-III **INTRODUCTION TO EARTHQUAKE ENGINEERING** **9**

Elements of Engineering Seismology – Definitions, Introduction to Seismic hazard, Earthquake phenomenon – Seismotectonics – Seismic Instruments – Characteristics of Strong Earthquake motion – Estimation of Earthquake Parameters.

UNIT-IV **EARTHQUAKE EFFECTS ON STRUCTURES** **9**

Effect of earthquake on different types of structures – Behaviour of RCC, Steel and prestressed Concrete Structures under earthquake loading – Pinching Effect – Bouchinger Effects – Evaluation of Earthquake forces – IS Code 1893: 2002 – Response Spectra – Lessons learnt from past earthquakes.

UNIT-V **CONCEPTS OF EARTHQUAKE RESISTANT DESIGN** **9**

Causes of damage – Planning considerations/Architectural concept (IS 4326–1993) – Guidelines for Earthquake resistant design – Earthquake resistant design of masonry buildings– Design consideration – Guidelines – Earthquake resistant design of R.C.C. buildings – Lateral load analysis – Design and detailing (IS 13920:1993).

Total Contact Hours : 45

Course Outcomes:

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

□	Apply the concept of static and dynamic analysis of structures on SDOF systems.
□	Analyze the modes of multi- degree of freedom system involving concepts of Numerical methods.
□	Get familiarized with theories, causes, and characteristics of earthquake.
□	Evaluate seismic forces for various structures as per Indian codal provision.
□	Plan an Earthquake resistant masonry & RCC structure as per Indian Code guidelines.
Text Book (s):	
1	Pankaj Agarwal "Earthquake Resistant Design of Structures",Prentice Hall of India Pvt Ltd.New Delhi,2006.
2	Anil K.Chopra, "Dynamics of Structures: Theory and Applications to Earthquake Engineering", Prentice Hall, Englewood Cliffs, New Jersy, Second Edition, 2001.
Reference Book(s) / Web links:	
1	Berg. Glen v., "Elements of Structure Dynamics" 'Prentice Hall Englewood Cliffs, New Jersy.1989.
2	Cheng, F.Y., "Matrix Analysis of Structure Dynamics", Marcel Dekker, New York, 2001.
3	Clough, R.W.and Penzien,J., " Dynamics of Structure",McGraw-Hill,inc.,New York,1993
4	Minoru Wakabayashi, Design of Earthquake Resistant Buildings, Mc Graw – Hill Book Company, 1986
5	Jai Krishna, Chandrasekaran.A.R., and Brijesh Chandra, Elements of Earthquake Engineering, South Asia Publishers, 1994.
6	William Thomson, "Theory of Vibration and its applications", George Allen Pub.
7	Manicka Selvam K., "Elementary Structural Dynamics", Dhanpatrai and sons, New Delhi,2001.
8	Hurty.W.C, Rubinstein.M.F,"Dynamic of Structure", Prentice Hall of India Pvt Ltd.NewDelhi.
9	Mario Paz, Structural Dynamics – Theory and Computations, Fourth Edition, CB publishers, 1997.
10	S.K.Duggal"Earthquake Resistant Design of Structures",Tata McGraw-Hill Publishing,2008
11	Moorthy.C.V.R., Earthquake Tips, NICEE, IIT Kanpur,2002.
IS Code Book(s):	
1	IS 1893:2002- Criteria for Earthquake Resistant Design of Structures.
2	IS 13920:1993- Ductile Design and Detailing of Reinforced concrete structures Subjected to Seismic forces-Code of Practice.
3	IS 4326-1993 Earthquake Resistant Design and Construction of Buildings-Code of Practice.

CE19P76	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO 1	3	3	3	2	1	1	1	1	1	1	1	2	3	1	1
CO 2	3	3	3	2	1	1	1	1	1	1	1	2	3	1	1
CO 3	3	2	3	2	2	1	1	1	1	1	1	2	3	1	1
CO 4	3	3	3	2	2	2	1	1	1	1	1	2	3	2	1
CO 5	3	3	3	2	2	2	2	2	1	1	1	3	3	3	3
Average	**3**	**2.8**	**3**	**2**	**1.6**	**1.4**	**1.2**	**1.2**	**1**	**1**	**1**	**2.2**	**3**	**1.6**	**1.4**

Subject Code	**Subject Name (Theory course)**	**Category**	**L**	**T**	**P**	**C**
CE19P77	**COMPUTER AIDED DESIGN OF STRUCTURES**	**PE**	**3**	**0**	**0**	**3**
Objectives:						
□	To introduce students about the software importance and applications in industry.					
□	To acquire knowledge in creating models using the software.					

□	To understand the working principles of software using finite element methods and its applications.
□	To analyze and design a steel or concrete structure using software program – linear analysis.
□	To acquire knowledge in artificial intelligence and its applications in industry.

UNIT-I	**INTRODUCTION**	**9**

Fundamental reason for implementing CAD - Software requirements – Hardware components in CAD system – Design process - Applications and benefits

UNIT-II	**COMPUTER GRAPHICS**	**9**

Graphic Software – Graphic primitives - Transformations - 2 Dimensional and 3 Dimensional transformations – Concatenation - Wire frame modeling - Solid modeling - Graphic standards - Drafting packages.

UNIT-III	**STRUCTURAL ANALYSIS**	**9**

Principles of structural analysis - Fundamentals of finite element analysis - Concepts of finite elements – Stiffness matrix formulation – Variational Method – Weighted residual method – Problems – Convergence criteria – Analysis packages and applications.

UNIT-IV	**DESIGN AND OPTIMIZATION**	**9**

Principles of design of steel and RC structures - Beams and Columns - Applications to simple design problems - Optimization techniques - Algorithms - Linear programming – Simplex Method.

UNIT-V	**EXPERT SYSTEMS**	**9**

Introduction to artificial intelligence - Knowledge based expert systems – Applications of Knowledge Based Expert Systems - Rules and decision tables - Inference mechanisms - simple applications.

	Total Contact Hours	**:**	**45**

Course Outcomes:

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

□	Get familiarized in analysis and design of any structure using software.
□	Able to deal with CAD software and hardware components.
□	Able to create any type of model using software and understand the finite element analysis concepts.
□	Get familiarized in latest artificial intelligence in industry.
□	Get familiarized in understanding the importance and applications of artificial intelligence using the software.

Text Book (s):

1	Groover M.P. and Zimmers E.W. Jr., "CAD/CAM, Computer Aided Design and Manufacturing", **Pearson Education**, Noida, 2003.
2	Krishnamoorthy C.S.Rajeev S., "Computer Aided Design", Narosa Publishing House, New Delhi, 2001.

Reference Book (s) / Web links:

1	. Harrison H.B., "Structural Analysis and Design", Part I and II Pergamon Press, Oxford,1990.
2	Rao S.S., "Optimisation Theory and Applications", Wiley Eastern Limited, New Delhi, 1984.
3	Richard Forsyth (Ed), "Expert System Principles and Case Studies", Chapman and Hall, London, 1989.

CE19P77	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	2	2	2	3	1	1	2	2	-	-	3	2	2	2
CO 2	3	2	2	2	3	1	1	2	1	-	-	3	2	2	2

CO 3	3	1	2	2	3	1	1	2	1	2	-	3	2	2	2
CO 4	3	2	3	3	3	1	1	2	2	-	-	3	2	2	2
CO 5	3	2	2	2	3	1	1	2	2	-	-	3	2	2	2
Average	**3**	**1.8**	**2.6**	**2.6**	**3**	**1**	**1**	**2**	**1.6**	**0.4**	**-**	**3**	**2**	**2**	**2**

Subject Code	**Subject Name (Theory course)**	**Category**	**L**	**T**	**P**	**C**
CE19P78	**AIR POLLUTION AND CONTROL ENGINEERING**	**PE**	**3**	**0**	**0**	**3**

Objectives:

- To analyze particulate and gaseous pollutants, acquire knowledge on ambient and stack sampling, sources and classification of air pollutants & their effects.
- To acquire knowledge on the fundamentals of atmospheric stability, wind profiles, plume patterns and dispersion theories and models.
- To decide on appropriate equipment for control of particulate matter in the atmosphere based on design, working principle, operational considerations and performance equation.
- To indicate appropriate equipments for the control of gaseous contaminants into the atmosphere based on design, working principle, operational considerations and performance equation.
- To procure knowledge about indoor air pollutants, its managing strategies, noise pollution and its control.

UNIT-I	**INTRODUCTION**	**7**

Structure and composition of Atmosphere – Definition, Scope and Scales of Air Pollution – Sources and classification of air pollutants and their effect on human health, vegetation, animals, property, aesthetic value and visibility- Ambient Air Quality and Emission standards –Ambient and stack sampling and Analysis of Particulate and Gaseous Pollutants.

UNIT-II	**METEOROLOGY**	**6**

Effects of meteorology on Air Pollution - Fundamentals, Atmospheric stability, Inversion, Wind profiles and stack plume patterns- Atmospheric Diffusion Theories – Dispersion models, Plume rise.

UNIT-III	**CONTROL OF PARTICULATE CONTAMINANTS**	**11**

Factors affecting Selection of Control Equipment – Gas Particle Interaction – Working principle, Design and performance equations of Gravity Separators, Centrifugal separators Fabric filters, Particulate Scrubbers, Electrostatic Precipitators – Operational Considerations.

UNIT-IV	**CONTROL OF GASEOUS CONTAMINANTS**	**11**

Factors affecting Selection of Control Equipment – Working principle, Design and performance equations of absorption, Adsorption, condensation, Incineration, Bio scrubbers, Bio filters – Process control and Monitoring - Operational Considerations.

UNIT-V	**INDOOR AIR QUALITY MANAGEMENT**	**10**

Sources, types and control of indoor air pollutants, sick building syndrome and Building related illness- Sources and Effects of Noise Pollution – Measurement – Standards –Control and Preventive measures.

	Total Contact Hours	**:**	**45**

Course Outcomes:

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

- Analyze particulate and gaseous pollutants; acquired knowledge on ambient and stack sampling, sources and classification of air pollutants & their effects.
- Evaluate the effects of meteorology on air pollution.

□	Control the emission of particulate matter into the atmosphere by choosing the appropriate equipment based on design, working principle, operational considerations and performance equation.
□	Control the emission of gaseous contaminants into the atmosphere by choosing the appropriate equipment based on design, working principle, operational considerations and performance equation.
□	Minimize indoor air pollutants, noise pollution and devise suitable preventive & control measures.
Text Book (s):	
1	Lawrence K. Wang, Norman C. Pareira, Yung Tse Hung, "Air Pollution Control Engineering", Tokyo, springer science + science media LLC,2004.
2	Anjaneyulu. Y, "Air Pollution and Control Technologies", Allied Publishers (P) Ltd., India 2002.
Reference Book (s):	
1	Noel de Nevers, "Air Pollution Control Engineering", Waveland press, Inc 2017.
2	David H.F. Liu, Bela G. Liptak, "Air Pollution", Lweis Publishers, 2000.
3	Arthur C. Stern, "Air Pollution (Vol.I – Vol.VIII)", Academic Press, 2006.
4	Wayne T.Davis, "Air Pollution Engineering Manual", John Wiley & Sons, Inc, 2000.
5	M.N Rao and HVN Rao, "Air Pollution",Tata Mcgraw Hill Publishing Company limited, 2007.
6	C.S.Rao, "Environmental Pollution Control Engineering", New Age International (P) Limited Publishers,2006.
7	https://nptel.ac.in/courses/105/102/105102089/
8	https://nptel.ac.in/courses/105/104/105104099/

CE19P78	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	1	1	1	1	3	3	2	1	1	1	1	3	1	1
CO 2	3	1	1	1	1	3	3	2	1	1	1	1	3	1	1
CO 3	3	2	2	2	1	3	3	2	1	1	1	1	3	2	1
CO 4	3	2	2	2	1	3	3	2	1	1	1	1	3	2	1
CO 5	3	1	1	1	1	3	3	2	1	1	1	1	3	1	1
Average	**3**	**1.4**	**1.4**	**1.4**	**1**	**3**	**3**	**2**	**1**	**1**	**1**	**1**	**3**	**1.4**	**1**

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
CE19P79	**ROCK MECHANICS**	**PE**	**3**	**0**	**0**	**3**

Objectives:

□	To gain knowledge about rock classification and index properties of rock systems.
□	To understand modes of rock failure, stress-strain characteristics and failure criteria of rocks.
□	To estimate stresses in rocks.
□	To apply rock mechanics in engineering.
□	To acquire knowledge about rock stabilization.

UNIT-I	**CLASSIFICATION AND INDEX PROPERTIES OF ROCKS**	**6**

Geological classification – Index properties of rock systems – Classification of rock masses for engineering purpose – Rock Mass Rating and Q System.

UNIT-II	**ROCK STRENGTH AND FAILURE CRITERIA**	**12**

Modes of rock failure – Strength of rock – Laboratory measurement of shear, tensile and compressive strength. Stress - strain behaviour of rock under Hydrostatic compression and deviatoric loading – Mohr –Coulomb failure criteria and Hock and Brown empirical criteria.		
UNIT-III	**INITIAL STRESSES AND THEIR MEASUREMENTS**	**10**
Estimation of initial stresses in rocks – influence of joints and their orientation in distribution of stresses – measurements of in-situ stresses – Hydraulic fracturing – Flat jack method – Over coring method.		
UNIT-IV	**APPLICATION OF ROCK MECHANICS IN ENGINEERING**	**10**
Simple engineering application – Underground openings – Rock slopes – Foundations and mining subsidence.		
UNIT-V	**ROCK STABILISATION**	**7**
Introduction – Rock support and Rock reinforcement – Principles – Support reaction curves Shotcreting.		
	Total Contact Hours : 45	

Course Outcomes:

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

- Classify the rocks and gain knowledge on index properties of rock systems.
- Understand modes of rock failure, stress-strain characteristics and failure criteria of rocks.
- Estimate the stresses in rocks.
- Gain knowledge about application of rock mechanics in engineering.
- Acquire knowledge about rock stabilization.

Text Book (s):

1. Goodman, P.E. “Introduction to Rock Mechanics”, John Wiley and Sons, 1999.
2. Ramamurthy T., “Engineering in Rocks for Slopes Foundations and Tunnels”, PHI Learning Pvt. Ltd., 3rd Edition, 2014.

Reference Book (s) / Web links:

1. Brown, E.T. “Rock Characterisation Testing and Monitoring”. Pergaman Press 1991.
2. Arogyaswamy, R.N.P., Geotechnical Application in Civil Engineering”, Oxford and IBH, 1991.
3. Brady, B.H.G. and Brown, E.T., Rock mechanics for underground mining (Third Edition), Kluwer Academic Publishers, Dordrecht, 2006.
4. Stillborg B., “Professional User Handbook for rock Bolting”, Tran Tech Publications, 1996.
5. Verma B. P., “Rock Mechanics for Engineers”, Khanna Publication, 1997.
6. https://nptel.ac.in/courses/105/106/105106055/
7. https://www.fhwa.dot.gov/clas/ctip/context_sensitive_rock_slope_design/ch_5_1.aspx#:~:text=There%20are%20many%20methods%20that,using%20combinations%20of%20these%20methods.
8. https://www.rocscience.com/assets/resources/learning/hoek/Rock-Mechanics-Introduction-1966.pdf
9. http://home.iitk.ac.in/~sarv/New%20Folder/Presentation1.pdf

CE19P79	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	2	2	2	1	1	1	1	1	1	1	2	3	2	2
CO 2	2	2	2	2	1	1	1	1	1	1	1	2	3	2	2
CO 3	2	2	2	2	1	1	1	1	1	1	1	2	3	2	2
CO 4	2	2	2	2	1	1	1	1	1	1	1	2	3	2	2
CO 5	2	2	2	2	1	1	1	1	1	1	1	2	3	2	2

Average	**2**	**2**	**2**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**3**	**2**	**2**

SEMESTER VIII

PROFESSIONAL ELECTIVE – V

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
CE19P81	**GROUND WATER ENGINEERING**	**PE**	**3**	**0**	**0**	**3**

Objectives:

- To acquire knowledge on rock properties, storage and various groundwater estimation methods.
- To obtain knowledge on various methods of estimating flow in well hydraulics.
- To understand the concepts of management model utilized for the effective groundwater management.
- To learn the impact of water quality standards and its environmental concern.
- To acquire knowledge on groundwater conservation.

UNIT-I	**HYDROGEOLOGICAL PARAMETERS**	**9**

Introduction – Water bearing Properties of Rock – Type of aquifers - Aquifer properties – permeability, specific yield, transmissivity and storage coefficient – Methods of Estimation – GEC norms - Steady state flow - Darcy's Law - Groundwater Velocity –- Dupuit Forchheimer assumption – Steady Radial Flow into a Well.

UNIT-II	**WELL HYDRAULICS**	**9**

Unsteady state flow - Theis method - Jacob method – Chow's method – Law of Times – Theis Recovery – Bailer method – Slug method - tests - Image well theory – Partial penetrations of wells – Well losses – Specific Capacity and Safe yield - Collector well and Infiltration gallery.

UNIT-III	**GROUNDWATER MANAGEMENT**	**9**

Need for Management Model – Database for Groundwater Management – Groundwater balance study – Introduction to Mathematical model – Model Conceptualization – Initial and Boundary Condition – Calibration – Validation – Future Prediction – Sensitivity Analysis – Uncertainty – Development of a model.

UNIT-IV	**GROUNDWATER QUALITY**	**9**

Ground water chemistry - Origin, movement and quality - Water quality standards – Drinking water – Industrial water – Irrigation water - Ground water Pollution and legislation - Environmental Regulatory requirements.

UNIT-V	**GROUNDWATER CONSERVATION**	**9**

Artificial recharge techniques – Reclaimed wastewater recharge – Soil aquifer treatment (SAT) – Aquifer Storage and Recovery (ASR) Seawater Intrusion and Remediation – Ground water Basin Management and Conjunctive use – Protection zone delineation, Contamination source inventory and remediation schemes.

Total Contact Hours	**:**	**45**

Course Outcomes:

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

- Get familiarized on rock properties, storage and various groundwater estimation methods.
- Apply the knowledge on various methods of estimating flow in well hydraulics.
- Understand the concepts of management model utilized for the effective groundwater management.
- Understand the impact of water quality standards and its environmental concern.
- Apply the knowledge on groundwater conservation.

Text Book (s):	
1	Raghunath H.M., "Ground Water Hydrology", New Age International (P) Limited, New Delhi, 2010.
2	Todd D.K., "Ground Water Hydrology", John Wiley and Sons, New York, 2007.
Reference Book (s) / Web links:	
1	R Charles, "Groundwater Science". Elsevier, Academic Press, 2002
2	Ramakrishnan, S, Ground Water, K.J. Graph arts, Chennai, 1998.
3	David K. Todd Larry W.Mays. "Groundwater Hydrology", John Wiley & Sons, Inc. 2007
4	https://nptel.ac.in/courses/105/103/105103026/
5	https://nptel.ac.in/courses/105/105/105105042/

CE19P81	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	1	1	1	-	1	1	1	1	1	1	1	-	1	-
CO 2	2	1	1	1	1	1	1	1	1	1	1	1	-	1	1
CO 3	2	2	1	1	1	1	1	1	1	1	1	2	-	1	1
CO 4	2	2	1	-	1	1	1	1	1	1	1	2	2	1	1
CO 5	2	2	-	-	-	1	1	1	1	1	1	2	2	1	1
Average	**2**	**1.6**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1.4**	**2**	**1**	**1**

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
CE19P82	**HYDROLOGY**	**PE**	**3**	**0**	**0**	**3**

Objectives:

- To gain a preliminary understanding of precipitation and losses.
- To develop hydrographs.
- To learn the impact and concept of flood and flood routing.
- To acquire knowledge on storage estimation and life of reservoirs.
- To develop a knowledge on sub surface water hydrology and management.

UNIT-I	PRECIPITATION AND ABSTRACTIONS	10

Hydrological cycle - Meteorological measurements – Requirements, types and forms of precipitation - Rain gauges - Spatial analysis of rainfall data using Thiessen and Isohyetal methods - Interception - Evaporation. Horton's equation, pan evaporation measurements and evaporation suppression – Infiltration - Horton's equation - double ring infiltrometer, infiltration indices.

UNIT-II	RUNOFF	8

Watershed, catchment and basin - Catchment characteristics - factors affecting runoff - Run off estimation using empirical – Strange's table and SCS methods – Stage discharge relationships - flow measurements - Hydrograph – Unit Hydrograph – IUH.

UNIT-III	FLOOD AND DROUGHT	9

Natural Disasters - Flood Estimation - Frequency analysis - Flood control - Definitions of droughts -Meteorological, hydrological and agricultural droughts - IMD method - NDVI analysis - Drought Prone Area Programme (DPAP).

UNIT-IV	RESERVOIRS	8

Classification of reservoirs, General principles of design, site selection, spillways, elevation – area - capacity - storage estimation, sedimentation - life of reservoirs – rule curve.

UNIT-V	GROUNDWATER AND MANAGEMENT	10
Origin - Classification and types - properties of aquifers - governing equations – steady and unsteady flow - artificial recharge - RWH in rural and urban areas.		
	Total Contact Hours : 45	

Course Outcomes:

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

- Get familiarized with different forms of precipitation and abstraction from precipitation.
- Infer hydrograph.
- Assess floods and flood routing.
- Understand the concept of reservoir, storage estimation and life of reservoir.
- Get familiarized with sub surface water hydrology and management.

Text Book (s):

1. Subramanya .K. "Engineering Hydrology"- McGraw Hill, 2017.
2. Jaya Rami Reddy .P. "Hydrology", Laxmi Publications 2016.

Reference Book (s) / Web links:

1. David K. Todd Larry W.Mays. "Groundwater Hydrology", John Wiley & Sons, Inc. 2007.
2. Ven Te Chow, Maidment, D.R. and Mays, L.W. "Applied Hydrology", McGraw Hill International Book Company, 1998.
3. Raghunath .H.M., "Hydrology",New Age International (P) Limited, New Delhi, 2010.
4. Linsley, R.K. and Franzini, J.B. "Water Resources Engineering", McGraw Hill International Book Company, 1995.
5. https://nptel.ac.in/courses/105/101/105101002/#
6. https://nptel.ac.in/courses/105/105/105105042/
7. https://nptel.ac.in/courses/105/108/105108079/
8. https://nptel.ac.in/courses/105/105/105105110/

CE19P82	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	1	1	1	-	1	1	1	1	1	1	1	-	1	-
CO 2	2	1	1	1	1	1	1	1	1	1	1	1	-	1	1
CO 3	2	2	1	1	1	1	1	1	1	1	1	2	-	1	1
CO 4	2	2	1	-	1	1	1	1	1	1	1	2	2	1	1
CO 5	2	2	-	-	-	1	1	1	1	1	1	2	2	1	1
Average	**2**	**1.6**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1.4**	**2**	**1**	**1**

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
CE19P83	**PARTICIPATORY WATER RESOURCE MANAGEMENT**	**PE**	**3**	**0**	**0**	**3**

Objectives:

- To learn basic concept of sociology and participatory approach in water resources management.
- To acquire knowledge on farmer participation – sustained system performance, WUA and constraints in organizing farmers association.
- To understand the multiple use of water, delivery systems, development and issues in Inter-sectoral water allocation.

□	To gain a preliminary understanding of approaches involved in water marketing, conservation and water rights.
□	To understand the concept of watershed development, management principles, problems in watershed management and assessment of management measures.

UNIT-I	**FUNDAMENTALS: SOCIOLOGY AND PARTICIPATORY APPROACH**	**6**

Sociology – Basic concepts – Perspectives - Social Stratification – Irrigation as Socio technical Process- Participatory concepts – Objectives of participatory approach.

UNIT-II	**UNDERSTANDING FARMERS PARTICIPATION**	**10**

Farmers participation – Need and Benefits – Comparisons of cost and benefit - Sustained system performance - Kinds of participation – Context of participation, factors in the environment – WUA - Constraints in organizing FA – Role of Community Organizer – Case Studies.

UNIT-III	**ISSUES IN WATER MANAGEMENT**	**9**

Multiple use of water – Issues in Inter-sectoral Water Allocation - domestic, irrigation, industrial sectors - modernization techniques – Rehabilitation – Command Area Development - Water delivery systems.

UNIT-IV	**PARTICIPATORY WATER CONSERVATION**	**10**

Global Challenges - Social – Economic – Environmental - Solutions – Political - Water Marketing – Water Rights - Consumer education – Success Stories Case Studies.

UNIT-V	**PARTICIPATORY WATERSHED DEVELOPMENT**	**10**

Concept and significance of watershed - Basic factors influencing watershed development - Principles of watershed management - Definition of watershed management – Identification of problems – Watershed approach in Government programmes - People's participation – Entry point activities - Evaluation of watershed management measures.

	Total Contact Hours	**:**	**45**

Course Outcomes:

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

□	Get familiarized with basic concept of sociology and participatory approach in water resources Management.
□	Get knowledge on farmer's participation - sustained system performance, WUA and constraints in organizing farmers association.
□	Perceive the multiple use of water, delivery systems , development and issues in Inter-sectoral water allocation.
□	Assess the preliminary understanding of approaches involved in water marketing, conservation and water rights.
□	Get familiarized with the concept of watershed development, management principles, problems in watershed management and assessment of management measures.

Text Book (s):

1	Desai A.R., Rural sociology in India, Popular Prakashan, Bombay, 1969.
2	Michael C.M., Putting people first, Sociology variables in Rural Development, Oxford University press, London 1985.

Reference Book (s) / Web links:

1	Chambers Robert, Managing canal irrigation, Cambridge University Press, 1989.
2	Korten F.F and Robert Y. Siy, Jr. Transforming a Bureaucracy – The experience of the Philippines National Irrigation Administration, Ateneo De Manila University Press, Manila 1989.
3	Sivasubramaniyan, K. Water Management, SIMRES Publication, Chennai, 2011.
4	Tideman, E.M., "Watershed Management", Omega Scientific Publishers, New Delhi, 1996.

5	Uphoff.N, Improving International Irrigation management with Farmer Participation – Getting the process Right – Studies in water Policy and management, No.11, Westview press Boulder,CO, 1986.
6	http://irapindia.org/IMTInIndia-Pa
7	http://mowr.gov.in/writereaddata/mainlinkFile/File421.pdf

CE19P83	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	1	1	1	1	1	1	1	1	-	1	-	2	1	1	-
CO 2	2	1	1	1	1	1	1	3	-	1	-	3	1	1	-
CO 3	2	2	1	1	1	2	3	3	1	1	-	2	3	1	3
CO 4	2	1	3	3	1	1	2	3	2	1	-	3	3	1	3
CO 5	1	1	3	3	1	2	2	1	2	1	2	3	3	1	2
Average	**1.6**	**1.2**	**1.8**	**1.8**	**1**	**1.4**	**1.8**	**2.2**	**1.7**	**1**	**2**	**2.6**	**2.2**	1	**2.7**

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
CE19P84	**GROUND IMPROVEMENT TECHNIQUES**	**PE**	**3**	**0**	**0**	**3**

Objectives:

- To gain knowledge about different problematic soils and various improvement techniques based on soil conditions.
- To acquire knowledge on various dewatering and drainage techniques.
- To evaluate different methods of in-situ compaction treatment for cohesionless and cohesive soils.
- To understand the concepts of earth reinforcement and application of geotextiles.
- To gain knowledge about different grouting techniques.

UNIT-I	**PROBLEMATIC SOIL AND IMPROVEMENT TECHNIQUES**	**8**

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-II	**DEWATERING**	**10**

Dewatering Techniques – Well points – Vacuum and electroosmotic methods – Seepage analysis for two dimensional flows for fully and partially penetrated slots in homogeneous deposits – Design for simple cases.

UNIT-III	**INSITU COMPACTION TREATMENT OF COHESIONLESS AND COHESIVE SOILS**	**10**

Insitu densification of cohesionless soils – Shallow and deep compaction – Dynamic compaction – Vibroflotation, Sand compaction piles and deep compaction. Consolidation of cohesionless soils – Preloading with sand drains and fabric drains, Stabilization of soft clay ground using stone columns and Lime piles - Installation techniques – Simple design – Relative merits of above methods and their limitations.

UNIT-IV	**EARTH REINFORCEMENT**	**9**

Concept of reinforcement – Types of reinforcement material – Reinforced earth wall – Mechanism – Simple design – Applications of reinforced earth; Functions of Geotextiles in filtration, drainage, separation, road works and containment applications.

UNIT-V	**GROUTING TECHNIQUES**	**8**

Types of grouts – Grouting equipment and machinery – Injection methods – Grout monitoring – Stabilization with cement, lime and chemicals – Stabilization of expansive soil.			
	Total Contact Hours	**:**	**45**

Course Outcomes:

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

□	Gain knowledge on various ground improvement techniques suggested for different problematic soils.
□	Get familiarised with various dewatering and drainage techniques.
□	Know different methods of in-situ compaction treatment for cohesionless and cohesive soils.
□	Understand the concepts of earth reinforcement and application of geotextiles.
□	Attain knowledge about different grouts and grouting techniques.

Text Book (s):

1	Purushothama Raj. P, "Ground Improvement Techniques", Lakshmi Publications, 2nd Edition, 2016.
2	Koerner, R.M. "Construction and Geotechnical Methods in Foundation Engineering", McGraw Hill, 1994.

Reference Book (s) / Web links:

1	Moseley, M.P., "Ground Improvement" Blockie Academic and Professional, Chapman and Hall, Glassgow, 1998.
2	Moseley, M.P and Kirsch. K., 'Ground Improvement", Spon Press, Taylor and Francis Group, London, 2nd Edition, 2004.
3	Jones C.J.F.P. "Earth Reinforcement and Soil Structure", Thomas Telford Publishing, 1996.
4	Winterkorn, H.F. and Fang, H.Y. "Foundation Engineering Hand Book". Van Nostrand Reinhold, 1994.
5	Das, B.M., "Principles of Foundation Engineering" (seventh edition), Cengage learning, 2010.
6	Coduto, D.P., "Geotechnical Engineering – Principles and Practices", Prentice Hall of India Pvt. Ltd. New Delhi, 2011.
7	Koerner, R.M., "Designing with Geosynthetics" (Sixth Edition), Xlibris Corporation, U.S.A 2012.
8	Nihar Ranjan Patra, "Ground Improvement Techniques", Vikas Publishing House, First Edition, 2012.
9	Mittal.S, "An Introduction to Ground Improvement Engineering", Medtech Publisher, First Edition, 2013.
10	https://nptel.ac.in/courses/105/108/105108075/
11	http://www.gpcet.ac.in/wp-content/uploads/2018/08/GIT_UNIT-1.pdf
12	http://www.gpcet.ac.in/wp-content/uploads/2018/08/GIT_UNIT-2.pdf
13	https://www.terrearmeeindia.com/our-business/retain/
14	https://theconstructor.org/building/geotextiles-types-functions-uses/1163/
15	https://www.slideshare.net/astraeaeos/grouting-48976072

Code Book(s):

1	IS Code 9759 : 1981 (Reaffirmed 1998) "Guidelines for Dewatering During Construction", Bureau of Indian Standards, New Delhi.
2	IS Code 15284 (Part 1): 2003 "Design and Construction for Ground Improvement – Guidelines" (Stone Column), Bureau of Indian Standards, New Delhi.

CE19P84	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	3	1	1	2	2	1	1	1	1	2	3	2	3

CO 2	3	3	3	1	1	2	2	1	1	1	1	2	3	2	3
CO 3	3	3	3	1	1	2	2	1	1	1	1	2	3	2	3
CO 4	3	3	3	1	1	2	2	1	1	1	1	2	3	2	3
CO 5	3	3	3	1	1	2	2	1	1	1	1	2	3	2	3
Average	**3**	**3**	**3**	**1**	**1**	**2**	**2**	**1**	**1**	**1**	**1**	**2**	**3**	**2**	**3**

Subject Code	**Subject Name (Theory course)**	**Category**	**L**	**T**	**P**	**C**
CE19P85	**CLIMATE CHANGE AND VULNERABILITY ASSESSMENT**	**PE**	**3**	**0**	**0**	**3**

Objectives:

- To understand the basic and concept behind the climate change.
- To know the global and national policies to combat the climate change impacts.
- To understand the basics of climate modelling and envisage the climate change impact based on different emission scenario.
- To assess the risk and vulnerability on different sectors due to climate change
- To know the validation of climate models and correlate the climate related case studies.

UNIT-I	**INTRODUCTION**	**9**

Global, Regional and Local climates, Ocean Circulation, weather parameters. Tropical climate, Monsoons and their role in global climate change.

UNIT-II	**NATIONAL ACTION PLAN ON CLIMATE CHANGE**	**9**

National and State Action Plan on Climate Change, Significance on Sustainable development of Natural resources – National Water Mission, Sustainable Agriculture Mission, Green India Mission, Coastal Conservation.

UNIT-III	**CLIMATE SCENARIOS**	**9**

Global and Regional Climate Scenarios – Representative Concentration Pathways (RCP 2.6, 4.5, 6.0 and 8.5), Global Circulation Model (GCM) - Statistical and Dynamical Downscaling of GCM – Regional Climate Model (RCM).

UNIT-IV	**IMPACTS AND VULNERABILITY ASSESSMENT – METHODOGLOGY**	**9**

Definitions of Risk, Hazards, Exposure, Sensitivity and Vulnerability. Climate Risk Assessment, IPCC Methodology – Vulnerability indices.

UNIT-V	**VALIDATION AND APPLICATION OF MODELS**	

Climate Projections and Validation– Uncertainty analysis – Bias Correction – Sectoral wise Case Studies in India.

	Total Contact Hours	**:**	**45**

Course Outcomes:

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

- Understand the basic and concept behind the climate change.
- Know the global and national policies to combat the climate change impacts.
- Understand the basics of climate modelling and envisage the climate change impact based on different emission scenario.
- Assess the risk and vulnerability on different sectors due to climate change.
- Know the validation of climate models and correlate the climate related case studies.

Text Book (s):

1. IPCC Fifth Assessment Report - Impacts, Adaptation and Vulnerability, Cambridge University Press, 2014.

2	Neelin David J, "Climate Change and Climate Modelling", Cambridge University Press, 2011.
Reference Book (s) / Web links:	
1	Thomas Stocker, "Introduction to Climate Modelling", Advances in Geophysical and Environmental Mechanics and Mathematics. Springer Publication, 2011.
2	India's National Action Plan on Climate Change (NAPCC), Government of India, 2018.
3	Michele Companion and Miriam S. Chaiken, Responses to Disasters and Climate Change: Understanding Vulnerability and Fostering Resilience, CRC Press, 2017.
4	Climate Change – The Science, Impacts and Solutions (2nd Edition) – A. Barrie Pittock, CSIRO Publishing, 2009.

CE19P85	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	3	3	2	2	1	3	1	1	1	3	3	3	2
CO 2	3	3	3	3	2	2	1	3	1	1	1	3	3	3	2
CO 3	3	3	3	3	2	2	1	3	1	1	1	3	3	3	2
CO 4	3	3	3	3	2	2	1	3	1	1	1	3	3	3	2
CO 5	3	3	3	3	2	2	1	3	1	1	1	3	3	3	2
Average	**3**	**3**	**3**	**3**	**2**	**2**	**1**	**3**	**1**	**1**	**1**	**3**	**3**	**3**	**2**

SEMESTER VIII

PROFESSIONAL ELECTIVE –VI

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
CE19P86	**MAINTENANCE, REPAIR AND REHABILITATION OF STRUCTURES**	**PE**	**3**	**0**	**0**	**3**

Objectives:

- To acquire knowledge on maintenance and to apply repair strategies based on assessment.
- To analyze the strength and durability aspects of concrete for quality assurance.
- To apply knowledge about various types of special concretes in repairing the structure.
- To evaluate the methodologies used for repair and protection techniques for deteriorated structures.
- To grasp the significance of retrofitting and rehabilitation of structures by strengthening and demolition techniques.

UNIT I	**MAINTENANCE AND REPAIR STRATEGIES**	**9**

Maintenance, Repair and Rehabilitation - Facets of Maintenance - Importance of Maintenance - Various aspects of Inspection - Assessment procedure for evaluating a damaged structure - causes of deterioration.

UNIT II	**STRENGTH AND DURABILITY OF CONCRETE**	**9**

Quality assurance for concrete – Strength, Durability of concrete - Cracks, different types causes – Effects due to climate, temperature, Sustained elevated, Corrosion - Effects of cover thickness.

UNIT III	**SPECIAL CONCRETES**	**9**

Polymer concrete - Sulphur infiltrated concrete - Fibre reinforced concrete - High strength concrete - High performance concrete - Vacuum concrete - Self compacting concrete – Geopolymer concrete - Reactive powder concrete – Bacterial Concrete - Concrete made with industrial wastes.

UNIT IV	**TECHNIQUES FOR REPAIR AND PROTECTION METHODS**	**9**

Non-destructive Testing Techniques, Load test for Stability - Epoxy injection, Shoring, Underpinning, Corrosion protection techniques – Corrosion inhibitors, Corrosion resistant steels, Coatings to reinforcement, cathodic protection.

UNIT V	**REPAIR, REHABILITATION AND RETROFITTING OF STRUCTURES**	**9**

Strengthening of Structural elements, Repair of structures distressed due to corrosion, fire, leakage, earthquake-Transportation of Structures from one place to other –Structural Health Monitoring- demolition techniques-Engineered demolition methods-Case studies.			
	Total Contact Hours	**:**	**45**

Course Outcomes:

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

□	Acquire knowledge on maintenance and to apply repair strategies based on assessment.
□	Analyze the strength and durability aspects of concrete for quality assurance.
□	Apply knowledge about various types of special concretes in repairing the structure.
□	Evaluate the methodologies used for repair and protection techniques for deteriorated structures.
□	Acquire knowledge on the significance of retrofitting and rehabilitation of structures by strengthening and demolition techniques.

Text Book (s):

1	Shetty.M.S. Jain A K., Concrete Technology - Theory and Practice, S.Chand and Company, Eighth Edition, 2019.
2	P.C.Varghese, Maintenance Repair and Rehabilitation & Minor works of building, PrenticeHall India Pvt Ltd 2014.

Reference Book(s) / Web links:

1	Dov Kominetzky.M.S., Design and Construction Failures, Galgotia Publications Pvt.Ltd. 2001.
2	Ravishankar.K. Krishnamoorthy.T.S, Structural Health Monitoring, Repair And Rehabilitationof Concrete Structures, Allied Publishers, 2004.
3	Hand book on Seismic Retrofit of Buildings, CPWD and Indian Buildings Congress, Narosa Publishers, 2008.
4	Hand Book on "Repair and Rehabilitation of RCC Buildings"–Director General works CPWD, Govt of India, New Delhi–2002.
5	B.Vidivelli, Rehabilitation of Concrete Structures Standard Publishes Distribution.1st edition2009.
6	R. Dodge Woodson, Concrete Structures, Protection, Repair and Rehabilitation, Butterworth Heinemann, Elsevier, New Delhi 2012.

CE19P86	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO 1	3	2	3	2	1	3	-	3	-	-	2	1	3	-	2
CO 2	2	3	3	-	-	3	-	3	-	2	-	1	3	3	2
CO 3	3	3	2	-	-	-	-	3	-	-	2	-	3	-	-
CO 4	1	2	3	2	1	3	1	3	-	2	-	2	3	3	3
CO 5	3	2	3	-	1	3	1	3	-	-	2	-	3	3	3
Average	**2.4**	**2.4**	**2.8**	**2**	**1**	**3**	**1**	**3**	**-**	**2**	**2**	**1.3**	**3**	**3**	**2.5**

Subject Code	**Subject Name (Theory course)**	**Category**	**L**	**T**	**P**	**C**
CE19P87	**PREFABRICATED STRUCTURES**	**PE**	**3**	**0**	**0**	**3**

Objectives:

□	To propagate the principles of prefabrication and its methods of production.
□	To develop different prefabricated structural components.
□	To acquaint the knowledge on efficient usage of materials and joint flexibility.
□	To acquire knowledge on various types of joints in prefabricated structural components.

□	To evaluate the impact of progressive collapse and abnormal loads.	
UNIT I	**INTRODUCTION**	**9**
Need for prefabrication - Principles - Materials - Modular co-ordination – Standardization – Systems Production – Transportation – Erection - Disuniting of Structures.		
UNIT II	**PREFABRICATED COMPONENTS**	**9**
Behavior of structural components – Large panel constructions – Construction of roof, floor slabs and Wall panels – Beams - Columns – Shear walls – Introduction to 3D printing technique.		
UNIT III	**DESIGN PRINCIPLES**	**9**
Design philosophy- Design of cross section based on efficiency of material used – Problems in design because of joint flexibility – Allowance for joint deformation - Demountable precast concrete systems.		
UNIT IV	**JOINTS AND CONNECTIONS IN STRUCTURAL MEMBERS**	**9**
Types of Joints – based on action of forces - compression joints - shear joints - tension joints - based on function - construction, contraction, expansion. Design of expansion joints - Dimensions and detailing - Types of sealants - Types of structural connections - Beam to Column - Column to Column - Beam to Beam - Column to foundation.		
UNIT V	**DESIGN FOR ABNORMAL LOADS**	**9**
Progressive collapse – Codal provisions – Equivalent design loads for considering abnormal effects such as earthquakes, cyclones etc. - Importance of avoidance of progressive collapse.		
	Total Contact Hours : 45	

Course Outcomes:

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

□	Identify the principles of prefabrication and its methods of production.
□	Develop various prefabricated structural components.
□	Analyze the joint flexibility problems in design and efficient material usage for prefabrication.
□	Acquire knowledge on various joints used in structural components.
□	Evaluate the importance of progressive collapse and abnormal loading conditions.

Text Book (s):

1	Bruggeling A.S. G and Huyghe G.F. "Prefabrication with Concrete", A.A. Balkema Publishers, USA, 1991.
2	Lewitt,M. " Precast Concrete- Materials, Manufacture, Properties And Usage", Applied Science Publishers, London And New Jersey, 1982 – Second edition, 2008.

Reference Book (s) / Web links:

1	Koncz T., "Manual of precast concrete construction", Vol. I, II and III, Bauverlag, GMBH, 1976.
2	"Handbook on Precast Concrete Buildings", Indian Concrete Institute, 2016.
3	"Structural design manual", Precast concrete connection details, Society for the studies in the use of precast concrete, Netherland Betor Verlag, 2009.
4	Bachmann, H. and Steinle, A. "Precast Concrete Structures", Ernst & Sohn, Berlin, 2011. (2019 Online edition available)

CE19P87	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	1	1	1	2	1	2	2	3	3	3	2	3	3	2	2
CO 2	1	1	1	2	1	2	2	3	3	3	2	3	3	2	2
CO 3	2	3	2	2	1	2	2	3	1	1	1	3	3	2	3
CO 4	1	2	1	2	1	2	2	3	3	3	2	3	3	2	2

CO 5	2	2	1	2	1	2	2	3	1	1	1	3	3	2	3
Average	**1.4**	**1.8**	**1.2**	**2**	**1**	**2**	**2**	**3**	**2.2**	**2.2**	**1.6**	**3**	**3**	**2**	**2.4**

Subject Code	**Subject Name (Theory course)**	**Category**	**L**	**T**	**P**	**C**
CE19P88	**MUNICIPAL SOLID WASTE MANAGEMENT**	**PE**	**3**	**0**	**0**	**3**

Objectives:

- To acquire knowledge on sources, types, characteristics, generation rates, effects of improper disposal of municipal solid waste and prevailing legislation in MSWM.
- To plan and devise suitable onsite storage methods for solid waste and onsite segregation methods and to know about the source reduction techniques.
- To select and formulate suitable collection methods for solid waste, and to manage operation and maintenance of transfer stations.
- To adopt suitable resource recovery techniques for various kinds of solid waste and to manage it's functioning under Indian conditions.
- To design & manage sanitary landfills, landfill liners, leachate and landfill gas.

UNIT-I SOURCES AND CHARACTERISTICS **9**

Sources and types of municipal solid wastes- Public health and environmental impacts of improper disposal of solid wastes- sampling and characterization of wastes - factors affecting waste generation rate and characteristics - Elements of integrated solid waste management – Requirements and salient features of Solid waste management rules (2016) - Role of public and NGO's - Public Private participation – Elements of Municipal Solid Waste Management Plan.

UNIT-II SOURCE REDUCTION, WASTE STORAGE AND RECYCLING **8**

Waste Management Hierarchy - Reduction, Reuse and Recycling - source reduction of waste – On-site storage methods – Effect of storage, materials used for containers – segregation of solid wastes – Public health and economic aspects of open storage – case studies under Indian conditions – Recycling of Plastics and Construction/Demolition wastes.

UNIT-III COLLECTION AND TRANSFER OF WASTES **8**

Methods of Residential and commercial waste collection – Collection vehicles – Manpower – Collection routes – Analysis of waste collection systems; Transfer stations –location, operation and maintenance; options under Indian conditions – Field problems- solving.

UNIT-IV PROCESSING OF WASTES **12**

Objectives of waste processing – Physical Processing techniques and Equipment; Resource recovery from solid waste composting and biomethanation, Thermal processing options – case studies under Indian conditions.

UNIT-V WASTE DISPOSAL **8**

Land disposal of solid waste- Sanitary landfills – site selection, design and operation of sanitary landfills – Landfill liners – Management of leachate and landfill gas- Landfill bioreactor – Dumpsite Rehabilitation.

Total Contact Hours : 45

Course Outcomes:

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

- Characterize the wastes along with prevailing MSW legislation.
- Suggest suitable onsite storage and onsite segregation methods along with source reduction techniques.
- Plan suitable collection method and to manage the operation & maintenance of transfer stations.
- Select and manage suitable resource recovery techniques depending on the type of waste under Indian conditions.

□	Plan and design sanitary landfill, landfill liners and safely collect & treat leachate and landfill gas.
Text Book (s):	
1	William A. Worrell, P. Aarne Vesilind (2012) Solid Waste Engineering, Cengage Learning, 2012.
2	John Pitchel (2014), Waste Management Practices-Municipal, Hazardous and industrial – CRC Press, Taylor and Francis, New York.
Reference Book (s) / Web links:	
1	CPHEEO (2014), "Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organisation, Government of India, New Delhi.
2	George Tchobanoglous and Frank Kreith (2002), "Handbook of Solid waste management", McGraw Hill, New York.
3	George Tchobanoglous, Hilary Theisen and Samuel Vigil (1993) "Integrated solid waste management – Engineering principles and management issues", McGraw-Hill Inc, New York.
4	https://nptel.ac.in/courses/120/108/120108005/
5	https://nptel.ac.in/courses/105/103/105103205/
6	https://nptel.ac.in/courses/105/105/105105160/

CE19P88	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	1	1	1	1	3	3	2	1	1	1	2	3	-	1
CO 2	3	1	1	1	1	3	3	2	1	1	1	2	3	-	1
CO 3	3	2	2	2	1	3	3	2	1	1	1	2	3	1	1
CO 4	3	1	1	1	1	3	3	2	1	1	1	2	3	-	1
CO 5	3	1	1	1	1	3	3	2	1	1	1	2	3	-	1
Average	**3**	**1.2**	**1.2**	**1.2**	**1**	**3**	**3**	**2**	**1**	**1**	**1**	**2**	**3**	**0.2**	**1**

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
CE19P89	**INDUSTRIAL WASTE WATER TREATMENT**	**PE**	**3**	**0**	**0**	**3**

Objectives:

- □ To acquire knowledge on sources, characteristics, Environmental Impacts and Regulatory requirements of Industrial Wastewater.
- □ To evaluate pollution prevention options.
- □ To design various primary, secondary and tertiary treatment process.
- □ To learn various quality requirements on wastewater reuse option and sludge characterization, treatment and disposal methods of sludge.
- □ To develop an understanding on various industrial manufacturing process and treatment flowcharts in industries such as Tannery, Textiles, Pulp and Paper, metal finishing, sugar and distilleries.

UNIT-I	**INTRODUCTION**	**8**

Industrial scenario in India – Uses of water by Industry – sources, generation rates and characteristics of Industrial wastewaters – Toxicity of Industrial Effluents and Bioassay Tests – Environmental Impacts of Industrial Wastewaters – Regulatory requirements for Industrial wastewaters.

UNIT-II	**INDUSTRIAL POLLUTION PREVENTION**	**5**

Prevention Vs Control of Industrial Pollution – Benefits and Barriers – Waste Minimization Strategies – Evaluation of Pollution Prevention Options – Cost benefit analysis – Payback period.

UNIT-III	TREATMENT OF INDUSTRIAL WASTEWATERS	13
Physico–Chemical Treatment Processes – Equalisation, Neutralisation, Oil Seperation, Flotation – Precipitation, Aerobic and Anaerobic Biological Treatment Processes – Sequencing batch reactors, membrane bioreactors, Advanced oxidation and Tertiary Treatment processes for removal of dissolved organics and inorganics- Ozonation, photocatalysis, Evaporation and membrane Technologies.		
UNIT-IV	**WASTEWATER REUSE AND RESIDUAL MANAGEMENT**	**10**
Individual and Common Effluent Treatment Plants –Zero Effluent Discharge Systems and Management of RO Rejects, Quality requirements for wastewater reuse – Industrial reuse, Disposal on water and land – Residuals of Industrial Wastewater treatment – Quantification and Characteristics of Sludge – Thickening, Digestion, Conditioning, Dewatering and Disposal of Sludge – Solidification – Incineration – Secured Landfills.		
UNIT-V	**CASE STUDIES**	**9**
Industrial manufacturing process description, Wastewater characteristics , Pollution Prevention Options and Treatment Flow sheets for selected Industries – Tanneries- Textiles- Pulp and Paper- Metal finishing – Sugar and Distilleries.		
	Total Contact Hours : 45	

Course Outcomes:

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

□	Acquire knowledge on sources, characteristics, and Environmental Impacts and Regulatory requirements of Industrial Wastewater.
□	Evaluate pollution prevention options.
□	Design various primary, secondary and tertiary treatment processes.
□	Analyze various quality requirements on wastewater reuse option and sludge characterization, treatment and disposal methods of sludge.
□	Assess various industrial manufacturing process and treatment flowcharts in industries such as Tannery, Textiles, Pulp and Paper, metal finishing, sugar and distilleries.

Text Book (s):

1	S.C.Bhatia, Handbook of Industrial Pollution and Control, Volume I & II, CBS Publishers New Delhi, 2003.
2	Mahajan, S.P.Pollution Control in Process Industries, Tata McGraw Hill Publishing Co., New Delhi, 1991.

Reference Book (s) / Web links:

1	Eckenfelder, W.W., „Industrial Water Pollution Control" , Mc-Graw Hill, 2000.
2	Nelson Leonard Nemerow, "Industrial waste treatment – contemporary practice and vision for the future", Elsevier, Singapore, 2007.
3	Frank Woodard, „ Industrial waste treatment Handbook" , Butterworth Heinemann, NewDelhi,2001.
4	World Bank Group, „ Pollution Prevention and Abatement Handbook – Towards Cleaner Production" , World Bank and UNEP, Washington D.C., 1998
5	Paul L. Bishop, „ Pollution Prevention:- Fundamentals and Practice" , Mc-Graw Hill International, Boston,2000.
6	Wang L.K., Yung-Tse Hung, Howard H.Lo and Constantine Yapijakis, „Handbook of Industrial and Hazardous Wastes Treatment" , Marcel Dekker, Inc., USA, 2004.
7	Arceivala, S.J., "Wastewater Treatment for Pollution Control", Tata McGraw Hill, 1998

CE19P89	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3

CO 1	3	1	1	1	-	3	3	1	1	1	1	2	3	-	1
CO 2	3	1	1	1	-	3	3	1	1	1	1	2	3	-	1
CO 3	3	1	1	1	-	3	3	1	1	1	1	2	3	-	1
CO 4	3	1	1	1	-	3	3	1	1	1	1	2	3	-	1
CO 5	3	1	1	1	-	3	3	1	1	1	1	2	3	-	1
Average	**3**	**1**	**1**	**1**	**-**	**3**	**3**	**1**	**1**	**1**	**1**	**2**	**3**	**-**	**1**