

FACULTY OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF CIVIL ENGINEERING
B.E., CIVIL ENGINEERING
REVISED REGULATIONS & SYLLABI
(Students Admitted From the Academic Year 2018-2019)

VISION

To become
School of Excellence in Civil Engineering
with **Conformity, Quality and Standards** in
teaching, research, training and consultancy
towards producing globally competent Civil Engineers.

MISSION

- M1:** To Promote quality in education, research and professional training for satisfying the needs of industry and society.
- M 2:** To provide state-of-the-art facilities and resources that contributes to a congenial learning environment.
- M 3:** To establish Centers of Excellence in emerging areas of Civil Engineering for the students to acquire domain specific expertise and also facilitate Industry- Institution interaction.
- M 4:** To inspire the students to pursue higher education and take competitive examinations and various career enhancing programs.
- M 5:** To instill the professional ethics and their role for sustainable development and corruption-free country.

PROGRAM EDUCATIONAL OBJECTIVES

PEO 1	To impart knowledge in the fundamentals of Civil Engineering such as Surveying, Planning, Structural Analysis, Design, Costing and Construction.
PEO 2	To develop soft skill and value addition through software platforms such as SURFER, 3D Home Architect, ARCHICAD, STAAD Pro, ArcGIS, QGIS, ANSYS, ERDAS, etc.

PEO 3	To ensure necessary aptitude and ethics through class room teaching, laboratory practice and field demonstration towards pursuing a quality professional practice.
PEO 4	To sensitize the need and importance to pursue for higher studies, research and exclusive preparations for competitive examinations.
PEO 5	To provide the subject specific expertise with objective information on the professional challenges with rational methodologies towards innovative solutions.

PROGRAMME OUTCOMES

After the successful completion of the B.E. (Civil Engineering) Degree Programme, the graduates will be able to:

PO 1: Engineering Knowledge: Apply knowledge of mathematics, science and engineering concepts to solve problems related to civil engineering.

PO 2: Problem Analysis: Identify, formulate and analyze Civil Engineering problems using the first principles of mathematics, sciences and engineering sciences and reach substantiate conclusions.

PO 3: Design/Development of Solutions: Design solutions for complex Civil Engineering problems and design system components satisfying standards laid by Indian Standard codes or processes to meet societal needs within realistic constraints.

PO 4: .Conduct Investigations of Complex Problems: Develop skills, select and apply modern engineering tools such as FEM, CAD, GIS and techniques for soft computing and optimization, including prediction and modelling of complex civil engineering problems.

PO 5: Modern Tool Usage: Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary settings.

PO 6: The Engineer and Society: Assess the societal needs and bring solutions with ethical principles in professional civil engineering practice with commitment, adhering to the norms of Civil Engineering practice.

PO 7: Environmental and Sustainability: Interact effectively with the engineering community and properly communicate with the society as well, by being able to comprehend through effective technical reports, documents, presentations and drawings, give and receive clear instructions, imperative to decision making for successful execution.

PO 8: Ethics: Demonstrate the knowledge and understanding of the engineering and management principles and apply these to one's work in construction, finance & asset management, public policy and administration in executing projects, as a member or leader in a team with self-confidence and courage.

PO 9: Individual and Teamwork: Appreciate the need to develop ability to design, implement and evaluate a field program to meet desired requirements within dynamic constraints related to economy, environment, social, political, health and safety aspects, manufacturability and sustainability, precisely the ability to engage in lifelong learning in the broadest context of technological change.

PO 10: Communications: Recognize the importance of Civil Engineering professional development by pursuing postgraduate studies or face competitive examinations that offer challenging and rewarding careers.

PO 11: Project Management and Finance: Create innovative construction materials to improve the performance of infrastructure in case of buildings and transportation systems.

PO 12: Life-Long learning: Develop and apply high performance structural materials and disaster-resistant systems.

Program Specific Outcomes:

The Civil Engineering curriculum prepares graduates to attain:

PSO 1: Apply principles of engineering, basic science and mathematics to model, analyze, design civil systems and processes.

PSO 2: Plan, operate, control, maintain and improve civil systems, components and processes.

PSO 3: Prepare the students to work professionally as civil engineers.

Mapping of POs with PEOs				
PO	PEO1	PEO2	PEO3	PEO4
PO1	✓			
PO2	✓			
PO3	✓	✓		
PO4	✓	✓	✓	✓
PO5		✓	✓	
PO6		✓	✓	✓
PO7			✓	✓
PO8			✓	
PO9			✓	✓
PO10		✓	✓	✓
PO11	✓	✓		
PO12	✓		✓	✓



ANNAMALAI UNIVERSITY
 FACULTY OF ENGINEERING AND TECHNOLOGY
 B.E. (Four Year) Degree Programme (FULL-TIME)
 Choice Based Credit System (CBCS)

Curriculum for First Year B.E

COURSES OF STUDY AND SCHEME OF EXAMINATIONS (REGULATION 2019-20)

SEMESTER I									
Course Code	Category	Course	L	T	P	CA	FE	Total	Credits
ETBS101	BS-I	Physics / Chemistry *	3	1	0	25	75	100	4
ETBS102	BS-II	Mathematics - I	3	1	0	25	75	100	4
ETES103	ES-I	Basic Electrical Engineering	3	1	0	25	75	100	4
ETBP104	BSP-I	Physics Laboratory / Chemistry Laboratory *	0	0	3	40	60	100	1.5
ETSP105	ESP-I	Electrical Engineering Laboratory	0	0	2	40	60	100	1
ETSP106	ESP-II	Engineering Workshop/ Manufacturing Practices	1	0	4	40	60	100	3
								Total Credits	17.5

SEMESTER II									
Course Code	Category	Course	L	T	P	CA	FE	Total	Credits
ETHS201	HS-I	English	2	0	0	25	75	100	2
ETBS202	BS-III	Physics / Chemistry**	3	1	0	25	75	100	4
ETES203	ES-II	Programming for Problem Solving	3	0	0	25	75	100	3
ETBS204	BS-IV	Mathematics – II	3	1	0	25	75	100	4
ETHP205	HSP-I	Communication Skills and Language Laboratory	0	0	2	40	60	100	1
ETBP206	BSP-II	Physics Laboratory / Chemistry Laboratory**	0	0	3	40	60	100	1.5
ETSP207	ESP-III	Computer Programming Lab	0	0	4	40	60	100	2
ETSP208	ESP-IV	Engineering Graphics and Drafting	1	0	4	40	60	100	3
								Total Credits	20.5

Students must undergo Internship for 4 weeks during summer vacation which will be assessed in the forthcoming III Semester.

- * For First Semester: Physics /Physics Laboratory – Mech, CSE,CSE (Big Data),CSE (AL),E&I, IT
- * For First Semester:Chemistry /Chemistry Laboratory – Civil, Civil and Structural, Manuf, EEE, Chemical, ECE
- ** For Second Semester: Chemistry /Chemistry Laboratory – Mech, CSE,CSE (Big Data),CSE (AL),E&I, IT
- * *For Second Semester: Physics /Physics Laboratory – Civil, Civil and Structural, Manuf, EEE, Chemical, ECE

HS	Humanities and Social Sciences including Management courses
BS	Basic Science courses
ES	Engineering Science Courses
CA	Continuous Assessment Marks
FE	Final Exam Marks

Students must undergo Internship for 4 weeks during summer vacation which will be assessed in the forthcoming III Semester.

SEMESTER – III									
Course Code	Category	Course	L	T	P	CA	FE	Total	Credits
ETBS301	BS-V	Engineering Mathematics-III	3	1	-	25	75	100	4
ETES302	ES-III	Environmental Studies	3	-	-	25	75	100	3
ETES303	ES-IV	Engineering Mechanics	3	-	-	25	75	100	3
CEES304	ES-V	Construction Engineering	2	-	-	25	75	100	2
CEPC305	PC-I	Introduction to Fluids Mechanics	3	1	-	25	75	100	4
CZPC306	PC-II	Concrete Technology	3	-	-	25	75	100	3
CESP307	ESP-V	Computer Practical-Building Drawings	-	-	3	40	60	100	1.5
CECP308	PCP-I	Fluid Mechanics Laboratory	-	-	3	40	60	100	1.5
CZCP309	PCP-II	Construction Materials Laboratory	-	-	3	40	60	100	1.5
ETIT310	IT-I	Internship Inter/ Intra Institutional Activities*	Four weeks during the summer vacation at the end of II Semester				100	100	4.0
*For the Lateral entry students total credit for III Semester is 23.5 as they are exempted from internship during summer vacation of II semester.							Total Credits		27.5

SEMESTER – IV									
Course Code	Category	Course	L	T	P	CA	FE	Total	Credits
CEBS401	BS-VI	Probability & Statistics for Civil Engineering	3	-	-	25	75	100	3
CZES402	ES-VI	Introduction to Solid Mechanics	2	-	-	25	75	100	2
CEPC403	PC-III	Surveying - I	3	-	-	25	75	100	3
CEPC404	PC - IV	Applied Hydraulic Engineering	3	-	-	25	75	100	3
CEPC405	PC-V	Geotechnical Engineering	3	-	-	25	75	100	3
CEPC406	PC-VI	Strength of Materials	3	-	-	25	75	100	3
CECP407	PCP-III	Surveying Laboratory-I	-	-	3	40	60	100	1.5
CECP408	PCP-IV	Hydraulic Engineering Laboratory	-	-	3	40	60	100	1.5
CECP409	PCP-V	Strength of Materials Laboratory	-	-	3	40	60	100	1.5
						Total Credits			21.5
Students must undergo Internship for 4 weeks during summer vacation which will be assessed in the forthcoming V Semester.									

SEMESTER – V										
Course Code	Category	Course	L	T	P	CA	FE	Total	Credits	
CEPC501	PC-VII	Water & Wastewater Engineering	3	-	-	25	75	100	3	
CEPC502	PC-VIII	Surveying -II	3	-	-	25	75	100	3	
CEPC503	PC-IX	Structural Analysis	3	-	-	25	75	100	3	
CEPC504	PC-X	Structural Concrete Design	3	-	-	25	75	100	3	
CEPE505	PE-I	Professional Elective – I	3	-	-	25	75	100	3	
CEPE506	PE-II	Professional Elective – II	3	-	-	25	75	100	3	
CECP507	PCP-VI	Environmental Engineering Laboratory	-	-	3	40	60	100	1.5	
CECP508	PCP-VII	Surveying Laboratory-II	-	-	3	40	60	100	1.5	
CECP509	PCP-VIII	Structural Design & Detailing Laboratory-I	-	-	3	40	60	100	1.5	
ETIT510	IT-II	Industrial Training / Rural Internship/Innovation / Entrepreneurship	<i>Four weeks during the summer vacation at the end of IV Semester</i>				100	100		4.0
						Total Credits			26.5	

SEMESTER VI

Course Code	Category	Course	L	T	P	CA	FE	Total	Credits
CEPC601	PC-XI	Highway Engineering	3	-	-	25	75	100	3
CEPC602	PC-XII	Structural Steel Design	3	-	-	25	75	100	3
CEPE603	PE-III	Professional Elective – III	3	-	-	25	75	100	3
CEPE604	PE-IV	Professional Elective – IV	3	-	-	25	75	100	3
CEPE605	PE-V	Professional Elective – V	3	-	-	25	75	100	3
#YYOE606	OE-I	Open Elective –I (inter department - FEAT)	3	-	-	25	75	100	3
CECP607	PCP-IX	Highway Engineering Laboratory	-	-	3	40	60	100	1.5
CECP608	PCP-X	Structural Design & Detailing Laboratory	-	-	3	40	60	100	1.5
Total Credits									21.0
Students must undergo Internship for 4 weeks during summer vacation which will be assessed in the forthcoming VII Semester.									

#YY – Branch Code of the branch which offers the Open Elective Course ((inter department other than allied dept-FEAT)

SEMESTER VII

Course Code	Category	Course	L	T	P	CA	FE	Total	Credits
ETHS701	HS-II	Professional Practices, Law & Ethics	2	-	-	25	75	100	2
CEPC702	PC-XIII	Planning & Cost Evaluation	3	-	-	25	75	100	3
CEPE703	PE-VI	Professional Elective – VI	3	-	-	25	75	100	3
CEPE704	PE-VII	Professional Elective – VII	3	-	-	25	75	100	3
#YYOE705	OE-II	Open Elective –II (inter department- Allied Branch)	3	-	-	25	75	100	3
CECP706	PCP-XI	Planning & Cost Evaluation Laboratory	-	-	3	40	60	100	1.5
ETIT707	IT-III	Industrial Training / Rural Internship/Innovation / Entrepreneurship	Four weeks during the summer vacation at the end of VI Semester				100	100	4.0
Total Credits									19.5

#YY – Branch Code of the branch which offers the Open Elective Course (**inter department- But Allied Branch**)

SEMESTER VIII

Course Code	Category	Course	L	T	P	CA	FE	Total	Credits
CEOE801	OE-III	Open Elective-III (from the department)	3	-	-	25	75	100	3
CEOE802	OE-IV	Open Elective-IV (from the department)	3	-	-	25	75	100	3
	PV-I	Project Work and Viva Voce	-	$\frac{PR}{10}$	$\frac{S}{2}$	40	60	100	6
						Total Credits			12

L	No. of Lecture Hours	TR	No. of Hours for Discussion on Industrial Training
T	No. of Tutorial Hours	S	No. of Seminar Hours on Industrial Training / Project
P	No. of Practical Hours	PR	No. of Hours for Discussion on Project work
CA	Continuous Assessment Marks	FE	Final Examination Marks
Credits	Credit points allotted to that course	Total	Total Marks

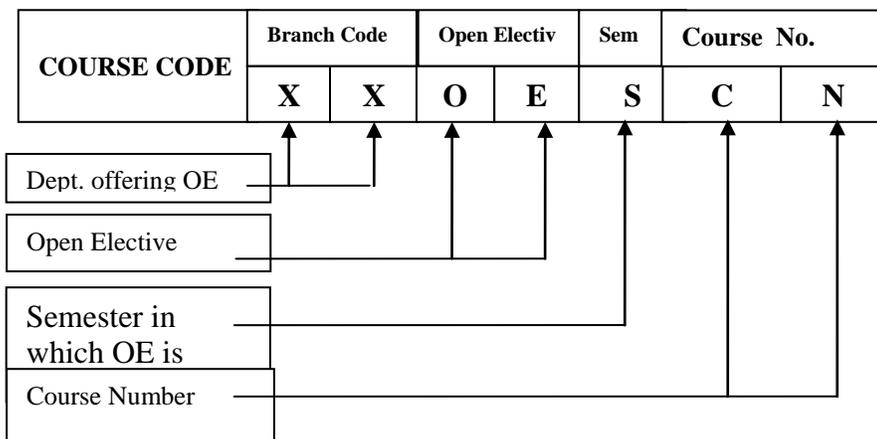
PROFESSIONAL ELECTIVES

The List of Courses under Professional Elective Category must be those courses which will be offered by the Department concerned - for the students from the same Department.

The first two characters must be the code of the branch offering the Professional Elective.

Since the last three characters are not known beforehand, the code for Professional electives can be given as follows:

P E S C N IN THE LIST OF PROFESSIONAL ELECTIVES.
OPEN ELECTIVES



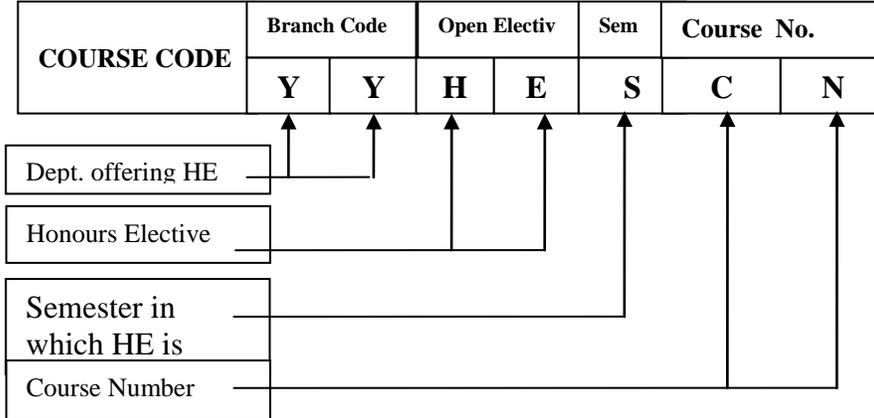
The List of Courses under Open Elective Category must be those courses which will be offered by the Department concerned - for the students from either the same Department and/or for the students from other Departments in FEAT.

In 6th and 7th Sem, the OE courses are taken from other Depts in FEAT, hence the codes are Y Y O E 6 0 6 & Y Y O E 7 0 5 in the TABLE where the first two characters are code of the branch offering the Open Elective (not known beforehand).

The 8th Sem OE can be given the code as , X X O E 8 0 1 & X X O E 8 0 2 in the TABLE- where XX corresponds to the branch code of the same Dept

Since the last three characters are not known beforehand, the code for open electives can be given as follows , X X O E S C N in the List of Open Electives.

HONOURS ELECTIVES

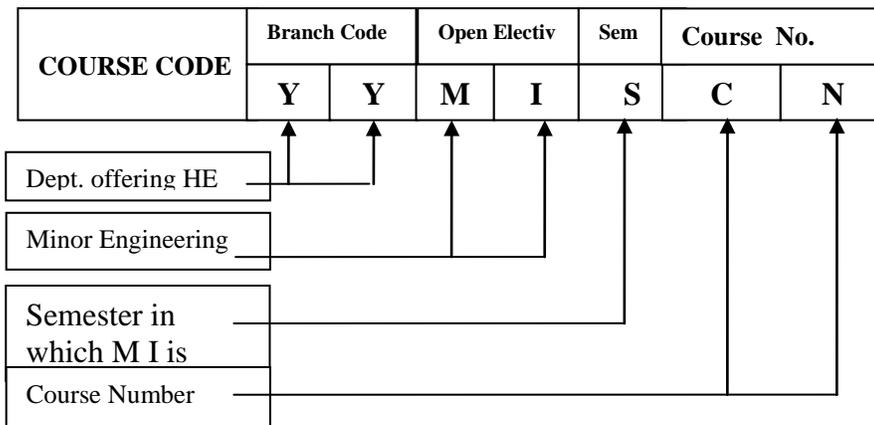


The List of Courses under Honours Elective Category must be those courses which will be offered by the Department concerned - for their own students.

The first two characters must be the branch code of the branch offering the Open Elective.

Since the last three characters are not known beforehand, the code for open electives can be given as follows, H E S C N in the List of Honours Electives.

MINOR ENGINEERING ELECTIVES



The List of Courses under Minor Engineering Elective Category must be those courses which will be offered by the Department concerned - for the students from other Departments in FEAT.

The first two characters must be the branch code of the branch offering the Minor Engineering Elective.

Since the last three characters are not known beforehand, the code for open electives can be given as follows, M I S C N in the List of Minor Engineering Electives.

PROFESSIONAL ELECTIVES

Sl.No	Course Code	Title of Subject	Credits
1	CEPESCN	Integrated Water Resources Management	3
2	CEPESCN	Irrigation Engineering	3
3	CEPESCN	Pre Fabricated Structures	3
4	CEPESCN	Traffic Engineering & Management	3
5	CEPESCN	Advanced Construction Techniques	3
6	CEPESCN	Membrane Technology	3
7	CEPESCN	Construction Planning & Management	3
8	CEPESCN	Industrial Wastewater Engineering	3
9	CEPESCN	Remote Sensing & GIS	3
10	CEPESCN	Transportation Engineering	3
11	CEPESCN	Architecture	3
12	CEPESCN	Railways, Air Ports and Harbour Engineering	3
13	CEPESCN	Urban Planning & Development	3
14	CEPESCN	Climate Change Adaptation & Mitigation	3

OPEN ELECTIVES

Sl.No	Course Code	Title of Subject	Credits
1	CEOE SCN	Air Pollution Monitoring & Control	3
2	CEOE SCN	Municipal SolidWaste Management	3
3	CEOE SCN	Economics & Finance for Civil Engineering	3
4	CEOE SCN	Environmental Impact Assessment	3
5	CEOE SCN	Coastal Engineering	3
6	CEOE SCN	Total Quality Management	3
7	CEOE SCN	Computer Aided Design of Structures	3
8	CEOE SCN	Online MOOC course or other courses	3

HONOUR ELECTIVES

Sl.No	Course Code	Title of Subject	Credits
1	CEHE SCN	Special Concrete Structures	4
2	CEHE SCN	Earth Quake Engineering	3
3	CEHE SCN	Advanced water Treatment	4
4	CEHE SCN	WaterShed Management	3
5	CEHE SCN	Geo Environmental Engineering	3
6	CEHE SCN	Intellectual Property Rights	3
7	CEHE SCN	Sustainable Engineering and Technology	3

MINOR ENGINEERING ELECTIVES

Sl.No	Course Code	Title of Subject	Credits
1	CEME SCN	Advanced Water Treatment	4
2	CEME SCN	Climate Change Adaptation & Mitigation	3
3	CEME SCN	Environmental Impact Assessment	3
4	CEME SCN	Total Quality Management	3
5	CEME SCN	Urban Planning & Development	3
6	CEME SCN	Special Concrete Structures	4

**SYLLABUS
FIRST SEMESTER**

Course code	ETBS101				
Category	Basic Science Course				
Course title	PHYSICS				
Scheme and Credits	L	T	P	Credits	
	3	1	0	4	

Course Objectives

At the end of the course the students would be exposed to fundamental knowledge in various engineering subjects and applications

- Interferometric techniques in metrology, communication and civil engineering.
- Application of quantum physics to optical and electrical phenomena.
- Structure identification of engineering materials.
- Applications of lasers Utilization of solar energy.

Unit – I Wave optics (9 Lectures)

Huygens' Principle, superposition of waves and interference of light by wave front splitting and amplitude splitting; Young's double slit experiment, Newton's rings, Michelson interferometer and Mach-Zehnder interferometer. Fraunhofer diffraction from a single slit and a circular aperture, the Rayleigh criterion for limit of resolution and its application to vision; diffraction gratings and their resolving power.

Unit – II Lasers (8 Lectures)

Introduction – Principles of Laser – Stimulated emission, Properties of laser beams: mono-chromaticity, coherence, directionality and brightness Einstein's theory of, stimulated emission A and B coefficients; amplification of light by population inversion, different types of lasers: gas lasers (He-Ne, CO₂), solid- state lasers (ruby, Neodymium), dye lasers, laser speckles, applications of lasers in science, engineering and medicine.

Unit – III Crystal Physics (7 Lectures)

Introduction to solid Materials – crystal structure – Geometry of lattice unit cell – Bravais’ lattice – crystal systems, Crystal structures of Materials –(Cordination number, Atomic radius, packing factor and packing density) – Types of crystal Lattice (Simple Cubic, Body Centered Cubic, Face Centered Cubic and Hexagonal Closed Packed) Miller Indices and their calculations - Finding Miller indices of crystal planes.

Unit - IV Quantum Mechanics (8 Lectures)

Heisenberg uncertainty Principle –Dual nature of Matter and radiation – De Broglie’s Wave length – wave Velocity and group velocity. The wave Equation, Schrödinger’s time dependent and independent wave equations - The Wave function and its physical significance - The particle in a box Problem (one dimensional box) - energy quantization – Eigen values and Eigen functions.

Unit - V Energy Physics (8 Lectures)

Introduction to energy sources - Energy sources and their availability (Conventional and Non- conventional energy sources) solar energy – Methods of Harvesting solar energy – Solar heat collector, solar water heater and solar cells. Wind energy – basic principle and components of wind energy Conversion system (WECS) – application of wind energy. Biomass - Biogas Generation - Classification of Biogas plants –Properties and application of Biogas.

Text Books

1. Arumugam.M. “Engineering Physics”, Anuradha agencies, 2nd Edition, 1997.
2. John Twidell & Tony Weir, “ Renewable Energy Resources”, Taylor & Francis, 2005.
3. Avadhanulu. M.N. and Kshirsagar P.G., “A Text Book of Engineering Physics”, S. Chand & Company Ltd., 7th Enlarged Revised Ed., 2005.
4. Gaur R.K. and Gupta S.L., “Engineering Physics”, Dhanpat Rai Publishers, New Delhi, 2003.
5. Rai.G.D. , “*Solar Energy Utilization*” Volume-1 & 2 by - Khanna Publishers, New Delhi.
6. Pajput. R. K. Non – Conventional energy sources and Utilization - S . Chand Publication – 2013.

Reference Books

1. Rajendran.V , “Engineering Physics”, Tata McGraw Hill publishers, 2009.
2. Rai G.D., “Non-conventional Energy sources”, Khauna Publications, 1993.
3. Mani. P. “Engineering Physics”, Dhanam Publication, Chennai, 2011.
4. Agarwal.M.P, “Solar Energy”, S.Chand & Co., I Edn, New Delhi, 1983.

Course code	ETBS102				
Category	Basic Science Course				
Course title	Mathematics - I				
Scheme and Credits	L	T	P	Credits	
	3	1	0	4	

Course Objectives:

The objective of this course is to familiarize the prospective engineers with techniques in calculus, multivariate analysis and linear algebra. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

Unit 1: Calculus: (6 lectures)

Evaluation of definite integrals and their properties-Applications of definite integrals to evaluate surface areas and volumes of revolutions. Improper integral-Beta and Gamma functions and their properties.

Unit 2: Calculus: (6 lectures)

Rolle's theorem-Mean value theorem. Indeterminate forms-L'Hospital's rule. Functions of two variables: Taylor's and Maclaurin's series expansions-Maxima and minima for functions of two variables.

Unit 3: Sequences and series: (10 lectures)

Convergence of sequence and series-tests for convergence: Comparison test(only for series with positive terms)-D'Alembert's ratio test-Cauchy's root test-Integral test-Leibnitz's test(Alternating series).

Unit 4: Vector Calculus (Differentiation): (8 lectures)

Gradient, divergence and curl- directional derivative-unit normal vector-irrotational and solenoidal vectors-expansion formulae for operators involving ∇ .

Unit 5: Matrices (10 lectures)

Rank of a matrix- Symmetric, skew-symmetric and orthogonal matrices-Characteristic equation- Eigen values and Eigen vectors - Cayley-Hamilton Theorem-Diagonalization of symmetric matrices by Orthogonal transformation.

Suggested Text/Reference Books

1. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
2. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
3. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
4. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Edition, Reprint, 2010.
5. D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
6. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
7. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

Course Outcomes: The students will learn:

- To apply differential and integral calculus to improper integrals. Apart from some other applications they will have a basic understanding of Beta and Gamma functions.
- The fallouts of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.
- The tool of sequences and series for learning advanced Engineering Mathematics.
- To deal with vector calculus that are essential in most branches of engineering.
- The essential tool of matrices and linear algebra in a comprehensive manner.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓										
CO2	✓			✓	✓					✓		
CO3	✓	✓							✓			✓
CO4	✓	✓										
CO5	✓	✓	✓		✓							

Course Code	ETES103
-------------	----------------

Category	Engineering Science Course			
Course Title	Basic Electrical Engineering			
Scheme and Credits	L	T	P	Credits
	3	1	0	4

Course Objectives:

- To understand the basic laws and theorems of electric circuits.
- To know the concept of AC and DC quantities.
- To understand the working of transformer.
- To know the operation and principles of electrical machines.
- To know the protective devices used in electrical installations.

Unit 1: DC Circuits (8 Hours)

Electrical circuit elements (R,L and C) -Voltage and Current sources - Kirchoff Current and Voltage laws-Thevenin's theorem and Norton's theorem - Analysis of simple circuits with dc excitation.

Unit 2: AC Circuits (8 Hours)

Representation of sinusoidal waveforms:Peak, Average and RMS values -Voltage and Current relationship in R, L and C- Power, Power factor and Power triangle- Analysis of single-phase RL, RC and RLC ac circuits - Three phase balanced circuits: Voltage and Current relations in Star andDelta connections.

Unit 3: Transformers (6 Hours)

Single-phase Transformer: Construction and Working principle, EMF equation, Losses, regulation and efficiency-Three-phase transformer: Construction and Connections -Auto-transformer: Principle, Saving of Copper.

Unit 4: Electrical Machines (8 Hours)

DC Motor: Construction, Working principle, Types, Speed control and Application - Three-phase cage induction motor: Construction, Working principle - Single-phase induction motor:Types and Applications – Alternator:Construction and Working principle, EMF equation.

Unit 5: Electrical Installations and Power Converters (12 Hours)

Types of Wires and Cables – Introduction to protective devices: Switch Fuse Unit(SFU), MCB, ELCB, MCCB – Earthing:Pipe and Plate Earthing -PN Junction Diode – Silicon Controlled Rectifier (SCR) - Rectifiers.

Suggested Text/ Reference Books

1. D.P.Kothari and I.J.Nagrath “Basic Electrical Engineering”, Tata McGraw Hill, 2010.
2. D.C.Kulshreshtha, “Basic Electrical Engineering”, McGraw Hill, 2009.
3. L.S.Borow, “Fundamentals of Electrical Engineering”, Oxford University Press, 2011.
4. E.Hughes, “Electrical and Electronics Technology”, Pearson, 2010.
5. V.D.Toro,”Electrical Engineering Fundamentals”, Prentice Hall India, 1989.

Course Outcomes

- Able to understand and analyze the basic electric circuits.
- Acquire knowledge about the principles and operations of Transformers.
- Acquire knowledge about the principles and working of Electric generators and Motors.
- Able to understand the characteristics of SCR and process of rectification.
- Acquire knowledge about the components of low voltage electrical installations and safety practices.

Course code	ETBP104				
Category	Basic Science Course				
Course title	Physics Laboratory				
Scheme and Credits	L	T	P	Credits	
	0	0	3	1.5	

List of Experiments:

1. Air Wedge
2. Newton's Rings
3. Simple Pendulum
4. Dispersive power of the Prism
5. Diffraction Grating
6. Acoustic diffraction Grating
7. Compound Pendulum
8. Kunt's tube experiment
9. Young's double slit experiment
10. Laser Grating
11. Torsional Pendulum
12. Young's Modulus – Non-uniform Bending
13. Young's Modulus – Uniform Bending.

Course Code	ETSP105			
Category	Engineering Science Course			
Course Title	Electrical Engineering Laboratory			
Scheme and Credits	L	T	P	Credits
	0	0	2	1

List of experiments/ demonstrations:

- Basic safety precautions, Introduction and use of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors.
- Measuring the steady – state and transient time-response of R-L,R-C, and R-L-C circuits to a step change in voltage (transient may be observed on a storage oscilloscope). Sinusoidal steady state response of R-L and R-C circuits – impedance calculation and verification. Observation of phase difference between current and voltage. Resonance in R-L-C circuits.
- Transformers: Observation of the no-load current waveform on an oscilloscope (non-sinusoidal wave-shape due to B-H curve nonlinearity should be shown along with a discussion about harmonics. Loading of a transformer: measurement of primary and secondary voltages and currents and power.
- Three-phase transformers: Star and Delta connections, Voltage and Current relationships (line-line voltage, phase –to – neutral voltage, line and phase currents). Phase-shifts between the primary and secondary sides. Cumulative three-phase power in balanced three-phase circuits.
- Demonstration of cut-out sections of machines: de machine (commutator -brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winding – slip ring arrangement) and single–phase induction machine.
- Torque Speed Characteristic of separately excited de motor.
- Synchronous speed of two and four-pole, three-phase induction motors. Direction reversal by change of phase-sequence of connections. Torque-Slip Characteristic of an induction motor. Generator operation of an induction machine driven at super synchronous speed.
- Synchronous Machine operating as a generator: stand-alone operation with a load.
- Control of voltage through field excitation.
- Demonstration of (a) dc-dc convertors (b) dc-ac convertors – PWM waveform (c) the use of dc-ac convertor for speed control of an induction motor and (d) Components of LT switchgear

Laboratory Outcomes

- Get an exposure to common electrical components and their ratings.
- Make electrical connections by wires of appropriate ratings.
- Understand the usage of common electrical measuring instruments.
- Understand the basic characteristics of transformers and electrical machines.
- Get an exposure to the working of power electronic convertors.

Course code	ETSP106			
Category	Engineering Science Courses			
Course title	Workshop / Manufacturing Practices			
Scheme and Credits	L	T	P	Credits
	1	0	4	3

Lectures & Videos: (10 ours)

1. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods (3 lectures)
2. CNC machining, Additive manufacturing (1 lecture)
3. Fitting operations & power tools (1 lecture)
4. Electrical & Electronics (1 lecture)
5. Carpentry (1 lecture)
6. Plastic moulding, glass cutting (1 lecture)
7. Metal casting (1 lecture)
8. Welding (arc welding & gas welding), brazing (1 lecture)

Suggested Text/Reference Books:

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
2. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology", 4th edition, Pearson Education India Edition, 2002.
3. Gowri P. Hariharan and A. Suresh Babu,"Manufacturing Technology – I" Pearson Education, 2008.
4. Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India, 1998.
5. Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGrawHill House, 2017.

Course Outcomes

Upon completion of this course, the students will gain knowledge of the different manufacturing processes which are commonly employed in the industry, to fabricate components using different materials.

Workshop Practice: (60 hours)

1. Machine shop (10 hours)
2. Fitting shop (8 hours)
3. Carpentry (6 hours)
4. Electrical & Electronics(8 hours)
5. Welding shop (8 hours (Arc welding 4 hrs + gas welding 4 hrs)
6. Casting (8 hours)
7. Smithy (6 hours)
8. Plastic moulding & Glass Cutting (6 hours)
9. Examinations could involve the actual fabrication of simple components, utilizing one or more of the techniques covered above.

Laboratory Outcomes

- Upon completion of this laboratory course, students will be able to fabricate components with their own hands.
- They will also get practical knowledge of the dimensional accuracies and dimensional tolerances possible with different manufacturing processes.
- By assembling different components, they will be able to produce small devices of their interest.

Course code	ETHS201				
Category	Humanities and Social Sciences including Management courses				
Course title	English				
Scheme and Credits	L	T	P	Credits	
	2	0	0	2	

Module 1: Vocabulary Building

- 1.1 The concept of Word Formation
- 1.2 Root words from foreign languages and their use in English
- 1.3 Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives, Count and uncount nouns.
- 1.4 Synonyms, antonyms, and standard abbreviations.
- 1.5 Language development - Wh questions asking and answering yes or no questions.

Module 2: Basic Writing Skills

- 2.1 Sentence Structures
- 2.2 Use of phrases and clauses in sentences
- 2.3 Importance of proper punctuation
- 2.4 Creating coherence and Techniques for writing precisely
- 2.5 Organizing principles of paragraphs in writing

Module 3: Nature and Style of sensible Writing

- 3.1 Describing and Defining
- 3.2 Classifying and Providing examples or evidence
- 3.3 Writing introduction and conclusion
- 3.4 Comprehension
- 3.5 Precis Writing

Module 4: Writing Practices & Oral Communication

- 4.1 Listening to lectures and making notes
- 4.2 Mechanics of presentation, asking and giving instruction
- 4.3 Essay Writing – Writing analytical essays and issue based essays.
- 4.4 Dialogue writing and conversation
- 4.5 Letter writing – Formal and informal

Module 5: Group Discussion and Job Application

- 5.1 Characteristics and practices of group discussion
- 5.2 Job application
- 5.3 Resume preparation
- 5.4 Writing reports – minutes of a meeting, accident, survey
- 5.5 E-mail – etiquette

Suggested Readings:

- (i) *Practical English Usage*. Michael Swan. OUP. 1995.
- (ii) *Remedial English Grammar*. F.T. Wood. Macmillan.2007
- (iii) *On Writing Well*. William Zinsser. Harper Resource Book. 2001
- (iv) *Study Writing*. Liz Hamp-Lyons and Ben Heasley. Cambridge University Press. 2006.
- (v) *Communication Skills*. Sanjay Kumar and PushpLata. Oxford University Press. 2011.
- (vi) *Exercises in Spoken English*. Parts. I-III. CIEFL, Hyderabad. Oxford University Press
- (vii) Raman, Meenakshi and Shama, Sangeetha – *Technical Communication Principles and Practice*, Oxford University Press, New Delhi,2014.

Course Outcomes

The student will acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.

Course Code	ETBS202			
Category	Basic Science Course			
Course title	Chemistry			
Scheme and Credits	L	T	P	Credits
	3	1	0	4

Unit – I : Water Chemistry and Surface Chemistry

Hardness of water – Softening of hard water by ion exchange method – Boiler feed water – boiler troubles – Internal treatment methods – Estimation of hardness by EDTA method – Desalination of brackish water – Reverse Osmosis. Disinfection of water – Break point chlorination – Adsorption – Types of Adsorption – Freundlich and Langmuir adsorption isotherms – Applications of adsorption

Unit – II : Electrochemistry and Corrosion

Electrode potential – Electrochemical cell – Measurement of EMF – Nernst equation for cell EMF – Concentration cells – Electrochemical series – Conductometry – Conductance, Cell constant – Types of conductometric titrations. Potentiometry – Principle of acid base titration. Corrosion – Dry and wet corrosion – Galvanic, concentration cell and pitting corrosion – Control of corrosion by Cathodic protection method.

Unit – III : Fuels and Storage Devices

Fuels – Classification – Calorific values – HCV and LCV – Analysis of coal – Proximate and ultimate analysis – Refining of petroleum. Cracking – Fixed bed – Synthetic petrol – Fischer – Tropsch process – Flue gas analysis by Orsat apparatus. Batteries – Primary and secondary – Dry cell – Lead acid storage battery – Ni-Cd battery – Lithium battery – H₂-O₂ fuel cell.

Unit – IV : Polymers and Nano Materials

Polymers – Types of polymerization – Addition, condensation and copolymerisation – Mechanism of addition polymerization (Free radical). Plastics – Thermoplastics and thermosetting plastics – Preparation, properties and uses of polyethylene, polyvinyl chloride, polystyrene, Nylon and bakelite. Nanochemistry – introduction to nano materials. Synthesis – Precipitation, sol-gel process, electrodeposition and chemical vapour deposition methods. Carbon nano tubes, fullerenes, nano wires and nano rods

Unit – V : Engineering Materials and Spectroscopic Techniques

Refractories – Classification, characteristics (Refractoriness, RUL, Thermal spalling, porosity) and uses, Lubricants – Classification, properties (cloud and pour point, flash and fire point, viscosity index) and applications. Principles of spectroscopy – Beer – Lambert’s Law – UV – Visible and IR spectroscopy – Basic principles and instrumentation (block diagram) – Fluorescence and its applications in medicine.

Suggested Text Books

1. Jain, P.C. and Monica Jain (2010) “Engineering Chemistry” Dhanpat Rai & Sons, New Delhi
2. Dara, S.S. and Umare, S.S. (2014) “Text Book of Engineering Chemistry” S. Chand & Co. Ltd., New Delhi.
3. Gopalan, R., Venkappaya, D. and Nagarajan, S. (2008) “Engineering Chemistry” Tata Mc Graw Publications Ltd., New Delhi.
4. Puri, B.R., Sharma, L.R. and Pathania, M.S. (2013) “Principles of Physical Chemistry” Vishal Publication Company, New Delhi.
5. Sharma, Y.R. (2010) “Elementary Organic Spectroscopy, Principle and Chemical Applications” S. Chand Publishers, New Delhi.
6. Asim K Das and Mahua Das (2017) “An Introduction to Nanomaterials and Nanoscience” CBS Publishers & Distributors Pvt. Ltd., New Delhi.

Course Outcomes

At the end of the course the student will be able to

- ❖ develop innovative methods to produce soft water for industrial uses, drinking purpose and understand concept of surface chemistry,
- ❖ study the concept of electrochemistry and its applications and corrosion control methods,
- ❖ understand the properties of fuels and applications of energy storage devices,
- ❖ synthesis and uses of various polymers and gain knowledge on refractories and lubricants,
- ❖ understand the concepts of certain analytical techniques and applications of nanochemistry.

Course code	ETES203				
Category	Engineering Science Course				
Course title	Programming for Problem Solving				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	

Unit 1:

Introduction to Programming, Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.), Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/Pseudocode with examples. From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code. (8 lectures)

Unit 2:

Arithmetic expressions and precedence, Conditional Branching and Loops, Writing and evaluation of conditionals and consequent branching, Iteration and loops. (14 lectures)

Unit 3:

Arrays: Arrays (1-D, 2-D), Character arrays and Strings, Basic Algorithms: Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of equations, notion of order of complexity through example programs (no formal definition required). (12 lectures)

Unit 4:

Function: Functions (including using built in libraries), Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference, Recursion: Recursion, as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort. (10 lectures)

Unit 5:

Structure: Structures, Defining structures and Array of Structures, Pointers: Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, notion of linked list (no implementation). File handling (only if time is available, otherwise should be done as part of the lab). (6 lectures)

Suggested Text Books

1. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
2. E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill

Suggested Reference Books

1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India

Course Outcomes

The student will learn

- To formulate simple algorithms for arithmetic and logical problems.
- To translate the algorithms to programs (in C language).
- To test and execute the programs and correct syntax and logical errors.
- 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.
- To apply programming to solve simple numerical method problems, namely root finding of function, differentiation of function and simple integration.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		✓		✓						✓		
CO2	✓	✓	✓		✓		✓	✓			✓	✓
CO3									✓			
CO4	✓				✓	✓	✓	✓				
CO5	✓		✓	✓		✓			✓		✓	✓

Course code	ETBS204			
Category	Basic Science Course			
Course title	Mathematics - II			
Scheme and Credits	L	T	P	Credits
	3	1	0	4

Module 1: Multivariable Calculus (Integration): (8 lectures)

Double integrals (Cartesian) - change of order of integration in double integrals - change of variables (Cartesian to polar) - Applications: Area as a double integral. Triple integrals (Cartesian) - Applications: Volume as a triple integral.

Module 2: Vector Calculus (Integration): (8 lectures)

Line, Surface and Volume integrals - Gauss divergence theorem (without proof) - Green's theorem in the plane (without proof) – Stokes theorem (without proof). Verification of the above theorems and evaluation of integrals using them.

Module 3: Ordinary differential equations: (8 lectures)

First order ordinary differential equations (Linear and Bernoulli's differential equations, exact differential equations). Solution of Second order ordinary linear differential equations with constant co-efficient (method of variation of parameters only). Solution of Second order ordinary linear differential equations with variable co-efficient (Euler and Legendre's linear equations).

Module 4: Complex Variable (Differentiation): (8 lectures)

Analytic functions and their properties-Cauchy-Riemann equations-harmonic functions - harmonic conjugate of elementary analytic functions– Construction of an analytic function. Mobius transformations.

Module 5: Complex Variable (Integration): (8 lectures)

Cauchy theorem (without proof) - Cauchy Integral formula (without proof) - Cauchy Integral formula for higher derivatives (without proof) – zeros and poles of an analytic functions – singularities. Residues

- Cauchy Residue theorem (without proof) - Evaluation of definite integral using them. Taylor's series and Laurent's series.

Suggested Text/Reference Books

1. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
2. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
3. W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems, 9th Edn., Wiley India, 2009.
4. S. L. Ross, Differential Equations, 3rd Ed., Wiley India, 1984.
5. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Ed., Mc-Graw Hill, 2004.
6. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint,
7. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

Course Outcomes

The objective of this course is to familiarize the prospective engineers with techniques in multivariate integration, ordinary and partial differential equations and complex variables. It aims to equip the students to deal with advanced level of mathematics and applications that would be essential for their disciplines.

The students will learn:

- The mathematical tools needed in evaluating multiple integrals and their usage.
- The effective mathematical tools for the solutions of differential equations that model physical processes.
- The tools of differentiation and integration of functions of a complex variable that are used in various techniques dealing engineering problems.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓							✓		✓	✓
CO2	✓	✓	✓		✓							
CO3	✓	✓	✓	✓					✓		✓	✓
CO4	✓	✓		✓								
CO5	✓	✓	✓						✓			
Course code	ETHP205											

Category	Humanities and Social Sciences including Management courses				
Course title	Communication Skills and Language Laboratory				
Scheme and Credits	L	T	P	Credits	
	0	0	2	1	

List of Topics

1. Listening Comprehension
2. Pronunciation, Intonation, Stress and Rhythm
3. Common Everyday Situations: Conversations and Dialogues
4. Communication at Workplace
5. Interviews
6. Formal Presentations

Suggested Software package: Globarena Package for communicative English
 The Globarena Package consists of the following exercises

1. Reading comprehension
2. Listening comprehension
3. Vocabulary exercises
4. Phonetics
5. Role Play in dialogues
6. Auto Speak

Suggested Readings:

1. English Pronouncing Dictionary Daniel Jones Current Edition with CD.
2. Spoken English- R. K. Bansal and J. B. Harrison, Orient Longman 2006 Edn.
3. A Practical course in English Pronunciation, (with two Audio cassettes) by J. Sethi, KamleshSadanand& D.V. Jindal, Prentice-Hall of India Pvt. Ltd., New Delhi.
4. A text book of English Phonetics for Indian Students by T.Balasubramanian (Macmillan)
5. English Skills for Technical Students, WBSCTE with British Council, OL.

Course code	ETBP206
Category	Basic Science Course

Course title	Chemistry Laboratory				
Scheme and Credits	L	T	P	Credits	
	0	0	3	1.5	

Objectives:

- To list the water quality standards
- To assess the composition of an alloy
- To appreciate the practical significance of acidimetry, alkalimetry, permananganometry, conductometry and potentiometry
- To analyse quantitatively the amount of a substance present in a given sample.

List of Experiments:

1. Determination of surface tension and viscosity
2. Thin layer chromatography
3. Ion exchange column for removal of hardness of water
4. Determination of chloride content of water
5. Determination of the rate constant of a reaction
6. Determination of cell constant and conductance of solutions
7. Potentiometry - determination of redox potentials and emfs
8. Saponification/acid value of an oil
9. Determination of the partition coefficient of a substance between two immiscible liquids
10. Adsorption of acetic acid by charcoal
11. Volumetric analysis

Course outcomes:

At the end of the course the students will be able to

- Gain knowledge in the quantitative chemical analysis of water quality related parameters.

Course code	ETSP207				
Category	Engineering Science Course				
Course title	Computer Programming Laboratory				
Scheme and Credits	L	T	P	Credits	
	0	0	4	2	

Objectives:

To make the students conversant with

- Water treatment techniques, disinfection methods and adsorption techniques
- Working principal of electrochemical cell and knowledge about corrosion and control of corrosion.
- Sources, refining of petroleum various types of fuels, and knowledge about primary and secondary cells.
- Types of polymers, polymerization products, Uses of polymers and introduction to nono materials.
- Engineering materials such as refractories, lubricants and principles of sepectroscopy – UV and IR

[The laboratory should be preceded or followed by a tutorial to explain the approach or algorithm to be implemented for the problem given]

Tutorial 1 : Problem solving using computers:

Lab1 : Familiarization with programming environment

Tutorial 2 : Variable types and type conversions:

Lab 2 : Simple computational problems using arithmetic expressions

Tutorial 3 : Branching and logical expressions:

Lab 3 : Problems involving if-then-else structures

Tutorial 4 : Loops, while and for loops:

Lab 4 : Iterative problems e.g., sum of series

Tutorial 5 : 1D Arrays: searching, sorting:

Lab 5 : 1D Array manipulation

- Tutorial 6** : 2D arrays and Strings
Lab 6 : Matrix problems, String operations
- Tutorial 7** : Functions, call by value:
Lab 7 : Simple functions
- Tutorial 8 &9** : Numerical methods (Root finding, numerical differentiation, numerical integration):
Lab 8 and 9 : Programming for solving Numerical methods problems
- Tutorial 10** : Recursion, structure of recursive calls
Lab 10 : Recursive functions
- Tutorial 11** : Pointers, structures and dynamic memory allocation
Lab 11 : Pointers and structures
- Tutorial 12** : File handling:
Lab 12 : File operations

Laboratory Outcomes

- To formulate the algorithms for simple problems
- To translate given algorithms to a working and correct program
- To be able to correct syntax errors as reported by the compilers
- To be able to identify and correct logical errors encountered at runtime
- To be able to write iterative as well as recursive programs
- To be able to represent data in arrays, strings and structures and manipulate them through a program
- To be able to declare pointers of different types and use them in defining self-referential structures.
- To be able to create, read and write to and from simple text files.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓					✓			
CO2				✓	✓							
CO3	✓		✓									
CO4	✓				✓							
CO5		✓	✓	✓					✓			

Course code	ETSP208			
Category	Engineering Science Courses			
Course title	Engineering Graphics and Drafting			
Scheme and Credits	L	T	P	Credits
	1	0	4	3

Traditional Engineering Graphics:

Principles of Engineering Graphics; Orthographic Projection; Descriptive Geometry; Drawing Principles; Isometric Projection; Surface Development; Reading a Drawing; Sectional Views; Dimensioning, True Length, Angle.

Computer Graphics:

Engineering Graphics Software; -Spatial Transformations; Orthographic Projections; Model Viewing; Co-ordinate Systems; Multi-view Projection; Exploded Assembly; Model Viewing; Animation; Spatial Manipulation; Surface Modelling; Solid Modelling; Introduction to Building Information Modelling (BIM)

(Except the basic essential concepts, most of the teaching part can happen concurrently in the laboratory)

COURSE OBJECTIVES:

- To develop the ability to produce simple engineering drawing and sketches based on current practice
- To develop the means for communication of ideas, thoughts and design of objects, related to engineering applications, to others through drawing
- To develop the skills to read manufacturing and construction drawings used in industry
- To develop a working knowledge of the layout of plant and equipment
- To develop skills in abstracting information from calculation sheets and schematic diagrams to produce working drawings for manufacturers, installers and fabricators

Unit 1: Introduction to Engineering Drawing

Introduction to Engineering Drawing: Lettering, Dimensioning and use of drawing instruments. Conic sections: Eccentricity method of/for drawing ellipse, parabola and hyperbola- Tangent and Normal from a point on the curve.

Unit 2: Orthographic Projections

Orthographic projections: Introduction – Projections of points Projections of Straight lines: Determination of true length and true angle of inclinations using half cone and trapezoidal methods – drawing the projections of straight lines using half cone method from true length and true angle of inclinations.

Unit 3: Projections of Regular Solids

Projections of solids in simple position: Projections of cube, Tetrahedron, prisms, pyramids, cone and cylinder.

Projections of solids: Auxiliary projections – projections of prisms, pyramids, cylinder and cone when the axis is inclined to only one plane.

Unit 4: Sections and Sectional Views of Right Angular Solids

Sections of solids: Sections of prisms, pyramids, cylinder and cones – true shape of section.

Developments of solids: Developments of lateral surfaces of solids using parallel and radial line methods.

Unit 5: Isometric Projections

Isometric projections: Projections of simple solids.

Conversion of pictorial view of simple objects into orthographic projections (only elevation and plan)

Overview of Computer Graphics covering

Introduction to CAD software: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars). The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.

Customisation & CAD Drawing

consisting of set up of the drawing page and the printer, including scale settings, Setting up of units and drawing limits; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines and other basic geometric entities.

Annotations, layering & other functions

applying dimensions to objects and annotations to drawings; Setting up and use of Layers, Printing documents to paper using the print command; orthographic projection techniques; Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation;

Suggested Text/Reference Books:

- (i) Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House
- (ii) Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
- (iii) Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
- (iv) Narayana, K.L. & P Kanniah (2008), Text book on Engineering Drawing, Scitech Publishers
- (v) (Corresponding set of) CAD Software Theory and User Manuals

Course Outcomes

All phases of manufacturing or construction require the conversion of new ideas and design concepts into the basic line language of graphics. Therefore, there are many areas (civil, mechanical, electrical, architectural and industrial) in which the skills of the CAD technicians play major roles in the design and development of new products or construction. Students are prepared for actual work situations through practical training in a new state-of-the-art computer designed CAD laboratory using engineering software.

This course is designed to prepare the students:

- to communicate effectively through drawing
- to use the techniques, skills, and modern engineering tools necessary for engineering practice

The student will learn :

- Introduction to engineering drawing and its place in society
- Exposure to the visual aspects of engineering graphics
- Exposure to engineering graphics standards
- Exposure to engineering communication

SEMESTER - III

ETBS301	ENGINEERING MATHEMATICS-III	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES

- To learn, partial differential equations, Fourier series, Boundary value problems.
- To learn the transforms such as Sine, Cosine, Fourier transform and Z-transforms.
- To gain knowledge of the method to find the Solution of difference equations.

Unit- I

Formation of partial differential equations by eliminating arbitrary constants and arbitrary functions - Solution of standard type of first order partial differential equations - Lagrange's linear equation - Linear partial differential equations of second order with constant coefficients.

Unit - II

Dirichle's conditions - General Fourier series - Odd and Even functions - Half range sine series - Half range cosine series - Complex form of Fourier series – Parseval's identity.

Unit - III

Solutions of one dimensional wave equation – One dimensional heat equation (without derivation) – Fourier series solutions in Cartesian co-ordinates.

Unit - IV

Fourier integral theorem (without proof) – Fourier transform pair – Sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem - Parseval's identity.

Unit - V

Z - transform – Elementary properties – Inverse Z – transform - Convolution theorem – Solution of difference equations using Z – transform.

TEXT BOOKS

1. Kandasamy P , Tilagavathy K and Gunavathy K, “Engineering Mathematics” ,6th edition., (Vol I & II) S.Chand& Co Ltd. 2006, New Delhi.
2. Ventakataraman M K, “Engineering Mathematics”, The National Publishing Co., Chennai, 2003.

REFERENCES

1. Veerarajan T, “Engineering Mathematics”, 3rd edition, Tata McGraw Hill Pub., 2005.
2. Singaravelu A, “Engineering Mathematics”, Meenakshi Publications, Chennai, 2004.
3. Nayaranan S, Manicavchagom Pillay T K and Ramanaiah G “Advanced Mathematics for Engineerirng students”, Vol.2 & 3, S. Viswanathan Publishers Pvt. Ltd., 1998
4. Bali.N.P. and Manish Goyal, “A Textbook of Engineeirng Mathematics”, 7th Edition, Laxmi Publications Pvt. Ltd., 2007

COURSE OUTCOMES

At the end of the course the students will be able to acquire knowledge on

- Partial differential equations.
- Fourier series.
- Fourier transform.
- Z-transforms and the methods of solving them.
- Solving boundary value problems.

Mapping of COs with Pos												
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓						✓				
CO2	✓	✓	✓		✓			✓		✓	✓	
CO3	✓	✓		✓	✓			✓	✓			
CO4	✓	✓				✓	✓	✓				
CO5	✓	✓	✓	✓				✓				✓

ETES302	ENVIRONMENTAL STUDIES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

To realize the importance of environment for engineering students.

To understand the basis of ecosystems

To make aware the student about global environmental problems and natural disasters.

To give the ideas about advance technologies of Engineering that will useful to protect environment.

Unit - I

Introduction - Multidisciplinary nature of environmental studies - Definition, scope and importance - Need for public awareness. Natural resources - Forest resources: use and over-exploitation - deforestation - case st

udies. Timber extraction - mining - dams and their effects on forest and tribal people. Water resources: Use and over-utilization of surface and ground water - floods - drought - conflicts over water - dams-benefits and problems. Mineral resources: Use and exploitation - environmental effects of extracting and using mineral resources - Food resources: World food problems - changes caused by agriculture and overgrazing - effects of modern agriculture - fertilizer-pesticide problems - Energy resources: Growing energy needs - renewable and non-renewable energy sources - use of alternate energy sources. Land resources: Land as a resource - land degradation - man induced landslides - soil erosion and desertification.- Role of an individual in conservation of natural resources - Equitable use of resources for sustainable lifestyles.

Unit - II

Concept of an ecosystem - Structure and function of an ecosystem - Producers, consumers and decomposers - Energy flow in the ecosystem - Ecological succession - Food chains, food webs and ecological - pyramids - Introduction, types, characteristic features, structure and function of the following ecosystem - Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Unit - III

Introduction – Definition: genetic, species and ecosystem diversity - Bio geographical classification of India - Value of biodiversity : consumptive use, productive use, social, ethical, aesthetic and option values - Biodiversity at global, National and local levels - India as a mega-diversity nation - Hot-spots of biodiversity - Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts - Endangered and endemic species of India - Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

Unit - IV

Definition - Cause, effects and control measures of Air pollution - Water pollution - Soil pollution - Marine pollution- Noise pollution - Thermal pollution - Nuclear hazards- Solid waste Management: Causes, effects and control measures of urban and industrial wastes - Role of an individual in prevention of pollution - Disaster management : floods, earthquake, cyclone and landslides. Sustainable development - Urban problems related to energy - Water conservation, rain water harvesting, and watershed management - Resettlement and rehabilitation of people; its problems and concerns. - Environmental ethics: Issues and possible solutions - Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust.

Wasteland reclamation - Consumerism and waste products - Environment Protection Act - Air (Prevention and Control of Pollution) Act - Water (Prevention and control of Pollution) Act - Wildlife Protection Act - Forest Conservation Act - Issues involved in enforcement of environmental legislation.

Unit - V

Population growth, variation among nations - Population explosion – Family Welfare Programme - Environment and human health - Human Rights - Value Education - HIV/AIDS - Women and Child Welfare - Role of Information Technology in Environment and human health -Case Studies.

Field work

Visit to a local area to document environmental assets-river/forest /grassland /hill/mountain - Visit to a local polluted site-Urban/Rural/Industrial/Agricultural - Study of common plants, insects, birds - Study of simple ecosystems-pond, river, hill slopes, etc. (**Field work Equal to 5 lecture hours**)

TEXT BOOKS

1. Agarwal, K.C. Environmental Biology, Nidi Publ, Ltd. Bikaner, 2001
2. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad –380 013, India, Email:mapin@icenet.net (R)

REFERENCES

1. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p
2. Clark R.S., Marine Pollution, Clarendon Press Oxford (TB)
3. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publ. House, Mumbai, 1196p
4. De A.K., Environmental Chemistry, Wiley Eastern Ltd.
5. Down to Earth, Centre for Science and Environment (R)
6. Gleick, H.P. 1993. Water in crisis, Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute Oxford Univ. Press. 473p
7. Hawkins R.E., Encyclopedia of Indian Natural History, Bombay Natural History Society, Bombay (R)
8. Heywood, V.H & Weston, R.T. 1995. Global Biodiversity Assessment. Cambridge Univ. Press 1140p.
9. Jadhav, H & Bhosale, V.M. 1995. Environmental Protection and Laws. Himalaya Pub. House, Delhi 284 p.
10. McKinney, M.L. & School, R.M. 1996. Environmental Science systems & Solutions, Web enhanced edition. 639p.
11. Mhaskar A.K., Matter Hazardous, Techno-Science Publication (TB)
12. Miller T.G. Jr. Environmental Science, Wadsworth Publishing Co. (TB)
13. Odum, E.P. 1971. Fundamentals of Ecology. W.B. Saunders Co. USA, 574p
14. Rao M N. & Datta, A.K. 1987. Waste Water treatment. Oxford & IBH Publ. Co. Pvt. Ltd. 345p.
15. Sharma B.K., 2001. Environmental Chemistry. Geol Publ. House, Meerut
16. Survey of the Environment, The Hindu (M)
17. Townsend C., Harper J, and Michael Begon, Essentials of Ecology, Blackwell Science (TB)
18. Trivedi R.K., Handbook of Environmental Laws, Rules Guidelines, Compliances and Standards, Vol I and II, Enviro Media (R)
19. Trivedi R. K. and P.K. Goel, Introduction to air pollution, Techno-Science Publication (TB)
20. Wanger K.D., 1998 Environmental Management. W.B. Saunders Co. Philadelphia, USA 499p

COURSE OUTCOMES

At the end students can able to:

1. Understand the importance of environment.
2. Analyze the importance of environment in engineering.
3. Apply their own ideas and demonstrate advanced technologies that will be useful to protect environment.
4. Employ awareness among the society about environmental problems and natural disasters.
5. Practice according to the present and future environmental issues.

Mapping of COs with POs												
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓										
CO2		✓	✓									
CO3					✓		✓		✓	✓		
CO4				✓		✓			✓		✓	
CO5						✓			✓			✓

ETES303	ENGINEERING MECHANICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce the fundamentals of forces and their effects with their governing laws.
- To understand the definitions of particle, body forces and their equilibrium conditions.
- To understand dynamics and its related motions.

Unit – I

Introduction to Engineering Mechanics covering, Force Systems Basic concepts, Particle equilibrium in 2-D & 3-D; Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces, Components in Space – Resultant- Moment of Forces and its Application; Couples and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems; Static Indeterminacy

Unit – II

Basic Structural Analysis covering, Equilibrium in three dimensions; Method of Sections; Method of Joints; How to determine if a member is in tension or compression; Simple Trusses; Zero force members; Beams & types of beams; Frames & Machines Centroid and Centre of Gravity covering, Centroid of simple figures from first principle, centroid of composite sections; Centre of Gravity and its implications; Area moment of inertia- Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Mass moment inertia of circular plate, Cylinder, Cone, Sphere, Hook.

Unit – III

Friction covering, Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, screw jack & differential screw jack Virtual Work and Energy Method- Virtual displacements, principle of virtual work for particle and ideal system of rigid bodies, degrees of freedom. Active force diagram, systems with friction, mechanical efficiency. Conservative forces and potential energy (elastic and gravitational), energy equation for equilibrium. Applications of energy method for equilibrium. Stability of equilibrium.

Unit – IV

Review of particle dynamics- Rectilinear motion; Plane curvilinear motion (rectangular, path, and polar coordinates). 3-D curvilinear motion; Relative and constrained motion; Newton's 2nd law (rectangular, path, and polar coordinates). Work-kinetic energy, power, potential energy. Impulse-momentum (linear, angular); Impact (Direct and oblique).

Unit - V

Introduction to Kinetics of Rigid Bodies covering, Basic terms, general principles in dynamics; Types of motion, Instantaneous centre of rotation in plane motion and simple problems; D'Alembert's principle and its applications in plane motion and connected bodies; Work energy principle and its application in plane motion of connected bodies; Kinetics of rigid body rotation

Mechanical Vibrations covering, Basic terminology, free and forced vibrations, resonance and its effects; Degree of freedom; Derivation for frequency and amplitude of free vibrations without damping and single degree of freedom system, simple problems, types of pendulum, use of simple, compound and torsion pendulums;

Tutorials from the above modules covering, To find the various forces and angles including resultants in various parts of wall crane, roof truss, pipes, etc.; To verify the line of polygon on various forces; To find coefficient of friction between various materials on inclined plane; Free body diagrams various systems including block-pulley; To verify the principle of moment in the disc apparatus; Helical block; To draw a load efficiency curve for a screw jack

TEXT BOOKS

- 1) Palanichamy, M.S and Nagan, S, "Engineering Mechanics (Statics and Dynamics)", Tata McGraw Hill Publishing Company, Ltd., New Delhi, 2010.
- 2) Natesan, S.C, "Engineering Mechanics (Statics and Dynamics)", first edition, Umesh Publications, New Delhi, 2002.

REFERENCES

1. Irving H. Shames (2006), Engineering Mechanics, 4th Edition, Prentice Hall
2. F. P. Beer and E. R. Johnston (2011), Vector Mechanics for Engineers, Vol I - Statics, Vol II, – Dynamics, 9th Ed, Tata McGraw Hill
3. R. C. Hibbler (2006), Engineering Mechanics: Principles of Statics and Dynamics, Pearson Press.

4. Andy Ruina and Rudra Pratap (2011), Introduction to Statics and Dynamics, Oxford University Press
5. Shames and Rao (2006), Engineering Mechanics, Pearson Education,
6. Hibler and Gupta (2010), Engineering Mechanics (Statics, Dynamics) by Pearson Education
7. Reddy Vijaykumar K. and K. Suresh Kumar(2010), Singer's Engineering Mechanics
8. Bansal R.K.(2010), A Text Book of Engineering Mechanics, Laxmi Publications
9. Khurmi R.S. (2010), Engineering Mechanics, S. Chand & Co.
10. Tayal A.K. (2010), Engineering Mechanics, Umesh Publications

COURSE OUTCOMES: At the end, Students can able to

1. Explain the forces and its related laws of mechanics in static and dynamic conditions.
2. Analyse the forces and its motions on particles, rigid bodies and structures.
3. Solve the moment of inertia of any sections and masses for the structural members.
4. Understand the principles of kinetics and dynamics.
5. Understand the concept of particle dynamics in motion.

Mapping of COs with POs												
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓									✓	✓
CO2		✓	✓	✓						✓		
CO3					✓		✓		✓			
CO4						✓			✓		✓	
CO5						✓			✓			

CEES304	CONSTRUCTION ENGINEERING	L	T	P	C
		2	0	0	2

COURSE OBJECTIVES

- To expose the students to construction practice through an understanding of different types of construction materials and their properties.
- To understand the techniques of construction, different finishing works and remedial practices for distressed structures.
- To impart knowledge of modern construction materials and equipments.

Unit - I

Stones (Dressed) – Bricks – Cement – Steel – Sand and Quarry Dust – Timber – FRP (Fibre Reinforced Polymer) – Composite materials – Physical and Chemical Properties – Manufacturing Process – Classification – Test on materials – IS Standards and Specifications for use in construction as per SP 21: 1983.

Unit - II

Introduction – Types of Soils – Classification of soils as per IS standards – Cohesion and Adhesion of soil – Bearing capacity of soil – Methods of assessing Bearing capacity of soils – Types of foundations – Shallow foundations – Deep foundations – Special types of foundations for Shore and Offshore structures – Foundations with Rock Anchors.

Unit - III

Introduction – Masonry – Types of Masonry – Reinforced Cement Concrete (RCC) works like Footings, Columns, Plinth Beams, Lintels, Sill slabs, Sunshades, Roof Beams and Roof Slabs – Fabrication of Steel – Bar Bending as per IS Standards (SP 34: 1987) – Cover Blocks – Placing of Bars in Formwork – Types of Roofing systems – Types of Stairs – Types of Doors, Windows and Ventilators – Methods of Termite proofing – Methods of Damp proofing.

Unit - IV

Types of floor finishes – Mud flooring, Cement flooring, Ceramic tile flooring, Marble and Granite flooring, Wooden flooring, flooring with puffed panels – Plastering (Interior and Exterior) – Pointing for walls and floors using grouts – White washing – Colour washing with different colour shades available in the markets – Painting – Types of painting for Interior and Exterior application – Formwork (Shuttering or Scaffolding) – Types of Formwork – Use of Shoring and Underpinning.

Unit - V

Introduction – Glass – Ceramics – PVC – UPVC – Refractory – Aluminium – Lightweight Concrete blocks – Poly Carbonate sheets – Insulated Puffed sheets – Sealant joints – Uses in construction. Cracks in buildings – Causes – Methods of repairs– Equipments used for repair works.

TEXT BOOKS

1. Arora.S.P, “Building Construction Technology” (Including Engineering Materials), 2010.
2. Rangwala.S.C, “Building Construction”, Charotar Publishing House Pvt. Limited, 2009.

REFERENCES

1. Sharma and Kaul, “Building Construction”, S.Chand & Company, New Delhi, 1987.
2. Rajput.R.K, “Engineering Materials”, S.Chand & Company, New Delhi. 2008.
3. Dr.Punmia.B.C, “Construction Engineering”, Laxmi Publishers Private Limited, New Delhi, 1993.
4. Gupta R.K. “Civil engineering Materials and Construction Practices”, Jain Brothers, (New Delhi).

STANDARDS

1. SP 21: 1983, Handbook on Summaries of Indian Standards for Building Materials, Bureau of Indian Standards, New Delhi.
2. SP 34: 1987, Handbook on Concrete Reinforcement and Detailing, Bureau of Indian Standards, New Delhi.

COURSE OUTCOMES

At the end of the course students will be able to

1. Compare the properties of most common and advanced building materials.

2. Acquire knowledge of testing of construction materials, their strength requirements and applications.
3. Recognize the functions of different building components.
4. Understand the usage of modern building materials and construction equipments.
5. Apply techniques to repair buildings.

Mapping of COs with POs												
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		✓									✓	
CO2	✓	✓		✓		✓		✓				
CO3							✓					
CO4			✓		✓					✓		
CO5									✓			✓

CEPC305	INTRODUCTION TO FLUID MECHANICS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES

- To introduce the concepts of fluid mechanics useful in Civil Engineering applications.
- To expose the students to fluid Statics, kinematics and dynamics.
- For measurement of pressure, computations of hydrostatic Forces on structural components and the concepts of Buoyancy all find useful applications in many engineering problems.

Unit – I

Basic Concepts and Definitions – Distinction between a fluid and a solid; Density - Specific weight - Specific gravity - Kinematic and dynamic viscosity; variation of viscosity with temperature - Newton law of viscosity; vapour pressure - boiling point - cavitation; surface tension - capillarity - Bulk modulus of elasticity - compressibility.

Unit – II

Fluid Statics - Fluid Pressure: Pressure at a point - Pascals law - pressure variation with temperature - density and altitude. Piezometer - U-Tube Manometer - Single Column Manometer - U-Tube Differential Manometer - Micromanometers. pressure gauges - Hydrostatic pressure and force: horizontal - vertical and inclined surfaces. Buoyancy and stability of floating bodies.

Unit - III

Fluid Kinematics- Classification of fluid flow : steady and unsteady flow; uniform and non-uniform flow; laminar and turbulent flow; rotational and irrotational flow; compressible and incompressible flow; ideal and real fluid flow; one - two and three dimensional flows; Stream line - path line - streak line and stream tube; stream function - velocity potential function. One- - two- and three -dimensional continuity equations in Cartesian coordinates

Unit - IV

Fluid Dynamics- Surface and body forces; Equations of motion - Euler's equation; Bernoulli's equation – derivation; Energy Principle; Practical applications of Bernoulli's equation : venturimeter - orifice meter and pitot tube; Momentum principle; Forces exerted by fluid flow on pipe bend; Vortex Flow – Free and Forced.

Unit - V

Dimensional Analysis and Dynamic Similitude - Definitions of Reynolds Number - Froude Number - Mach Number - Weber Number and Euler Number; Buckingham's π -Theorem.

TEXT BOOKS

1. Modi P M and S M Seth, "Hydraulics and Fluid Mechanics", Standard Book House.
2. Bansal, R.K. "Fluid Mechanics," Lakshmi Publications Pvt., Ltd.

REFERENCES

1. Ojha C.S.P., R. Berndtsson and P. N. Chadramouli, "Fluid Mechanics and Machinery", Oxford University Press, 2010
2. Subramanya, K. "Theory and Applications of Fluid Mechanics", Tata McGraw Hill
3. Daugherty R.L., J.B. Franzini and E.J. Finnemore, "Fluid Mechanics with Engineering Applications", International Student Edition, Mc Graw Hill.
4. Munson, B.R., Okiishi, T.H., Huebsch, W.W. and Rothmayer, A.P., 2013. Fluid mechanics. Singapore: Wiley.

COURSE OUTCOMES

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

1. Understand the broad principles of fluid statics, kinematics and dynamics
2. Understand definitions of the basic terms used in fluid mechanics
3. Understand classifications of fluid flow
4. Apply the continuity, momentum and energy principles
5. Apply dimensional analysis

Mapping of COs with POs												
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓									✓	✓
CO2		✓	✓									
CO3				✓	✓		✓		✓			✓
CO4						✓	✓		✓		✓	
CO5						✓			✓	✓		

CZPC306	CONCRETE TECHNOLOGY	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES

- To develop systematic knowledge about the nature and basic properties of the ingredients of concrete.
- To familiarize testing procedures of fresh and hardened concrete.
- To introduce fundamentals and principles of mix design.

Unit - I

Portland cement – Definition – History – Composition – Hydration of Portland cement – Stiffening and Hardening of cement paste – Specification as per IS Code 269-1989 – Types of Portland cement – Physical and Chemical Properties of cement – Testing of cement.

Unit - II

Aggregates – Natural and Mineral aggregates – Characteristics of aggregates and their significance – Testing of aggregates – Importance of aggregates in concrete – Specifications as per IS Code 2386 (Part I to VIII) – 1963– Specifications as per IS Code 383-1970 – Water Testing – Specifications.

Unit - III

Concrete ingredients – Manufacturing process – Storing – Batching – Mixing – Transporting – Placing – Finishing – Curing – Properties of fresh concrete – Workability measurements – Testing methods – Segregation – Bleeding – Slump loss – Concrete at early age – Setting time – Concrete admixture and its types.

Unit - IV

Hardened concrete – Mechanical Properties and their significance – Testing methods as per IS Code 516-1959 – Compressive strength of concrete and its factors – Short term and long term properties – Drying shrinkage – Creep – Modulus of elasticity – Resistance to dimensional changes – Resistance to weather – Resistance to chemical attack – Durability of concrete.

Unit – V

Objectives of mix design – Concept of concrete mix proportioning – Methods of mix proportioning – IS Code 10262-2009 and ACI Committee 211.1.91 method – Fly ash based mix design – Effect of replacement materials in mix design.

TEXT BOOKS

1. Mehta, P.K. and Monteiro, P.J.M., “Concrete, Microstructure, Properties and Materials”, Indian Concrete Institute, 1997.
2. Shetty, M.S., “Concrete Technology”, S.Chand & Co., New Delhi, 2002.

REFERENCES

1. Neville, A.M., “Properties of Concrete”, Pitman Publishing Limited, London, 2011.
2. Gambhir, M.L., “Concrete Technology”, Tata McGraw Hill Co., New Delhi, 2004.
3. Neville, A.M. and Brooks J.J., “Concrete Technology”, Pearson Education, Indian Reprint, 2002.
4. Gupta, Y. O. "Concrete technology and good construction practices." New Age International Publishers, New Delhi(2013).

STANDARDS

1. IS: 269 – 1989, Specification for Ordinary Portland cement 33 Grade (Fourth Revision), 1998.
2. IS: 2386 (Part I to VIII) – 1963, Method of Tests for Aggregate for Concrete, Bureau of Indian Standards, New Delhi.
3. IS: 383 – 1970, Specification for Coarse and Fine Aggregates from Natural Sources for Concrete, Bureau of Indian Standards, New Delhi.
4. IS: 516 – 1959, Method of Tests for Strength of Concrete, Bureau of Indian Standards, New Delhi.
5. IS: 10262 – 2009, Recommended Guidelines for Concrete Mix Design, Bureau of Indian Standards, New Delhi.
6. ACI Committee 211.1,91 Standard Practice for Selecting Proportions for Normal, Heavy weight and Mass Concrete, ACI Manual of Concrete Practice Part 1, 1991, American Concrete Institute, Detroit.
7. SP 23:1982, Handbook on Concrete Mixes

CESP307	COMPUTER PRACTICAL-BUILDING DRAWINGS	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES

- To introduce the student to basic principles of Building drawing.
- To learn to draft plan, elevation and sectional views of buildings in accordance with development and control rules satisfying orientation and functional requirements as per National Building Code.
- To enable the students to develop manual and computer aided drafting skills for planning.

Exercises:

1. Conventional symbols.
2. Paneled and flush doors.
3. Paneled and glazed windows.
4. Lean to roof and small sheds.
5. Residential buildings with fully tiled roof with hips & valleys.
6. R.C.C. flat roofed single roomed building.
7. Residential building with single bedroom (load bearing structure).
8. Residential building with double bedroom (framed structure).
9. Residential building with R.C.C. roofed hips & valleys.
10. Residential double storied building with R.C.C. roof.
11. Library building with R.C.C. flat roof.
12. Primary health centre for rural areas with R.C.C. flat roof.
13. Single storied school building with R.C.C. flat roof.
14. Bank building with R.C.C. flat roof.
15. Mini shopping mall building.

TEXT BOOKS

1. Shah. M.G., Kal.C.M. and Patki. S.Y., “Building drawing with an integrated approach to Built Environment”, Fourth Edition, 1996.
2. Kaleem. S., Zaidi. A. and Suhail Siddiqui, “Drawing and Design of Residential and commercial buildings”, Standard Publications, 2001.

REFERENCES

1. Venugopal. K. and Praburaja. V., “ Building Drawing”, New Age International Publishers, 1996.
2. Rangwala. S.C., “Civil Engineering Drawing,”

3. Verma. B.P., “Civil Engineering Drawing and House planning”,
4. CloisE.Kicklighter., “Architecture, Residential Drawing and Design”, The Good Heart - Willcox Company Inc., 2000.
5. Donald E. Hepler and Paul I. Wallach., “Architecture, Drafting and Design”, Tata McGraw Hill Book Co., New Delhi, 1998.

COURSE OUTCOMES

At the end of the course students will be able to

1. Understand conventional symbols used in drawing.
2. Draft plan, elevation and sectional views of doors & windows, lean to roof and different types of buildings.
3. Understand the regulations as per National Building Code.
4. Identify the functional requirements and building rules.
5. Understand and usage of computer tool to draw a plan of various buildings

Mapping of COs with POs												
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓		✓		✓			✓			
CO2		✓			✓			✓			✓	✓
CO3			✓	✓			✓			✓		
CO4		✓			✓			✓			✓	
CO5			✓				✓			✓		✓

CECP308	FLUID MECHANICS LABORATORY	L	T	P	C
		-	-	3	1.5

COURSE OBJECTIVES

- To understand the practical methods for determination of co-efficient of discharge.
- To study characteristic features of pumps and turbines by carrying out experiments.
- To understand the significance and role of such utilities in their further course of study.

LIST OF EXPERIMENTS

1. Measurement of viscosity
2. Study of Pressure Measuring Devices
3. Stability of Floating Body
4. Hydrostatics Force on Flat Surfaces/Curved Surfaces
5. Verification of Bernoulli's Theorem
6. Venturimeter
7. Orifice meter
8. Impacts of jets
9. Flow Visualisation -Ideal Flow
10. Length of establishment of flow
11. Velocity distribution in pipes
12. Laminar Flow
 - i) Determination of Co-efficient of discharge of **Mouthpiece**
 - ii) Determination of Co-efficient of discharge of **Venturimeter**
 - iii) Determination of Co-efficient of Head loss due to **Sudden Change in Section**
 - iv) Determination of Co-efficient of Head loss due to **Friction in Pipes**
 - v) Determination of Co-efficient of discharge of **Rectangular Notch**
 - vi) Determination of Co-efficient of **Impact of Jet on Vanes**
 - vii) Determination of **Metacentric Height** of a floating vessel

REFERENCES

1. Subramanya K., "Flow in open channels", Tata McGraw Hill, New Delhi 2000.
2. Modi P.N. and Seth S.M., "Hydraulics and Fluid Mechanics", Standard Book House, New Delhi, 2002.

3. Nagaratnam, S., Fluid Machines and Systems, Tata McGraw Hill, 1989.
4. Aris, R. (1989). Vectors, tensors, and the basic equations of fluid mechanics. New York, USA: Dover Publications.

COURSE OUTCOMES

At the end of the course students will be able to

1. Determine the rate of flow using various experiments.
2. Study the various losses occurred in different sections
3. Compute forces exerted using impact of jet on different vanes.
4. Develop characteristics curves to determine the specific speed of pumps.
5. Develop characteristics curves to determine the specific speed of turbines.
- 6.

Mapping of COs with POs												
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓		✓					✓			
CO2		✓	✓			✓		✓				✓
CO3		✓	✓		✓					✓	✓	
CO4							✓	✓				
CO5	✓		✓			✓			✓			

CZCP309	CONSTRUCTION MATERIALS LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES

To facilitate the understanding of the behavior of construction materials such as

- Fine aggregates
- Coarse aggregate
- Concrete and bricks

Exercises

I. TEST ON FINE AGGREGATES

1. Grading of fine aggregates
2. Test for specific gravity and test for bulk density
3. Compacted and loose bulk density of fine aggregate

II. TEST ON COARSE AGGREGATE

1. Determination of impact value of coarse aggregate
2. Determination of elongation index
3. Determination of flakiness index
4. Determination of aggregate crushing value of coarse aggregate

III. TEST ON CONCRETE

1. Test for Slump
2. Test for Compaction factor
3. Test for Compressive strength - Cube & Cylinder
4. Test for Flexural strength

IV. TEST ON BRICKS AND BLOCKS

1. Test for compressive strength of bricks and blocks
2. Test for Water absorption of bricks and blocks
3. Determination of Efflorescence of bricks
4. Test on tiles

REFERENCES

1. Construction Materials Laboratory Manual, Anna University, Chennai-600 025.
2. IS 4031 (Part 1) – 1996 – Indian Standard Method for determination of fineness by drysieving.
3. IS 2386 (Part 1 to Part 6) – 1963 – Indian Standard methods for test for aggregate for concrete
4. IS 383 – 1970 Indian Standard specification for coarse and fine aggregates from natural sources for concrete.

COURSE OUTCOMES

The students will have the required knowledge in the area of

- Behaviour of construction materials
- Properties of construction materials
- Properties of construction elements
- Behaviour of fresh and hardened concrete
- Mechanical and durable properties of bricks and blocks

Mapping of COs with POs												
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓				✓			✓			✓
CO2		✓	✓	✓						✓	✓	
CO3					✓		✓		✓			✓
CO4	✓					✓			✓			
CO5						✓			✓		✓	

CEBS401	PROBABILITY & STATISTICS FOR CIVIL ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce the fundamentals of probability and statistics to civil engineering students in order to deal with uncertainty in civil engineering systems
- To emphasise the practical aspects of the use of these methods
- To identify the strength relationship between variables and using regression and correlation.

Unit –I : Data Description and Treatment & Fundamentals of Probability

Introduction – Decision making in Engineering – Types of uncertainty Data description and treatment – Classification of data – nominal, ordinal, interval and ratio scales – Graphical description of the data – histograms and Frequency diagrams – Descriptive measures: Central tendency measures, dispersion measures, percentiles, Box-and-Whisker plots – applications Fundamentals of Probability – Sample sets, sample Spaces and Events – basic operations – mathematics of probability – conditional probability – Baye’s theorem Random variables and their probability distributions – probability of discrete random variables – probability of continuous random variables – moments- applications

Unit –II: Probability Distributions for Discrete and Continuous Random Variables

Probability distributions for discrete random variables – Bernoulli’s, binomial, geometric and poisson distributions – applications

Probability distributions for continuous random variables – Uniform, normal, log normal, exponential and gamma distributions – statistical probability distributions – Students’ t, Chi-square and F – distributions – Extreme value distributions – Gumbel and Weibul distributions – applications

Unit – III: Fundamentals of Statistical Analysis and Hypothesis Testing

Fundamentals of statistical analysis – Estimation of parameters – Properties of estimators: bias, precision, , Mean Square Error (MSE) – Estimation of Moments – Method of moments, Method of Maximum likelihood – Sampling distributions of mean and variance – applications Hypothesis Testing: Hypothesis tests of means – Hypothesis tests of variance – Tests of distributions – applications

Unit – IV: Analysis of Variance, Confidence intervals and Sample size determination

Analysis of Variance – Test of population means- multiple comparisons in the ANOVA test: Duncan’s multiple range test, Scheffe’s test – Test of population variances – Randomized Block Design model – applications
Confidence intervals and Sample size determination – General procedure – confidence intervals for the mean, variance – sample size determination – applications

Unit – V : Correlation and Regression Analysis

Correlation analysis – graphical analysis – bivariate correlation – separation of variations – computation of correlation coefficient - applications
Introduction to regression – Zero-intercept model – principle of least squares – fitting linear bivariate model – SEE - applications
Multiple Regression analysis – calibration of multiple linear models - applications

TEXT BOOKS

1. Bilal M. Ayyub and Richard H. McCuen, 2003, “Probability, Statistics, and Reliability for Engineers and Scientists, Second Edition, Chapman & Hall/CRC.
2. Ravichandran L, “ Probability and statistics for engineers” 2000, WILEY-INDIA publishers.

REFERENCES

1. Holicky, Milan, 2013, Introduction to Probability and Statistics for Engineers, Springer-Verlag Berlin Heidelberg
2. Carlton, Matthew A., Devore, Jay L., 2017, With Applications In Engineering, Science, And Technology, Springer International Publishing
3. Devore, Jay L., Berk, Kenneth N., 2012, Modern Mathematical Statistics With Applications, Springer-Verlag New York.
4. Montgomery, D.C., Runger, G.C. And Hubele, N.F., 2011. Engineering Statistics. Wiley.

CZES402	INTRODUCTION TO SOLID MECHANICS	L	T	P	C
		2	0	0	2

COURSE OBJECTIVES

- To introduce to continuum mechanics and material modelling of engineering materials based on first energy principles
- To understand the strength, stiffness (deformation characteristics), and stability of the various members in a structural system.
- The behaviour of a member depends not only on the fundamental laws that govern The equilibrium of forces, but also on the mechanical characteristics of the material.

UNIT I Simple Stresses and Strains

Concept of stress and strain, St. Venant's principle, stress and strain diagram, Elasticity and plasticity – Types of stresses and strains, Hooke's law – stress – strain diagram for mild steel – Working stress – Factor of safety – Lateral strain, Poisson's ratio and volumetric strain – Elastic moduli and the relationship between them – Bars of varying section – composite bars – Temperature stresses. Strain Energy – Resilience – Gradual, sudden, impact and shock loadings – simple applications. Compound Stresses and Strains- Two dimensional system, stress at a point on a plane, principal stresses and principal planes, Mohr circle of stress, ellipse of stress and their applications. Two dimensional stress-strain system, principal strains and principal axis of strain, circle of strain and ellipse of strain - Relationship between elastic constants.

UNIT II Shear Force and Bending Moment

Bending moment and Shear Force Diagrams- Bending moment (BM) and shear force (SF) diagrams. BM and SF diagrams for cantilevers simply supported and fixed beams with or without overhangs. Calculation of maximum BM and SF and the point of contra flexure under concentrated loads, uniformly distributed loads over the whole span or part of span, combination of concentrated loads (two or three) and uniformly distributed loads, uniformly varying loads, application of moments.

UNIT III Flexural and Shear Stresses

Flexural stresses - Theory of simple bending – Assumptions – Derivation of bending equation: $M/I = f/y = E/R$ - Neutral axis – Determination of bending stresses – Section modulus of rectangular and circular sections (Solid and Hollow), I,T, Angle and Channel sections – Design of simple beam sections.

Shear Stresses- Derivation of formula – Shear stress distribution across various beam sections like rectangular, circular, triangular, I, T angle sections.

UNIT IV Slope and Deflection, Torsion and Springs

Slope and deflection- Relationship between moment, slope and deflection, Moment area method, Macaulay's method. Use of these methods to calculate slope and deflection for determinant beams.

Torsion - Derivation of torsion equation and its assumptions. Applications of the equation of the hollow and solid circular shafts, torsional rigidity, Combined torsion and bending of circular shafts, principal stress and maximum shear stresses under combined loading of bending and torsion.

Analysis of close-coiled-helical springs.

UNIT V Thin and Thick Cylinders

Thin Cylinders and Spheres- Derivation of formulae and calculations of hoop stress, longitudinal stress in a cylinder, and sphere subjected to internal pressures.

TEXT BOOKS

1. Sadhu Singh, "Strength of Materials", Khanna Publishers, New Delhi, 2000.
2. Vaidyanathan. R., Perumal.P. and Lingeswari.S., "Mechanics of Solids and Structures", Volume I, Scitech Publications Private Limited, Chennai, 2006.

REFERENCES

1. Timoshenko, S. and Young, D. H., “Elements of Strength of Materials”, DVNC, New York, USA.
2. Kazmi, S. M. A., “Solid Mechanics” TMH, Delhi, India.
3. Hibbeler, R. C. Mechanics of Materials. 6th ed. East Rutherford, NJ: Pearson Prentice Hall, 2004
4. Crandall, S. H., N. C. Dahl, and T. J. Lardner. An Introduction to the Mechanics of Solids. 2nd ed. New York, NY: McGraw Hill, 1979
5. Laboratory Manual of Testing Materials - William Kendrick Hall
6. Mechanics of Materials - Ferdinand P. Beer, E. Russel Jhonston Jr., John T. Dewolf – TMH 2002.
7. Strength of Materials by R. Subramanian, Oxford University Press, New Delhi.

COURSE OUTCOMES

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

1. Describe the concepts and principles, understand the theory of elasticity including strain/displacement and Hooke’s law relationships; and perform calculations, relative to the strength and stability of structures and mechanical components;
2. Define the characteristics and calculate the magnitude of combined stresses in individual members and complete structures; analyze solid mechanics problems using classical methods and energy methods;
3. Analyse various situations involving structural members subjected to combined stresses by application of Mohr’s circle of stress; locate the shear center of thin wall beams
4. Calculate the deflection at any point on a beam subjected to a combination of loads; solve for stresses and deflections of beams under unsymmetrical loading
5. Solve torsion problems in bars and thin walled members.

Mapping of COs with POs												
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓										
CO2		✓	✓								✓	✓
CO3					✓		✓		✓	✓		
CO4						✓			✓			
CO5						✓			✓			

CEPC403	SURVEYING-I	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce the principles of various surveying methods and survey instruments.
- To expose students to Levelling by several methods.
- To learn to handle survey instruments and Area and Volume computations.
- To solve problems and understand applications of surveying to civil engineering projects.

UNIT I Chain surveying

Surveying – Levelling – Classification – Division principle and uses of surveying – Fundamental of measurement – drawing to scale – symbols used in surveying – Linear measurement – Chain Surveying – accessories in chain surveying – triangulation by chain – technical terms used in chain surveying – Cross- staff – offset – measurement of area by chain traversing – error – obstacles in chain surveying – problems - field book – use.

UNIT II Compass surveying

Horizontal angles – Bearing – compass – prismatic – Meridian and its types – declination – Fore and back bearing – Whole Circle Bearing and Reduced Bearing – closed and open traverse – applications – area calculation – Local attraction and its correction – detection – methods – corrected bearing and angles – problems.

UNIT III Levelling

Levelling – MSL – Datum – Technical terms – level and its types – staffs and its types Temporary adjustment – principles of levelling – Reduction of levels – methods – HI/HC methods – Rise and fall method – missing data – problems.

UNIT IV Types of levelling and contour

Differential levelling – Fly levelling – application – reciprocal levelling – correction for curvature – refraction – gradient of a line – problems.

Contouring – types – characteristics – methods – interpolation – uses of contour maps.

UNIT V Areas and volumes

Computation of area – field notes – plan – mid-ordinate – Trapezoidal method – Simpson’s method – Computation of volume – methods – L/S, C/S – Earth work excavation – storage capacity of reservoir – Setting out buildings – positioning of structure – foundation setting out.

Project works: General requirements and specifications for Engineering project surveys,

Reconnaissance, Preliminary and Locations surveys for highway, railway and canals; Layout of culverts, canals, bridges and buildings.

TEXT BOOKS

1. Agor. R, “A text book on Advanced Surveying “, Khanna Publishers, 4th Edition, New Delhi, 2007.
2. Arora. K.R., “A text book on Surveying Volume I and II”, Standard Publishers, New Delhi, 2006.

REFERENCES

1. Punmia, B.C., Ashok K.Jain and Arun K.Jain, “Surveying Volume I & II”, Laxmi Publications, 2005.
2. Kanetkar, T.P. and Kulkarni, S.V., “Surveying and Levelling”, Pune Vidyarthi Griha Prakashan, 1988.
3. Rangwala.S.C, “Surveying and Levelling”, Charotar Publishing House, Gujarat, 2005.
4. Clark D., Plane and Geodetic Surveying, Vols. I and II, C.B.S. Publishers and Distributors, Delhi, Sixth Edition

COURSE OUTCOMES

At the end of the course students will be able to

1. Possess knowledge about chain surveying, compass surveying, plane table surveying and Levelling.
2. Gain knowledge about Survey Instruments, their care and adjustments.
3. Use all surveying equipments, prepare LS & CS, contour maps and carryout surveying works related to land and civil engineering projects.
4. Use the levelling concept to produce the contour maps
5. Compute the areas and volumes of earthwork

Mapping of COs with POs												
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓										
CO2		✓	✓					✓			✓	✓
CO3				✓	✓	✓			✓	✓		
CO4			✓	✓							✓	✓
CO5					✓	✓		✓		✓		

CEPC404	APPLIED HYDRAULIC ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce the students to various hydraulic engineering problems like open channel flows and their computations.
- To understand the methods of dimensional analysis.
- To impart knowledge on characteristics and working principles of hydraulic machines.

UNIT I

Types of flow in open channels – geometrical properties of channel sections – velocity distribution in a channel section – Chezy’s formula – Manning’s formula – Most economical sections of a channel – rectangular, trapezoidal, triangular and circular sections – uniform flow computations – specific energy and critical depth – critical flow and its computation.

UNIT II

Gradually varied flow – dynamic equation – classification of channel bottom slopes – classification of water surface profiles – characteristics of surface profiles – integration of the varied flow equation by the step method.

Hydraulic jump in rectangular channels – types of hydraulic jumps – surges in open channels – positive and negative surges.

UNIT III

Dimensions – Dimensional homogeneity – Methods of dimensional analysis – Rayleigh’s method – Buckingham’s π -method – use of dimensional analysis.

Model investigation – similitude – types of similarities – dimensionless numbers – Reynolds, Froude, Euler, Mach and Weber numbers – Model laws – types of models – application of dynamic similarity to specific model investigations – submerged objects and partially submerged objects.

UNIT IV

Impulse-momentum principle – dynamic force exerted by fluid jet on stationary flat plate: (a) plate normal to jet (b) inclined plate – force on moving flat plate – force on curved stationary plate – force on single moving curved plate – fluid jet on moving curved surface of a turbine blade – velocity diagrams for turbine blades – work done on tangential flow runner – jet propulsion – propulsion of ships – forces caused by flow round a pipe-bend – angular momentum equation – radial flow over turbine blade – work done by radial runner.

Different classification of turbines – Pelton turbine: main components and their functions – design of component parts of Pelton turbine – force, power and efficiency – Francis turbine: different types – main components – design of components – torque, power and efficiencies – Kaplan turbine: components – force, torque, power and efficiencies – governing of water turbines – selections of turbines.

UNIT V

Pumps – classification of pumps – working principle of single acting and double acting pumps – slip and coefficient of discharge – rate of delivery – velocity and acceleration of water – speed indicator diagrams – effect of bent delivery pipe on separation – air vessels – suction in pumps with air vessels – pressure in cylinder on delivery stroke with air vessels – maximum speed of pump with air vessel – power required to drive the pump fitted with air vessels. Comparison with reciprocating pumps – principle and operation – different classifications of centrifugal pumps – specific speed – layout, accessories and starting of centrifugal pumps – static head, manometric head and gross head – power – overall efficiency – loss of head in pipes and fittings – fundamental equations of centrifugal pumps – work done and manometric efficiency – minimum starting speed – priming of pumps – cavitation in pumps – NPSH – multi-stage pumps – deep well pumps.

TEXT BOOKS

1. Jagdish Lal, “Hydraulic machines”, Metropolitan Book Co. Pvt. Ltd. Reprint 2011.
2. Subramanya. K., “Flow in open channels”, Tata McGraw Hill, New Delhi 2000.

REFERENCES

1. Ven Te Chow, “Open Channel Hydraulics”, McGraw Hill, New York, 2009.
2. Mays. L. W., “Water Resources Engineering”, John Wiley and Sons (WSE), New York, 2005.
3. Jain. A.K., “Fluid Mechanics”, Khanna Publishers, New Delhi. 2010.
4. Srivastava. R., “Flow through open channels”, Oxford University Press, New Delhi, 2008.
5. Modi. P.N. and Seth. S.M., “Hydraulics and Fluid Mechanics”, Standard Book House, New Delhi, 2002.

COURSE OUTCOMES

At the end of the course students will be able to

1. Relate the theory and practice of problems in hydraulic engineering.
2. Apply knowledge of fluid mechanics in addressing open channel flow problems.

3. Solve problems in uniform, gradually varied and rapidly varied flows in steady state conditions.
4. Understand the working principle of pumps.
5. Understand the working principle of turbines.

Mapping of COs with POs												
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓			✓						
CO2			✓			✓		✓		✓		✓
CO3				✓				✓	✓		✓	
CO4		✓						✓				
CO5		✓	✓			✓						✓

CEPC405	GEOTECHNICAL ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To understand the nature, properties and behavioral response of soils is essential for a safe and stable design of foundations.
- To understand the behavior of soils as a supporting medium for structures.
- To develop knowledge required for successful structural engineering practice

+

UNIT I

Introduction–Types of soils, their formation and deposition, Definitions: soil mechanics, soil engineering, rock mechanics, geotechnical engineering. Scope of soil engineering. Comparison and difference between soil and rock. Basic Definitions and Relationships-Soil as three-phase system in terms of weight, volume, voids ratio, and porosity. Definitions: moisture content, UNIT weights, degree of saturation, voids ratio, porosity, specific gravity, mass specific gravity, etc. Relationship between volume weight, voids ratio- moisture content, UNIT weight- percent air voids, saturation- moisture content, moisture content- specific gravity etc. Determination of various parameters such as: Moisture content by oven dry method, pycnometer, sand bath method, torsional balance method, nuclear method, alcohol method and sensors. Specific gravity by density bottle method, pycnometer method, measuring flask method. UNIT weight by water displacement method, submerged weight method, core-cutter method, sand-replacement method.

UNIT II

Plasticity Characteristics of Soil - Introduction to definitions of: plasticity of soil, consistency limits-liquid limit, plastic limit, shrinkage limit, plasticity, liquidity and consistency indices, flow & toughness indices, definitions of activity and sensitivity. Determination of: liquid limit, plastic limit and shrinkage limit. Use of consistency limits. Classification of Soils-Introduction of soil classification: particle size classification, textural classification, unified soil classification system, Indian standard soil classification system. Identification: field identification of soils, general characteristics of soil in different groups. On completion of this module, the students must be able to:

UNIT III

Permeability of Soil - Darcy's law, validity of Darcy's law. Determination of coefficient of permeability: Laboratory method: constant-head method, falling-head method. Field method: pumping- in test, pumping- out test. Permeability aspects: permeability of stratified soils, factors affecting permeability of soil. Seepage Analysis- Introduction, stream and potential functions, characteristics of flow nets, graphical method to plot flow nets.

UNIT IV

Effective Stress Principle - Introduction, effective stress principle, nature of effective stress, effect of water table. Fluctuations of effective stress, effective stress in soils saturated by capillary action, seepage pressure, quick sand condition.

UNIT V

Shear Strength: Definition, different shear tests, interpretation of results, shear strength parameters & theory, shear strength of cohesive & non-cohesive soils.

TEXT BOOKS

1. Dr. Punmia.B.C, "Soil Mechanics & Foundation Engineering", Lakshmi Publications, 2005.
2. Moorthy, V.N.S., "Soil Mechanics & Foundation Engineering", CRS Press, 2002.

REFERENCES

1. Arora, "Soil Mechanics & Foundation Engineering", Standard Publishers Distributors, 2005.
2. SP 36 – 1 (1987): "Compendium of Indian Standards on Soil Engineering: Part-1 Laboratory Testing of Soils for Civil", Bureau of Indian Standards, New Delhi.
3. Shamsher Prakash, "Problems in Soil Mechanics", Asia Publishing House, 1972.
4. Terzaghi, K. and Peck.R.B, "Soil Mechanics in Engineering Practice", John Wiley & Sons, 1996.
5. Venkataramaiah. C, "Geotechnical Engineering", New Age International Publishers, 2006.

COURSE OUTCOMES

On completion of this module, the student must be able to:

1. Understand the different types of soil based on their formation mechanism and relationships of the soil
2. Understand the behaviour of soils based on their moisture contents and classify any soils based on their particle size distribution and index properties;

3. Understand the physical significance of effective stress and its relation with pore pressure.
4. Effect of capillary action and seepage flow direction on the effective stress at a point in the soil mass.
5. Understand the soil characters such as shear strength and stress distribution.

Mapping of COs with POs												
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓										✓
CO2		✓	✓									✓
CO3					✓		✓		✓	✓	✓	
CO4						✓			✓			
CO5						✓			✓			✓

CEPC406	STRENGTH OF MATERIALS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To know the method of finding slope and deflection of beams and trusses using energy theorems and to know the concept of analysing indeterminate beam.
- To estimate the load carrying capacity of columns, stresses due to unsymmetrical bending and various theories for failure of material.
- To analyse the members subjected to axial, bending, and torsional loads.

UNIT I Energy Principles

Strain energy and strain energy density – strain energy due to axial load (gradual, sudden and impact loadings) , shear, flexure and torsion – Castigliano’s theorems – Maxwell’s reciprocal theorem - Principle of virtual work – UNIT load method - Application of energy theorems for computing deflections in determinate beams, plane frames and plane trusses – lack of fit and temperature effects - Williot Mohr's Diagram.

UNIT II Indeterminate Beams

Concept of Analysis - Propped cantilever and fixed beams - fixed end moments and reactions – sinking and rotation of supports - Theorem of three moments – analysis of continuous beams – shear force and bending moment diagrams.

UNIT III Columns and Cylinders

Euler’s column theory – critical load for prismatic columns with different end conditions – Effective length – limitations - Rankine-Gordon formula - Eccentrically loaded columns – middle third rule - core of a section – Thin cylindrical and spherical shells – stresses and change in dimensions -Thick cylinders – Compound cylinders – shrinking on stresses.

UNIT IV State of Stress in Three Dimensions

Stress tensor at a point – Stress invariants - Determination of principal stresses and principal planes - Volumetric strain. Theories of failure: Maximum Principal stress theory – Maximum Principal strain theory – Maximum shear stress theory – Total Strain energy theory – Maximum distortion energy theory – Application problems.

UNIT V Advanced Topics

Unsymmetrical bending of beams of symmetrical and unsymmetrical sections – Shear Centre - curved beams – Winkler Bach formula – stresses in hooks.

TEXTBOOKS

1. Punmia B.C., Ashok Kumar Jain and Arun Kumar Jain, "Theory of Structures" (SMTS) Vol - II, Laxmi Publishing Pvt Ltd, New Delhi 2017.
2. Rattan.S.S., "Strength of Materials", Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2011.

REFERENCES

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. Singh. D.K., " Strength of Materials", Ane Books Pvt. Ltd., New Delhi, 2016
4. Egor P Popov, "Engineering Mechanics of Solids", 2nd edition, PHI Learning Pvt. Ltd., New Delhi, 2012.
5. Rajput R.K. "Strength of Materials (Mechanics of Solids)", S.Chand & company Ltd., New Delhi, 2015.
6. Basavarajiah and Mahadevapa, Strength of Materials, University press, Hyderabad, 2016

COURSE OUTCOMES

Students will be able to

1. Determine the strain energy and compute the deflection of determinate beams, frames and trusses using energy principles.
2. Analyze propped cantilever, fixed beams and continuous beams using theorem of three moment equation for external loadings and support settlements.
3. find the load carrying capacity of columns and stresses induced in columns and cylinders
4. Determine principal stresses and planes for an element in three dimensional state of stress and study various theories of failure
5. Determine the stresses due to Unsymmetrical bending of beams, locate the shear center, and find the stresses in curved beams

Mapping of COs with POs												
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓									✓	
CO2		✓	✓									✓
CO3					✓		✓	✓	✓		✓	
CO4						✓			✓			
CO5						✓			✓			

CECP407	SURVEYING LABORATORY-I	L	T	P	C
		-	-	3	1.5

COURSE OBJECTIVES

- To conduct experiments on Surveying and Levelling.
- Understand the principles of surveying.
- Know about compass surveying and plane table surveying.
- Understand the concepts of leveling and its applications.

List of experiments:

I Chain Surveying

1. Study of Chains and its accessories
2. Ranging a line and taking offsets
3. Cross-Staff Survey (Area of a traversing by Chain triangulation)

II Compass Surveying

1. Study of prismatic compass and its accessories
2. Determination of area of an extent by radiation methods
3. Open Traversing and Closed Traversing
4. Determination of distance of two inaccessible points

III Plane Table Surveying

1. Study of Plane Table Accessories
2. Determination of Area of an extent by radiation method
3. Determination of distances using Intersection method
4. Determination of a point using resection – Three point problem

IV Levelling

1. Study of Dumpy level and Telescopic Levelling staff
2. Simple Leveling – Determination of Reduced levels using Height of Collimation Method
3. Simple Leveling – Determination of Reduced levels using Rise & Fall Method
4. Differential Leveling – Determination of Reduced levels using Height of Collimation Method
5. Differential Leveling – Determination of Reduced levels using Rise & Fall Method

TEXT BOOKS

1. Agor. R, “A text book on Advanced Surveying”, Khanna Publishers, 4th Edition, New Delhi, 2007.
2. Arora. K.R., “A text book on Surveying Volume I and II”, Standard Publishers – New Delhi, 2006.

REFERENCES

1. Punmia, B.C., Ashok K. Jain and Arun K. Jain (2005). “Surveying Volume I & II” Laxmi Publications, 2002.?
2. Kanetkar, T.P. and Kulkarni, S.V., “Surveying and Levelling”, Pune Vidyarthi Griha Prakashan, 1988.
3. Heribert Kahmen and Wolfgang Faig, Surveying, Walter de Gruyter, 1995.
4. Clark D., Plane and Geodetic Surveying, Vols. I and II, C.B.S. Publishers and Distributors, Delhi, Sixth Edition

COURSE OUTCOMES

At the end of the course students will be able to

1. Possess knowledge on traversing using conventional surveying instruments.
2. Determine the area of the traverse.
3. Find out the inaccessible distance between the points.
4. Determine the difference in elevation and setting the MSL in the various locations.
5. Gain overall knowledge about Survey Instruments, their care and adjustments.

Mapping of COs with POs												
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓					✓				✓
CO2			✓					✓	✓	✓	✓	
CO3	✓		✓						✓	✓	✓	
CO4			✓			✓			✓		✓	
CO5	✓					✓			✓		✓	✓

CECP408	HYDRAULIC ENGINEERING LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES

Students will be able to

- Verify the principles studied in theory by performing the experiments
- Determine the rate of flow in various sections
- Determine the Various losses in pipes
- Determine the characteristics of rotodynamic and positive displacement pumps

LIST OF EXPERIMENTS

A. Flow Measurement

1. Calibration of Rotameter
2. Calibration of Venturimeter / Orificemeter
3. Bernoulli's Experiment

B. Losses in Pipes

4. Determination of friction factor in pipes
5. Determination of minor losses

C. PUMP

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/Kaplan turbine

E. Determination of Metacentric height

12. Determination of Metacentric height of floating bodies

REFERENCES

1. Sarbjit Singh. "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.

COURSE OUTCOMES

The students will be able to

1. Measure the flow in various sections.
2. Calculate the losses in pipes.
3. Develop the characteristics curves, thus specific speed can be arrived for the rotodynamic and positive displacement pumps .
4. Determine the performance characteristics of turbines
5. Develop the ship model by finding the metacentre.

Mapping of COs with POs												
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓							✓	✓	
CO2	✓			✓		✓			✓			✓
CO3			✓	✓		✓			✓		✓	
CO4			✓						✓		✓	✓
CO5	✓		✓						✓			✓

CECP409	STRENGTH OF MATERIALS LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES

- To provide practical training on testing of conventional engineering materials like steel and wood.
- To understand the stress – deformation response under axial and transverse loading conditions in the above tests.

List of Experiments:

1. Tension test on Steel rods
2. Double Shear test on Steel rods
3. Deflection test on Steel and Wooden beams
4. Compression test on wooden specimens
5. Impact test
6. Hardness tests on different metals
7. Test on helical springs
8. Torsion test

REFERENCES

1. Rajput. R.K, “Strength of Materials”, S.Chand & Co., September 2000.
2. Dr. Punmia. B.C, et al, “Strength of Materials and Theory of Structures - Vol.1”, Laxmi Publications, 2000.
3. Sadhu Singh, “Strength of Materials”, Khanna Publishers, New Delhi, 1988.
4. Ramamrutham. S, “Strength of Materials”, Dhanpat Rai sons, New Delhi, 1992.
5. Hiraskar. G.K, “Strength of Materials”, Khanna Publishers, New Delhi, 1984.

COURSE OUTCOMES

At the end of the course students will be able to

1. Understand the different material properties.
2. Gain knowledge between the stress and strain,
3. Develop the Young’s modulus and Poisson’s ratio
4. Understand the different loading conditions such as transverse and axial

5. Determine the hardness of different metals

Mapping of COs with POs												
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓			✓		✓				
CO2		✓		✓	✓			✓			✓	✓
CO3	✓			✓					✓			
CO4				✓		✓					✓	
CO5	✓		✓						✓			

CEPC501	WATER & WASTEWATER ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To make the students conversant with basic principles of wastewater engineering.
- To learn about collection, conveyance, characterization, treatment and disposal of domestic wastewater.
- To apply knowledge of mathematics, physics, chemistry, and microbiology to solve and analyze engineering problems related to water and wastewater collection, transport, quality and treatment.

UNIT I

Definitions: Sewage, Sewer and Sewerage – Collection & Conveyance of sewage – Classification of sewerage systems – Quantity of sewage – Fluctuation of sewage flow – Hydraulics of sewers – Self cleaning velocity – Shapes of sewers – Hydraulic design of sewers –Hydraulic design of storm water drains.

UNIT II

Materials for sewers – Joints in sewers – Laying & testing of sewers –Ventilation – Cleaning of sewers – Sewer appurtenances – Pumps – Types of pumps – Pumping station. Principles and layout of house drainage systems – Sanitary fixtures and fittings – one pipe systems and two pipe systems.

UNIT III

Characteristics and composition of wastewater – Analysis of physical, chemical and biological characteristics – B.O.D. and its significance – Population Equivalent – Domestic, Municipal and Industrial wastewater – Objectives of wastewater disposal – Methods of disposal – discharge into bodies of water – Hydraulic of sewers: Self cleansing velocity, Decomposition cycles.

UNIT IV

Septic tanks and disposal arrangements – Imhoff tank – Intermittent sand filters – Oxidation Pond & Ditch – Aerobic, Anaerobic and combinations of processes – Primary & Secondary Treatment – UNIT operation & processes in wastewater treatment: Screens, Grit chamber, Skimming tank and Settling tanks.

UNIT V

Aerobic Methods: Activated Sludge Process – Methods of Aeration – Trickling Filters – Anaerobic Methods: Digesters – Disinfection for reuse – Sludge treatment – Sludge digesters – Methods of sludge disposal – Operation and maintenance aspects.

TEXT BOOKS

1. Punmia, B.C., Ashok Kumar Jain and Arun Kumar Jain, “Environmental Engineering – 2: Wastewater Engineering”, Laxmi Publications, 2004.
2. Rangwala, S.C., “Water Supply and Sanitary Engineering”, Charotar Publication House Pvt. Ltd., Gujarat, 2013.

REFERENCES

1. Garg, S.K., “Sanitary Engineering”, Khanna Publishers, 2005.
2. Duggal, K.N., “Environmental Engineering”, S.Chand & Company, 2004.
3. Metcalf, L. and Eddy, H.P., “Wastewater Engineering, Collection, Treatment, and Disposal”, McGraw Hill Publishers, 4th Edition, 2003.
4. DAVIS & CORWELL, “ENVIRONMENTAL ENGINEERING”, MCGRAW-HILL SERIES IN CIVIL AND ENVIRONMENTAL ENGINEERING, 2012.
5. Gerald Kiely, “Environmental Engineering”, Tata McGraw-Hill Education, 2007.

COURSE OUTCOMES

At the end of the course students will be able to

1. Apply the main procedures and methods of treatment for wastewater.
2. Develop on Environmental Management Systems.
3. Explain different methodologies for collection and conveyance of wastewater.
4. Examine the physical, chemical and biological characteristics of wastewater.
5. Suggest suitable methods for treatment and disposal.
- 6.

Mapping of COs with POs												
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓					✓				✓
CO2		✓	✓						✓			
CO3				✓		✓	✓	✓			✓	
CO4			✓						✓			✓
CO5	✓					✓	✓		✓			✓

CEPC502	SURVEYING-II	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To understand the geodetic measurements and control survey methodology and its adjustments.
- To understand the use Astronomy, modern surveying such as Total Station and GPS
- To introduce the concepts of Engineering Project Survey.

UNIT I Theodolite Surveying

Theodolite – classification – part of transit theodolite – adjustments – measurement of horizontal and vertical angles – traversing – methods.

Trigonometric Survey – heights and distances – base accessible – base inaccessible – single and double plane methods – numerical problems.

UNIT II Tachometric Surveying

Tachometer principle – stadia – tangential – methods – derivation of formula – determination of constants – analytics lens – uses – staff held vertical – normal – line of sight inclined – numeric problems. Tacheometric contouring - Contouring Gradient – Uses of contour plan and map. Sub-tense bar – principle – use – problems.

UNIT III Curves and Triangulation

Curves – classification – necessity – elements of simple curve – calculation – degree of simple curve – setting out a simple curve – various methods – difficulties in setting out simple curve – numerical problems related to simple curves only.

Horizontal and vertical control – triangulation – principle – purpose – classification – field work – triangulation station marking – signals – intervisibility of stations – numeric problems – baseline measurements – methods.

UNIT IV Adjustment of errors and field astronomy

Errors in surveying – types – accidental errors – laws of weights – standard error – methods – methods of correlates – normal equation method – least squares.

Field astronomy – geometry of sphere – spherical triangle – solution – Napier's rule – various co-ordinate systems – shortest distance between two points – earth surface – Equation of time.

UNIT V Modern Surveying

Total station – Classification- working principles of electro-optical and microwave – Sources of Errors; Care and maintenance of Total station – Trilateration - applications.

GPS – Basic concepts – space, control and user segments – satellite configuration, signal structure – orbit determination and representation – Antispoofing and selective availability- hand held and geodetic receivers- Data processing and applications.

Engineering project surveys - requirements and specifications, various stages of survey work Setting out works- simple circular curves and Building Marking using Total stations – Area Computation Using GPS.

TEXT BOOKS

1. Agor, R., “A text book on Advanced Surveying “, Khanna Publishers, IV Edition, New Delhi, 2007.
2. Arora, K.R. “A text book on Surveying Volume I and II”, Standard Publishers New Delhi, 2006.

REFERENCES

1. Punmia, B.C., Ashok K. Jain and Arun K. Jain, “Surveying Volume I & II”, Laxmi Publications, 2005.
2. Kanetkar, T.P. and Kulkarni, S.V., “Surveying and Levelling”, Pune Vidyarthi Griha Prakashan, 1988.
3. Seeber G. Satellite Geodesy, Water De Gruyter, Berlin,1998.

COURSE OUTCOMES

At the end of the course students will be able to

1. Understand the principle and concept of conventional methods
2. Understand the advantages of electronic theodolite over conventional instruments
3. Gain a knowledge on field astronomical survey
4. Gain knowledge on the working principle of Total station and GPS, its components, signal structure and error sources.
5. Understand various GPS surveying methods and processing techniques used in GPS observations.

Mapping of COs with POs												
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓		✓	✓			✓				
CO2	✓					✓		✓		✓		✓
CO3								✓	✓	✓	✓	
CO4	✓		✓		✓						✓	
CO5					✓	✓			✓		✓	✓

CEPC503	STRUCTURAL ANALYSIS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To understand the background on principles of structural Analysis
- Students will be exposed to the theories and concepts of both concrete and steel design and analysis both at the element and system levels
- Hands-on design experience and skills will be gained and learned through problem sets

UNIT I

Analysis for moving loads - Influence Line Diagram (ILD) – Muller Breslau Principle for Influence Lines- ILD for simply supported beams- ILD for simple supported beams - ILD for single over hang beams - ILD for Propped cantilever beams with flexural hinges- simply simple beams with floor girders – Problems with single concentrated loads, two loads , train of loads, UDL longer than span and shorter than span - Maximum SFD and BMDs - ILD for Simple Plane truss problems. ILD for continuous beams and rigid frames (no problems) - Indirect model analysis for indeterminate structures

UNIT II

Arch action – Types of Arches - Analysis of Three-hinged and Two-hinged arches with effect of temperature change, rib shortening yielding of supports - Influence lines - Parabolic and Circular arches – Settlement effects

UNIT III

Cables and Suspension bridges – Cable Theorem – Cable under uniformly distributed loads (Cable Equation) - Horizontal thrust on the cable -Tension in the cable - Length of the cable - Effect of temperature on the cable - Stiffening girders in suspension bridges - Analysis of three-hinged and two-hinged stiffening girders with sample support level and

different support levels. ILD for moving loads over suspension bridges. Analysis Beams Curved in Plan – Analysis of Space trusses using tension coefficient method.

UNIT IV

Stiffness or Displacement equation - Member stiffness – Stiffness coefficients – Element and Global stiffness matrices - Transformations of stiffness matrices, load vectors and displacements vectors- Choice of displacements restricted to two - Analysis of continuous beams, frames, Analysis of simple plane truss, Problems with temperature changes, pre-strains and support settlements.

UNIT V

Approximate methods: substitute frame method for gravity loads, Portal and cantilever methods for lateral loads. Simple frames used for water tanks, industrial bends, bunkers and silos staging.

Plastic Bending Beams- Assumptions- Plastic moment of resistance - Plastic Modulus Shape and Load factors-Plastic hinge and mechanism - Plastic analysis of indeterminate beams and frames - Upper and lower bound theorems.

TEXT BOOKS

1. Punmia.B.C, et al, Theory of Structures - Vol.I & II, Lakshmi Publications, New Delhi, 2004.
2. Ramamrutham.S & Narayan.R, (1993) Theory of Structures, Dhanpat Rai and Sons, 1992.

REFERENCES

1. Bhavikatti.S.S, Structural Analysis,Vol. I and II, Vikas Publishing House Pvt.Ltd., New Delhi, 2008.
2. Reddy.C.S, Basic Structural Analysis, Tata McGraw Hill Book Co., New Delhi, 1996.
3. Wang.C.K, Intermediate Structural Analysis, Tata McGraw Hill Book Co., New Delhi, 1984.
4. Vazirani and Ratwani, Analysis of Structures - Vol.I.& II, Khanna Publishers, New Delhi,1996.
5. Devdas Menon, “Structural Analysis”, Narosa Publishing House, New Delhi, 2009.
6. Viadyanathan. R and Perumal. P, Comprehensive Structural Analysis Vol. I & II, Laxmi Publications, New Delhi, 2003.
7. Negi.L.Sand Jangid.R.S, Structural Analysis, Tata McGraw Hill Book Co., New Delhi, 2003.
8. Gambhir, M.L., Fundamentals of Structural Mechanics and Analysis, PHI Learning Pvt. Ltd., New Delhi, 2011.

COURSE OUTCOMES

At the end Students will be able to

1. Analyze the indeterminate structures like beams and frames with different end conditions.
2. Explain the concepts of influence lines and its effects.
3. Analyse the arch structures and suspension cable bridges.
4. Solve the structural problems with different methods of analysis.
5. Solve the problems on trusses and elements

Mapping of COs with POs												
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓			✓	✓		✓				✓
CO2		✓						✓				
CO3		✓	✓	✓			✓					✓
CO4				✓	✓				✓			✓
CO5			✓	✓					✓			

CEPC504	STRUCTURAL CONCRETE DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce the different types of philosophies related to design of basic structural elements such as slabs, beams and columns with reference to Indian standard code of practice.
- To learn to design footings.

UNIT I

Objectives of structural design – Structural systems – Structural analysis and Design – Use of Design codes and Hand books – Stress-strain curves of concrete and steel as per IS:456-2000 and ACI 318-14 – Modulus of Elasticity of concrete and steel – Design Philosophies – Working stress method – assumptions – Concept of transformed sections – modular ratio – permissible stresses – Stress block characteristics – Ultimate Load method – assumptions – Stress block characteristics – Limit State method – assumptions – Partial Safety factors for materials – Partial Safety factors for loads – Ultimate limit state – Serviceability limit state – Stress block characteristics – Moment of resistance expressions for balanced, under and over reinforced rectangular sections for rectangular beams using working stress method – Simple problems.

UNIT II

Flexure alone: Analysis and Design of Singly Reinforced rectangular beams – Flanged beams (T & L beams) – Doubly Reinforced rectangular beams – Limit state method – Roof beams, Cantilever beams – Lintel beams – Plinth beams – Reinforcement detailing as per SP 34: 1987 and IS 13920: 1993.

UNIT III

Shear – Shear stresses distribution in rectangular beams – Shear stress distribution in flanged beams – Shear stresses distribution in rectangular beams due to torsion – Design shear strength of concrete – Flexural shear code recommendations for rectangular and flanged sections – Problems. Bond – Factors affecting bond resistance as per IS 456:2000 – Check for development length – Check for crack width – Deflection computations – short term and long term. Design of one and two way concrete slabs – Circular slabs – Cantilever slabs – Dog legged staircase as per IS 456:2000 standards – Reinforcement detailing as per SP 34: 1987 and IS 13920: 1993.

UNIT IV

Design of Short and Slender Columns as per IS 456:2000 standards – Design of Columns subjected to axial compression and uni-axial bending – Columns subjected to axial compression and biaxial bending – Axial load verses moment Interaction charts – Reinforcement detailing as per SP 34: 1987 and IS 13920: 1993.

UNIT V

Design of Isolated rectangular footings with concentric column loads – Design of Isolated rectangular footings with eccentric column loads – Design of circular footings with concentric column loads – Design of combined footings – Reinforcement detailing as per SP 34: 1987 and IS 13920: 1993.

TEXT BOOKS

1. Unnikrishna Pillai .S and Devdas Menon, “Reinforced Concrete Design”, Tata McGraw Hill Publications, 1988.
2. Krishnaraju.N, “Advanced R.C.Design”, Tata McGraw Hill Publications, 1995.

REFERENCES

1. Shah. V.L and Karve, “Illustrated R.C. Design”, Structures Publications, 2010.
2. Ramamrutham. S and Narayan. R, “Design of R.C. Structures”, Dhanpat Rai & Sons, 1993.
3. Mallick. S.K and Gupta. A.P, “Reinforced Concrete”, Oxford I B H, 1987.
4. Punmia.B.C, et al, “R.C.Structures - Vol.I & II”, Laxmi Publications, 1992.

STANDARDS

1. IS 456: 2000, Code of Practice for Plain and Reinforced Concrete, Bureau of Indian Standards, New Delhi.
2. IS 13920: 1993, Code of Practice for Ductile Detailing of Reinforced Concrete Structures subjected to Seismic forces, Bureau of Indian Standards, New Delhi.
3. SP 34: 1987, Handbook on Concrete Reinforcement and Detailing, Bureau of Indian Standards, New Delhi.

COURSE OUTCOMES

At the end of the course students will be able to

1. Understand the behaviour of Reinforced Concrete and its design philosophies.
2. Gain knowledge about the rudimentary principles of designing reinforced concrete structural elements as per the existing codes.
3. Learn the stress distribution and flextural shear for different elements
4. Develop the knowledge on designing the columns
5. Learn the designing the footing for various structures

Mapping of COs with POs												
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		✓	✓		✓			✓				
CO2			✓	✓		✓	✓			✓		✓
CO3		✓				✓						✓
CO4		✓		✓							✓	
CO5		✓		✓					✓			✓

CECP507	ENVIRONMENTAL ENGINEERING LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES

- To quantify water and wastewater pollutants.
- To determine concentration of air pollutants.
- To analyze the characteristics of water, wastewater and ambient air.
- To study the growth of microorganisms and its quantification.

List of Experiments:

1. Determination of **Chloride** content in water sample.
2. Determination of **Dissolved Oxygen** in water sample.
3. Determination of **pH** in water sample.
4. Determination of **Hardness** in water sample.
5. Determination of **Total Solids (TDS, TSS)** in water sample.
6. Determination of **Turbidity** of various water and wastewater samples using Nephelo Turbidity meter.
7. Determination of **Electrical Conductivity** of water samples.
8. Determination of **Sulphates** in water sample.
9. Determination of **Chemical Oxygen Demand** for water sample.
10. Determination of **Bio-Chemical Oxygen Demand** for water sample.
11. Determination of **Residual Chlorine** in water sample.
12. Determination of **Chlorine Demand** for water sample.
13. Determination of optimum dosage of coagulant using Jar test apparatus.
14. Determination of infiltration capacity using Double ring infiltrometer.

REFERENCES

1. AWWA, WEF, “Standard Methods for the Examination of Water and Wastewater”, APHA, 2005.
2. Sawyer, C.N., McCarty, P.L., and Parkin, G.F., “Chemistry for Environmental Engineering”, 4th Edition, Tata McGraw-Hill Publishing Company Limited, 2000.
3. Environmental Engineering Laboratory Manual by B. Kotain & Dr. N. Kumarswamy – NEERJ Laboratory Manual.
4. Droste, R.L. and Gehr, R.L., 2018. Theory and practice of water and wastewater treatment. John Wiley & Sons

COURSE OUTCOMES

At the end of the course students will be able to:

1. Quantify the pollutant concentration in water, wastewater and ambient air.
2. Recommend the degree of treatment required for water and wastewater.
3. Analyze the survival conditions for the microorganisms and their growth rate.

4. Recommend the quantity of chemicals required for water treatment
5. Give suggestion and remedy for water treatment

Mapping of COs with POs												
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓		✓			✓			✓	✓	✓
CO2		✓	✓		✓	✓		✓	✓			
CO3						✓					✓	
CO4	✓						✓				✓	✓
CO5		✓				✓	✓					✓

CECP508	SURVEYING LABORATORY-II	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES

- To conduct experiments on Theodolite Surveying
- To determine the height of the object by Trigonometric leveling
- To find out the tacheometric constant
- To find out the horizontal distance and elevation by tacheometric surveying

List of Experiments:

I Theodolite and Trigonometric Surveying

1. Study of Transit theodolite, fundamentals of various accessories
2. Measurement of horizontal angle by repetition method
3. Measurement of horizontal angle by reiteration method
4. Trigonometric levelling – Single plane method – Base accessible
5. Trigonometric levelling – Single plane method – Base inaccessible
6. Trigonometric levelling – Double plane method – Base inaccessible
- 7.

II Tacheometric Surveying

1. Determination of tacheometric constants
2. Determination of Distance and elevation by stadia hair method
3. Determination of Distance and elevation by tangential method
4. Determination of Gradient of a line using stadia hair and tangential method
5. Determination of distances and heights using Subtense bar

III Demonstration

1. Study of GPS
2. Study of Total Station

IV Survey Camp (One Week Mandatory)

1. Longitudinal Section and Cross Section of Canal / Bund
2. Block Contouring
3. Hill Contouring
4. Setting out work – Simple Curves
5. Building Marking

TEXT BOOKS

1. Agor, R., “A text book on Advanced Surveying “, Khanna Publishers, 4th Edition, New Delhi, 2007.
2. Arora, K.R. “A text book on Surveying Volume I and II”, Standard Publishers New Delhi, 2006.

REFERENCES

1. Punmia, B.C., Ashok K. Jain and Arun K. Jain, “Surveying Volume I & II”, Laxmi Publications, 2005.
2. Kanetkar, T.P. and Kulkarni, S.V., “ Surveying and Levelling”, Pune Vidyarthi Griha Prakashan, 1988.
3. Heribert Kahmen and Wolfgang Faig, Surveying, Walter de Gruyter, 1995.
4. Clark D., Plane and Geodetic Surveying, Vols. I and II, C.B.S. Publishers and Distributors, Delhi, Sixth Edition

COURSE OUTCOMES

At the end of the course students will be able to

1. Possess the knowledge to find the horizontal and vertical angle by theodolite surveying
2. To find out the inaccessible distance by theodolite surveying
3. To find out the difference in elevation by tacheometric surveying
4. To find out the gradient between the points
5. Possesses the knowledge of GPS and Total Station
- 6.

Mapping of COs with POs												
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓		✓				✓	✓	✓	✓	✓
CO2			✓		✓	✓	✓	✓	✓			
CO3					✓		✓	✓	✓			
CO4			✓		✓					✓		
CO5		✓	✓		✓				✓			✓

CECP509	STRUCTURAL DESIGN & DETAILING LABORATORY-I	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES

- Train students to use latest software available to solve structural engineering problems.
- Learn documentations procedures.

List of Experiments:

- Plate 1. Draw cross section, longitudinal sections of Concrete Beams with reinforcement details as per SP 34: 1987, IS 13920: 1993.
- Singly and Doubly Reinforced Concrete Beams
 - Flanged beams: T and L shaped Reinforced Concrete Beams
 - Rectangular Continuous Beams
 - Lintel Beams with sunshade
 - Plinth Beams
 - One way and two way slabs.
 - Continuous slabs
- Plate 2. Draw cross section, longitudinal sections of Concrete staircase with reinforcement details as per SP 34: 1987, IS 13920: 1993.
- Dog legged staircase
- Plate 3. Draw cross section, longitudinal sections of Column with Footings and reinforcement details as per SP 34: 1987, IS 13920: 1993.
- Rectangular Column with Isolated Footings
 - Circular Column with Circular Isolated Footings
- Plate 4 & 5. Draw cross section, longitudinal sections and reinforcement details for the followings
- Strap footing
 - Raft foundation (IS: 2950 (Part I) -1981).
- Plate 6, 7 & 8. Draw cross section, longitudinal sections and reinforcement details as per IS: 2911 (Part 1/Sec 1) - 2010, IS 2911 (Part III): 1980 and SP 34: 1987.
- Pile with Pile cap (Two pile group)
 - Pile with Pile cap (Three pile group)
 - Pile with Pile cap (Four pile group)

Plate 9 & 10. Draw cross section, longitudinal sections and reinforcement details as per SP 34: 1987.

- a. Cantilever Type Retaining Wall
- b. Counter fort Type Retaining Wall

Plate 11. Analysis of Symmetrical and Un-Symmetrical Building Frames(Gravity, Wind and Earthquake Loads) using STADD PRO and Etabs Softwares

TEXTBOOKS

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

REFERENCES

1. Krishnamurthy D,Structural Design and Drawing VolI,IIandIII,CBS Publishers, 2010.
2. Shah V L and Veena Gore,Limit State Design of Steel Structures
3. IS800-2007,Structures Publications, 2009.
4. IS 456(2000) Indian Standard Plain and Reinforced Concrete-Code of Practice, Bureau of Indian Standards, New Delhi.
5. SP34 Handbook on Concrete Reinforcement and Detailing, Bureau of Indian Standards, New Delhi.
6. IS 800 (2007) Indian Standard General Construction In Steel—Code of Practice, Bureau of Indian Standards, New Delhi.
7. IS 875 Part 1 (2003) Code of Practice for Design Loads (Other Than Earthquake) for Buildings and Structures, Code of Practice-Dead Load, Bureau of Indian Standards, New Delhi.
8. IS 875 Part 2 (2003) Code of Practice for Design Loads (Other Than Earthquake) for Buildings and Structures, Code of Practice-Imposed Load, Bureau of Indian Standards, New Delhi.
9. IS 875 Part 3 (2003) Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures, Code of Practice-Wind Load, Bureau of Indian Standards, New Delhi.
10. IS 3370 Part 1 (2009) Indian Standard Concrete Structures for Storage of Liquids-Code of Practice—General Requirements, Code of Practice, Bureau of Indian Standards, New Delhi.
11. IS 3370 Part 2 (2009) Indian Standard Concrete Structures for Storage of Liquids-Code of Practice-Reinforced Concrete Structures, Code of Practice, Bureau of Indian Standards, New Delhi.
12. IS 3370—Part 4 (2008) Indian Standard Code of Practice for Concrete Structures for The Storage of Liquids-Design Tables, Code of Practice, Bureau of Indian Standards, New Delhi.

13. IS 804 (2008) Indian Standard Specification for Rectangular Pressed Steel Tanks, Code of Practice, Bureau of Indian Standards, New Delhi.
14. IS 805 (2006) Indian Standard Code of Practice for Use of Steel in Gravity Water Tanks, Code of Practice, Bureau of Indian Standards, New Delhi.
15. IRC 112-2011, Code of Practice for Concrete Road Bridges, The Indian Roads Congress, New Delhi.
16. IRC 6-2014, Standard Specifications and Code of Practice for Road Bridges Section: II- Loads and Stresses, The Indian Roads Congress, New Delhi.

COURSE OUTCOMES

At the end of the course the student will be able to

1. Design and draw reinforced concrete Cantilever and Counterfort Retaining Walls
2. Design and draw flat slab as per code provisions
3. Design and draw reinforced concrete and steel bridges
4. Design and draw reinforced concrete and steel water tanks
5. Design and detail the various steel trusses and cantry girders

Mapping of COs with POs												
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓					✓	✓		✓	✓
CO2				✓		✓	✓	✓	✓			
CO3		✓			✓		✓	✓	✓	✓		
CO4	✓		✓				✓			✓		
CO5		✓		✓	✓							

CEPC601	HIGHWAY ENGINEERING	L	T	P	C
		3	-	-	3

COURSE OBJECTIVES

- To enable students to differentiate between road pavement structures, to analyze road pavement structures, to differentiate between the different types of materials used and to design road pavements.
- Maintenance of highways as per IRC standards, specifications and methods.
- To give the students the satisfaction of producing for themselves a full road pavement design, they are taken through one of the available methods and they perform examples so they can see how the principles and their application come together in a design

UNIT I Highway Planning and Alignment

Significance of highway planning – Modal limitations towards sustainability - History of road development in India – factors influencing highway alignment – Soil suitability analysis - Road ecology - Engineering surveys for alignment, objectives, conventional and modern methods -Classification of highways – Locations and functions – Typical cross sections of Urban and Rural roads

UNIT II Geometric Design of Highways

Cross sectional elements - Sight distances – Horizontal curves, Super elevation, transition curves, widening at curves – Vertical curves - Gradients, Special consideration for hill roads - Hairpin bends – Lateral and vertical clearance at underpasses.

UNIT III Design of Flexible and Rigid Pavements

Pavement components and their role - Design principles -Design practice for flexible and rigid Pavements (IRC methods only) – Embankments- Problems in Flexible pavement design.

UNIT IV Highway Construction Materials and Practice

Highway construction materials, properties, testing methods – CBR Test for subgrade - tests on aggregate & bitumen – Test on Bituminous mixes-Construction practice including modern materials and methods, Bituminous and Concrete road construction, Polymer modified bitumen, Recycling, Different materials – Glass, Fiber, Plastic, Geo-Textiles, Geo-Membrane (problem not included) – Quality control measures - Highway drainage — Construction machineries.

UNIT V Evaluation and Maintenance of Pavements

Pavement distress in flexible and rigid pavements – Types of maintenance – Pavement Management Systems - Pavement evaluation, roughness, present serviceability index, skid resistance, structural evaluation, evaluation by deflection measurements – Strengthening of pavements –Highway Project formulation.

TEXTBOOKS:

1. Khanna.S. K., Justo.C.E.G and Veeraragavan A. "Highway Engineering", New Chand Publishers, 2014.
2. Kadiyali.L.R. "Principles and Practice of Highway Engineering", Khanna Technical Publications, 8th edition Delhi, 2013.

REFERENCES

1. Indian Road Congress (IRC), Guidelines for the Design of Flexible Pavements, (Third Revision), IRC: 37-2012
2. Indian Road Congress (IRC), Guidelines for the Design of Plain Jointed Rigid Pavements for Highways, (Third Revision), IRC: 58-2012
3. Yang H. Huang, "Pavement Analysis and Design", Pearson Education Inc, Ninth Impression, South Asia, 2012
4. Ian D. Walsh, "ICE manual of highway design and management", ICE Publishers, Ist Edition, USA, 2011
5. Fred L. Mannering, Scott S. Washburn and Walter P.Kilareski, "Principles of Highway Engineering and Traffic Analysis", Wiley India Pvt. Ltd., New Delhi, 2011
6. Garber and Hoel, "Principles of Traffic and Highway Engineering", CENGAGE Learning, New Delhi, 2010
7. O'Flaherty.C.A "Highways, Butterworth – Heinemann, Oxford, 2006
8. IRC-37–2012,The Indian roads Congress, Guidelines for the Design of Flexible Pavements, New Delhi

CEPC602	STRUCTURAL STEEL DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To design simple steel elements and the corresponding fastening systems are dealt with the course.
- To learn the design of steel structural elements along with advanced design concepts to enhance their design concepts with the relevant codal standards.

UNIT I

Introduction to Structural steel and their types- Advantages of structural steel- Design mythology- Limit State Design – Stress-strain curve of structural steels- Partial safety factors for loads and Materials – Deflection Limits. Bolted connections –shear capacity – Tension capacity – Bearing Capacity – Bolts subjected to combined shear and tension– Design of connections as per IS 800 – 2007 provisions. Welded connections – Butt joint – Lap joint – weld subjected to combination of normal and shear stress – combination of bearing bending and shear – Design of connections as per IS 800 – 2007 provisions.

Wind on Industrial steel Buildings - Design wind speed and pressure – Internal and external wind pressure coefficients from codes – Wind forces on members with height - Wind forces on Cladding, Louvers, hoarding structures, Microwave Towers – wind motion due to Vortex Shedding, dynamic response factor for along wind and across wind.

UNIT II

Tension members – Types – Design strength due to yielding of cross section – Rupture of critical section – Plates – Threaded rod single Angles – Other sections – Block shear – Bolted and welded connection of Tension members – Design of Tension members as per IS 800 – 2007 provisions.

Compression members – Effective lengths – Slenderness ratios – Imperfection factor – Stress reduction factor – Buckling class of cross sections – Design details – Column Bases Angle Struts – Laced Columns – Battened columns – Design of compression members as per IS 800 – 2007 provisions.

UNIT III

Industrial buildings – Types – Elements of an industrial building – Loads on industrial buildings – Roof trusses – Components of a roof truss – Loads on roofs – Analysis and Design of roof truss. Tubular Trusses, joint details, tubular scaffoldings. Analysis and design of hoarding structures under dead live and wind load conditions (SP 64 (2001)).

UNIT IV

Beams – Effective span of Beams – Design strength in Bending Torsional Buckling – Effective Length for simply supported beams – Shear – Beams of unsymmetrical sections – Plate girders – Elements of a plate girder Design of beams and plate girders as per IS 800 – 2007 provisions. Design of gantry girder – Braced industrial buildings – Un-braced industrial frames–Base plate with anchor bolt details - detailing as per IS standards

UNIT V

Plastic analysis and design – Advantages and disadvantages – Plastic bending of beams – Plastic neutral axis – Plastic modulus – Plastic moment of resistance – Shape factor – Load factor – Plastic hinge – Collapse mechanisms – Theorems of plastic analysis – Analysis and Design of beams and frames

Cold Form light gauge section- Type of cross section, Stiffened, multiple stiffened and un-stiffened element, Design of light gauge compression, tension and flexural members – Detailing as per IS: 802(Part 1 to part 3):1995

TEXT BOOKS

1. Duggal.S.K , Limit state Design of Steel Structures, Tata McGraw Hill Education Private Ltd,2000.
2. Sairam.K.S, Design Of Steel Structures, Pearson Publications, 2013.

REFERENCES

1. Shiyekar, Limit state Design of Steel Structures, Phi Learning Pvt Ltd,2010
2. Subramanian.N, Design of Steel Structures, Oxford University Press,2008

CECP607	HIGHWAY ENGINEERING LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES

- To learn the principles and procedures of testing of aggregates
- To learn the principles and procedures of testing of binding material.

LIST OF EXPERIMENTS

TEST ON AGGREGATES

- Sieve Analysis
- Elongation and Flakiness Index Test
- Deval Abrasion Test
- Impact Value Test
- Crushing Value Test

TEST ON BITUMEN

- Penetration Test
- Viscosity Test
- Softening Point Test
- Ductility Test
- Flash and Fire point

TESTS ON BITUMINOUS MIXES

- Marshall Stability and Flow Values

REFERENCES

1. Highway Materials and Pavement Testing, Nem Chand and Bros., Roorkee, Revised Fifth Edition, 2009
2. Methods for testing tar and bituminous materials, IS 1201–1978 to IS 1220– 1978, Bureau of Indian Standards
3. Methods of test for aggregates, IS 2386 – 1978, Bureau of Indian Standards
4. Mix Design Methods Asphalt Institute Manual Series No. 2, Sixth Edition,1997, Lexington, KY, USA.

COURSE OUTCOMES

At the end of the course students will be able to

1. Understand the properties and test procedures of aggregate, bituminous materials, composites and recycled waste products.
2. Know the different types of bituminous pavement construction and its principles
3. Learn the properties of various aggregate used as pavement materials through relevant tests.
4. Know the principles and procedures of testing Concrete.
5. Arive the stability value of bituminous mix.

Mapping of COs with POs												
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓						✓	✓			
CO2			✓		✓		✓	✓	✓		✓	✓
CO3		✓		✓		✓	✓	✓	✓	✓		
CO4			✓		✓						✓	
CO5			✓						✓		✓	✓

CECP608	STRUCTURAL DESIGN & DETAILING LABORATORY-II	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES

- To design simple steel elements and the corresponding fastening systems are dealt with the course.
- To learn the design of steel structural elements along with advanced design concepts to enhance their design concepts with the relevant codal standards.
 - Use of Software
 - CAD based Structural Drawing
 - Specifications & Drawings
 - For typical cases of Design of Foundation, Column, Beam
 - Special Structures

LIST OF EXPERIMENTS

1. Wind on Industrial steel Buildings - Wind forces on Cladding, Louvers, hoarding structures, Microwave Towers
2. Design details – Column Bases Angle Struts – Laced Columns – Battened columns
3. Design of compression members as per IS 800 – 2007 provisions.
4. Industrial buildings – Roof trusses — Analysis and Design of roof truss. Tubular Trusses, joint details, tubular scaffoldings.
5. Beams –Plate girders – Elements of a plate girder Design of beams and plate girders as per IS 800 – 2007 provisions.
6. Plastic analysis and design –Analysis and Design of beams and frames

TEXT BOOKS

1. Duggal.S.K , Limit state Design of Steel Structures, Tata McGraw Hill Education Private Ltd,2000.
2. Sairam.K.S, Design Of Steel Structures, Pearson Publications, 2013.

REFERENCE BOOKS

1. Shiyekar, Limit state Design of Steel Structures, Phi Learning Pvt Ltd,2010
2. Design of Steel Structures, Subramanian.N, Oxford University Press,2008

3. Design of Steel Structures Textbook, Bhavikatti.S.S, I.K. International Publishing House Pvt. Ltd, 2012.
4. Krishnamachar B.S. and AjithaSimha., “Design of Steel Structures”, Tata McGraw Hill Publishing Company Ltd., New Delhi,1985.
5. IS 800-2007, Code of Practice for use of Structural Steel in General Building Construction, Bureau of Indian Standards, New Delhi.

STANDARDS

1. IS: 800 – 2007, General Construction in Steel – Code of Practice.
2. IS: 875(Part3): Wind Loads on Buildings and Structures.Teaching resource materials by INSDAG, Kolkatta.
3. IS: 802(Part 1 to part 3):1995 Code of practice for use of cold formed light gauge steel structural members in general building construction.
4. IS: 806- 1968 Code of practice for use of steel tubes in general building construction.
5. IS: 4014- 1967(Part I and II) Code of practice for steel tubular scaffolding.
6. SP: 6 (2) - 1962 Steel beams and plate girders.
7. SP: 6 (5) - 1980 Structural use of light gauge steel.
8. IS codes for Aluminium Structures, IS:3908, 3909, 3921, 5384, 6445, 6476, 6475, 6449, 8147, Bureau of Indian Standards.
9. SP 64 (2001): Explanatory Handbook on Indian Standard Code of Practice for Design Loads (other than Earthquake).

COURSE OUTCOMES

At the end of the course students will be able to

1. Get the fundamental knowledge about the different types of Steel sections available in the market.
2. Know the design of Connections and Different types of members and Various load conditions
3. To design the Industrial steel Buildings
4. To design the Compression and tension members
5. To design the various types of beams

Mapping of COs with POs												
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓		✓				✓	✓			
CO2			✓		✓		✓	✓	✓		✓	
CO3		✓				✓	✓	✓	✓	✓		✓
CO4		✓	✓						✓		✓	
CO5		✓	✓						✓		✓	

ETHS701	PROFESSIONAL PRACTICES, LAW & ETHICS	L	T	P	C
		2	0	0	2

COURSE OBJECTIVES

- To enable the students to create an awareness on Engineering Ethics and Human Values.
- To instill Moral and Social Values and Loyalty and to appreciate the rights of others.

UNIT I Human Values

Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management

UNIT II Engineering Ethics

Senses of ‘Engineering Ethics’ – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg’s theory – Gilligan’s theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories.

UNIT III Engineering as Social Experimentation

Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.

UNIT IV Safety, Responsibilities and Rights

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.

UNIT V Global Issues

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership –Code of Conduct – Corporate Social Responsibility.

TEXT BOOKS

1. Mike W. Martin and Roland Schinzinger, “Ethics in Engineering”, Tata McGraw Hill, New Delhi, 2003.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, “Engineering Ethics”, Prentice Hall of India, New Delhi, 2004 .

REFERENCES

1. Charles B. Fleddermann, “Engineering Ethics”, Pearson Prentice Hall, New Jersey, 2004.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, “Engineering Ethics – Concepts and Cases”, Cengage Learning, 2009.
3. John R Boatright, “Ethics and the Conduct of Business”, Pearson Education, New Delhi, 2003
4. Edmund G Seebauer and Robert L Barry, “Fundamentals of Ethics for Scientists and Engineers”, Oxford University Press, Oxford, 2001.
5. Laura P. Hartman and Joe Desjardins, “Business Ethics: Decision Making for Personal Integrity and Social Responsibility” Mc Graw Hill education, India Pvt. Ltd.,New Delhi, 2013.
6. World CommUNITY Service Centre, ‘ Value Education’, Vethathiri publications, Erode, 2011

COURSE OUTCOMES

Upon completion of the course, the student shall be able to

1. Apply ethics in society,
2. Discuss the ethical issues related to engineering
3. Realize the responsibilities and rights in the society.
4. Realize the safety and risk in engineering.
5. Understand the global issues in ethics.

Mapping of COs with POs												
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓						✓	✓		✓	✓
CO2			✓		✓	✓	✓	✓	✓			
CO3				✓			✓	✓	✓	✓	✓	
CO4							✓	✓			✓	
CO5							✓	✓			✓	

CEPC702	PLANNING & COST EVALUATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To equip the students with current practices in cost and material estimates.
- To identify the methods adopted for different structural components.
- To impart knowledge on valuation practices necessary to make the student a complete civil engineer.
- To learn the tender procedure.

UNIT-I

Introduction – Philosophy – Purpose – Types of estimates – UNITS of Measurements – Simple Problems in Approximate method of Estimates – Specifications – necessity – Type of Specifications – Writing Technical Specifications for Earth work excavation, PCC, Brick work, RCC, Plastering, Flooring, DPC, Painting, White washing.

UNIT-II

Detailed estimates – Types – Estimate for Compound Wall – Simple Load Bearing and framed structures – Septic Tank – Water Sump – Estimates for Bituminous and Cement Concrete Roads – Retaining walls–culverts (Additional Practice in class room using computer softwares).

UNIT-III

Purpose – Requirements – Schedule of Rates and Standard Data Book –Observed Data – Market Rates –Standard Data for Man Hours and Machineries for Common Civil Works – Rate Analysis for different items of construction work – Mortar – Concrete – Brick and R.R Masonry – Plastering works – Pointing – DPC works – Canals and Roads – Preparation of Abstract(Additional Practice in class room using computer softwares)–Analysis of Rates for item work asked, the data recording labour, Rights of material and Rates of labour.

UNIT-IV

Introduction – Types of Tenders – TTA Act 2000 – Drafting Model Tender Notice – Tender documents – Tender Procedure – E-Tendering – Digital signature certificates – Reverse actions – Contracts – Types of Contracts– Formation of contracts – Construction of Contract documents – Essentials of Contract conditions– Introduction to Arbitration and legal Requirements.

UNIT-V

Introduction – Necessity – Types of Valuations – Introduction to Important terms like Market value, Scrap value, Guideline value, Earning value, Monopoly value, Distress value, Capital gain, free hold and Lease hold properties, Gift tax, Capitalized value, Depreciation– Valuations for Lands and Buildings – Fixation of Rent.

TEXT BOOKS

1. Dutta B.N., “Estimating and Costing in Civil Engineering”, S.Dutta& Company, Lucknow, 2005.
2. Chakraborti M., “Estimating and Costing Specifications in Civil Engineering”, Kolkatta.

REFERENCE BOOKS

1. Rangwala S.C., “Elements of Estimating and Costing in Civil Engineering”, Charotar Publishing House, India.
2. Kohli D.D. and Kohli R.C., “A Text Book of Estimating and Costing” (Civil).
3. Banerjee D.N., “Principles and Practices of Valuation”, Eastern Law House, V Edition, 1998.
4. Vazirani, V.N. and Chandola S.P., “Estimating and Costing”, Khanna Publishers, New Delhi.
5. Rangwala S.C., “Valuations of Real Properties”
6. Kanagasabapathy B., “Practical Valuations”
7. “Hand book of Consolidated Data – 8/2000, Volume I”, TNPWD.
8. “TamilNadu Transparencies in Tender Act, 2000”.

COURSE OUTCOMES

Upon completion of the course, the student shall be able to

1. Know the different types of rough estimates.
2. Know the different methods of detailed estimates.
3. Work out the rate for different construction works.
4. Understand the procedure of tenders and contract acts.
5. Gain the knowledge of valuation on lands and buildings.

Mapping of COs with POs												
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓		✓							✓	✓	
CO2		✓	✓			✓	✓	✓				
CO3		✓	✓					✓		✓		
CO4					✓							
CO5						✓	✓	✓				

CECP706	PLANNING & COST EVALUATION LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES

- To equip the students with current practices in cost and material estimates in the field.
- To estimate the quantity of materials for different structural components .
- To impart knowledge on hands on practice with valuation practices necessary to make the student a complete civil engineer.

EXERCISE

1. Quantity Estimation of different materials used in the following structures
Residential Buildings
Pipeline Projects
Industrial Infrastructures
Road works
2. Use of Software for Quantity Surveying
3. Use of Expert Systems for Cost Evaluation
4. Case Studies on E-Tender and Global Tender

COURSE OUTCOMES

Upon completion of the course, the student shall be able to

1. Know the different methods of detailed estimates.
2. Work out the rate for different construction works.
3. Understand the procedure of tenders and contract acts.
4. Gain the knowledge of valuation on lands and buildings.
5. Have a practice of quantity estimation and valuation on site.

Mapping of COs with POs												
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓		✓				✓	✓	✓	✓	
CO2			✓		✓		✓	✓	✓			
CO3						✓	✓	✓	✓			✓
CO4						✓		✓	✓		✓	
CO5						✓		✓	✓		✓	

CEST707	SEMINAR/INDUSTRIAL TRAINING/SWACHH PRACTICAL	L	T	P	C
		0	TR	S	2
			1	2	

COURSE OBJECTIVES

- To expose students to the 'real' working environment and get acquainted with the organization structure, business operations and administrative functions.
- To have hands-on experience in the students' related field so that they can relate and reinforce what has been taught at the university.
- To promote cooperation and to develop synergetic collaboration between industry and the university in promoting a knowledgeable society.
- To set the stage for future recruitment by potential employers

COURSE OUTCOMES

Upon completion of the course, the student shall be able to

1. Demonstrate the ability to identify, formulate and solve engineering problems.
2. Demonstrate the skills to use modern engineering tools, software's and equipment to analyze problems.
3. Demonstrate the knowledge of professional and ethical responsibilities.
4. Understand the impact of engineering solutions on the society and also will be aware of contemporary issues.
5. Develop confidence for self education and ability for life-long learning

Mapping of COs with POs												
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓			✓		✓	✓		✓	
CO2					✓		✓	✓	✓	✓		✓
CO3							✓	✓	✓			
CO4						✓	✓	✓				
CO5								✓		✓		✓

CEPV803	PROJECT WORK AND VIVA-VOCE	L	T	P	C
		0	PR	S	10
			6	4	

COURSE OBJECTIVES

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same.
- To train the students in preparing project reports and to face reviews and viva voce examination.

COURSE OUTCOMES

1. On Completion of the project work students will be in a position to take up any challenging practical problems and find solution by formulating proper methodology
2. Carrying out any experimental works on construction planning, water resource planning & management and environmental aspects
3. Understand the modelling, analysis and design concepts related to civil engineering applications.

Mapping of COs with POs												
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓						✓			
CO2				✓	✓	✓			✓	✓	✓	
CO3						✓	✓	✓		✓	✓	

PROFESSIONAL ELECTIVES

CEPESCN	INTEGRATED WATER RESOURCES MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce the students to the interdisciplinary analysis of water and conceptual design of intervention strategies.
- To develop a knowledge-base on capacity building on IWRM.
- To develop the ability among students to synthesis data and technical concepts for application in Integrated Water Resources Management.

UNIT I IWRM Framework

Definition – Objectives – Principles - Evolution of IWRM - IWRM relevance in water resources management – Paradigm shift : Processes and prospective outcomes

UNIT II Contextualizing IWRM

UN formulations - SDG goals - IWRM in Global, Regional and Local water partnership – Institutional transformation - Bureaucratic reforms - Inclusive development

UNIT III Emerging Issues in Water Management

Emerging Issues -- Drinking water management in the context of climate change - IWRM and irrigation - Flood – Drought – Pollution – Linkages between water, health and poverty

UNIT IV IWRM and Water Resources Development in India

Rural Development - Ecological sustainability- -Watershed development and conservation - Ecosystem regeneration – Wastewater reuse - Sustainable livelihood - Food security

UNITV Aspects of Integrated Development

Capacity building - Conceptual framework of IWRM – Problems and policy issues - Solutions for effective integrated water management - Case studies

TEXT BOOKS

1. Mollinga P. *et al.* “Integrated Water Resources Management”, Water in South Asia Volume I, Sage Publications, 2006.
2. Sithamparanathan, Rangasamy, A., and Arunachalam, N., “Ecosystem Principles and Sustainable Agriculture”, Scitech Publications (India) Pvt.Lt, Chennai, 1999.

REFERENCES

1. Cech Thomas V., Principles of Water Resources: History, Development, Management and Policy. John Wiley and Sons Inc., New York. 2003.
2. Murthy, J.V.S., “Watershed Management in India”, Wiley Eastern Ltd., New York, 1995.
3. Dalte, S.J.C., “Soil Conservation and Land Management”, International Book Distribution, India, 1986.
4. Mollinga .P. “ Integrated Water Resources Management”, Water in South Asia Volume I, Sage Publications, 2006.

COURSE OUTCOMES

The students will be able to

1. Understand objectives, principles and evolution of integrated water resources management.
2. Have an idea of contextualizing IWRM
3. Gain knowledge in emerging issues in water management, flood, drought, pollution and poverty.
4. Understand the water resources development in India and wastewater reuse.
5. Gain knowledge on integrated development of water management.

Mapping of COs with POs												
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓		✓		✓		✓	
CO2			✓	✓		✓		✓		✓	✓	✓
CO3		✓		✓		✓	✓				✓	
CO4						✓			✓		✓	
CO5	✓					✓			✓		✓	

CEPESCN	IRRIGATION ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To impart knowledge about utilization of water for Irrigation and idea about irrigation system.
- The student is exposed to different phases in irrigation practices and Planning and management of irrigation.
- Student will be imparted required knowledge on Irrigation storage and distribution canal system and Irrigation management.

UNIT I Crop Water Requirement

Need and classification of irrigation- historical development and merits and demerits of irrigation-types of crops-crop season-duty, delta and base period- consumptive use of crops-estimation of Evapotranspiration using experimental and theoretical methods

UNIT II Irrigation Methods

Tank irrigation – Well irrigation – Irrigation methods: Surface and Sub-Surface and Micro Irrigation – design of drip and sprinkler irrigation – ridge and furrow irrigation-Irrigation scheduling – Water distribution system- Irrigation efficiencies.

UNIT III Diversion and Impounding Structures

Types of Impounding structures - Gravity dam – Forces on a dam -Design of Gravity dams; Earth dams, Arch dams- Diversion Head works - Weirs and Barrages

UNIT IV Canal Irrigation

Canal regulations – direct sluice - Canal drop – Cross drainage works-Canal outlets – Design of prismatic canal-canal alignments-Canal lining - Kennedy's and Lacey's Regime theory-Design of unlined canal

UNIT V Water Management in Irrigation

Modernization techniques- Rehabilitation – Optimization of water use-Minimizing water losses- On farm development works-Participatory irrigation management- Water resources associations- Changing paradigms in water management-Performance evaluation-Economic aspects of irrigation

TEXTBOOKS

1. Dilip Kumar Majumdar, "Irrigation Water Management", Prentice-Hall of India, New Delhi, 2008.
2. Garg S. K., "Irrigation Engineering and Hydraulic structures", Khanna Publishers, 23rd Revised Edition, New Delhi, 2009

REFERENCES

2. Punmia B.C., et. al; Irrigation and water power Engineering, Laxmi Publications, 16th Edition, New Delhi, 2009
3. Duggal, K.N. and Soni, J.P., "Elements of Water Resources Engineering", New Age International Publishers, 2005
3. Linsley R.K. and Franzini J.B, "Water Resources Engineering", McGraw-Hill Inc, 2000
4. Chaturvedi M.C., "Water Resources Systems Planning and Management", Tata McGraw-Hill Inc., New Delhi, 1997.

COURSE OUTCOMES

Students will be able to

1. Have knowledge and skills on crop water requirements.
2. Understand the methods and management of irrigation.
3. Gain knowledge on types of Impounding structures
4. Understand methods of irrigation including canal irrigation.
5. Get knowledge on water management on optimization of water use.

Mapping of COs with POs												
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓			✓	✓	✓	✓	✓	
CO2			✓	✓	✓	✓					✓	✓
CO3	✓					✓					✓	
CO4		✓					✓				✓	
CO5			✓			✓	✓				✓	

CEPESCN	PRE FABRICATED STRUCTURES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

1. To impart knowledge to students on modular construction, industrialized construction.
2. To learn to design prefabricated elements and their construction methods.
3. To gain Knowledge on construction methods using prefabricated elements.

UNIT I

Need for prefabrication – Principles – Materials – Modular coordination – Modules/UNITs – Standardization of Systems – Production – Transportation – Erection Equipments – Erection Techniques.

UNIT II

Structural Systems: Skeletal Frame System – Large Panel System – Cell System. Systems for Lateral Load Resistance: Low-rise Portals and Frames – Multi-Storied Frames – Wall System. Roof and Floor Systems: Roof System – Floor System. Precast Concrete Components: Beams – Columns – Roof UNITs – Floor UNITs – Wall UNITs – Foundation UNITs – UNITs for Miscellaneous Applications.

UNIT III

Introduction – Materials – Loads: Dead Load – Live Load – Wind Load – Seismic Load – Equivalent Seismic Load Method – Response Spectrum Method – Time History – Abnormal Loads – Fire Resistance. Load Factor: Load Combinations. Analysis of Precast Frames: Skeletal Frames – Inverted U Shaped Frame – L Shaped Frame – H-Shaped Frame. Analysis of Frames with Stability Elements: Shear Walls to Resist Lateral Loads – Details of Typical Example Building – Seismic Parameters of Analysis – Modelling and Analysis. Analysis of Voided Slab Floor Elements: Method of Analysis – Analysis of Typical Voided Slab using Grillage Analogy – Calculation of Member Properties – Loading – Longitudinal Analysis – Transverse Analysis.

UNIT IV

Design Consideration: Moment Resistance of Slabs - Moment Resistance of Rectangular Beams - Moment Resistance of T Beams - Moment Resistance of Inverted T Beams - Moment Resistance of L Beams – Axial Load Capacities of Short and Slender Columns. Joints and Connections in Precast Buildings: Introduction – Scope – Details of Connections: Column to Foundation Connections – Wall to Foundation Connection – Beam to Column Connection – Column to Column Connection – Floor to Beam Connection – Wall Panel to Wall Panel Connection. Tolerances. Connection Materials – Mechanical Couplers – Dowels – Welded Head Studs – Bolted and Threaded Connections – Inserts – Expansion Inserts – Bearing Pads – Connecting Elements – Other Load Transfer Materials.

UNIT V

Production, Handling and Erection of Precast Elements: Production, Planning and Set up. Types of Precast Concrete Products: Foundations – Structural Elements. Moulds – Column Mould – Beam Mould – Wall Mould – Slab Mould – Other Moulds. Mould Tolerances, Production, Demoulding Techniques, Concrete and Vibrations, Precast Concrete Products Tolerances, Curing and Storage, Transportation, Handling Equipments for Precast Components, Handling Devices for Lifting, Erection Schemes and Supports, Other Accessories for Erection Works, Safety, Installation of Precast Element: Installation of vertical Members – Installation of Beams – Installation of Slabs – Installation of Special element. Common Defects and Acceptance Criteria: Hollow Core Slabs-Pre-stressed Planks/Slabs - RCC Products – Non- Conforming Products – Quality Assessment.

TEXT BOOKS

1. Indian Concrete Institute (ICI), “Handbook on Precast Concrete for Buildings”, 1st Edition, 2016.
2. Gerostiza, C. Z., Hendrikson, C. and Rehat, D. R., “Knowledge based process planning for construction and manufacturing”, Academic Press Inc., 1994.

REFERENCES

1. CBRI, “Building materials and components”, India, 1990.
2. Konecz, T., “Manual of precast concrete construction”, Vol. I, II and III, Bauverlag, GMBH, 1976.
3. Society for the studies in the use of precast concrete, “Structural design manual”, Precast concrete connection details, Netherland Betor Verlag, 2009.
4. Glover.C.W.,” Structural Precast Concrete” , Asia Publishing House, Bombay, 1967.

COURSE OUTCOMES

At the end of the course, students will be able to

1. Realize the need for prefabrication in construction.
2. Design some of the prefabricated elements
3. Understand the construction techniques involved in building framed structures.
4. Insist on Quality in precast construction.
5. Understand the production, Handling and Erection of Precast Elements

Mapping of COs with POs												
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		✓	✓	✓	✓			✓			✓	✓
CO2	✓	✓	✓	✓		✓	✓	✓				
CO3			✓	✓		✓		✓		✓		✓
CO4	✓						✓		✓		✓	✓
CO5	✓		✓	✓					✓		✓	

CEPESCN	TRAFFIC ENGINEERING & MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To give an overview of traffic engineering characteristics, traffic control and design.
- To understand the techniques of traffic survey and traffic regulation.
- To expose students to traffic management and traffic safety with integrated approach in traffic planning.
- To learn the environmental impact of traffic.

UNIT I Introduction to Traffic Engineering

Introduction - Objectives and scope of traffic engineering - Components of road traffic: vehicle, driver and road - Road user and vehicle characteristics and their effect on road traffic - Fundamentals of Traffic Flow – Urban Traffic problems in India and Sustainable approach.

UNIT II Traffic Surveys

Traffic Surveys – Speed, journey time and delay surveys – Vehicles Volume Survey including non- motorized transports – Methods and interpretation – Origin Destination Survey – Methods and presentation – Parking Survey – Accident analyses -Methods, interpretation and presentation – Statistical applications in traffic studies and traffic forecasting – Level of service – Concept, applications and significance.

UNIT III Geometric Design of Traffic Engineering

Control of traffic movements through time sharing and space sharing concepts - Intersection Design – channelization – Rotary intersection design – Signal design – Coordination of signals – Grade separation – Traffic signs including VMS and road markings – Significant roles of traffic control personnel – Bus stop location and bus bay design – Road lighting – Regulations on vehicles – drivers and traffic.

UNIT IV Traffic Studies

Concept and significance of traffic safety - Road accidents – Causes, effect, prevention, and cost – Road traffic accidents scenario in India - Engineering measures of traffic safety– Traffic and environment hazards – Air and Noise Pollution, causes, abatement measures – Promotion and integration of public transportation – Promotion of non-motorized transport.

UNIT V Traffic Management System Application

Nature of traffic problems in cities – Area Traffic Management System – Traffic System Management (TSM) with IRC standards – Traffic Regulatory Measures – Travel Demand Management (TDM) – Direct and indirect methods – Congestion and parking pricing – All segregation methods – Coordination among different agencies – Intelligent Transportation Systems: applications in traffic management and control.

TEXTBOOKS

1. Kadiyali.L.R. , “Traffic Engineering and Transport Planning”, Khanna Publishers, Delhi, 2013
2. Indian Roads Congress (IRC) Specifications: “Guidelines and Special Publications on Traffic Planning and Management”

REFERENCES

1. Pignataro.L., “Traffic Engineering - Theory and Practice”, John Wiley, 1973
2. Salter. R.I and Hounsell.N.B., “ Highway Traffic Analysis and Design”, Macmillan Press Limited, 1996.
3. Fred L. Mannering, Scott S. Washburn and Walter P.Kilareski, “Principles of Highway Engineering and Traffic Analysis”, Wiley India Private Limited, New Delhi, 2011.
4. Garber and Hoel, “Principles of Traffic and Highway Engineering”, Cengage Learning, New Delhi, 2010
5. SP: 43-1994, “Guidelines on Low-cost Traffic Management Techniques for Urban Areas”, IRC Specifications, 1994.
6. Institute of Transportation Engineers, “Transportation and Traffic Engineering Hand Book”, Prentice Hall, 1982
7. John E. Tyworth, “Traffic Management Planning - Operations and Control”, Addison Wesley Publishing Company, 1997.
8. Hobbs.F.D. , “Traffic Planning and Engineering”, University of Birmingham, Peragamon Press Limited, 2005.
9. Taylor.M.A.P. and Young.W., “Traffic Analysis – New Technology and New Solutions”, Hargreen Publishing Company, 1998.

COURSE OUTCOMES

At the end of the course students will be able to

1. Understand the concepts of traffic engineering and its characteristics.
2. Perform traffic studies.
3. Explain traffic control and design.
4. Realize the importance of traffic management.
5. Identify the specification of traffic facilities.

Mapping of COs with POs												
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓									
CO2		✓	✓	✓		✓				✓		✓
CO3		✓	✓			✓		✓				
CO4					✓	✓		✓	✓		✓	
CO5	✓							✓			✓	

CEPESCN	ADVANCED CONSTRUCTION TECHNIQUES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To Demonstrate the major changes that have occurred in the representation and construction of buildings between the modern and pre-modern eras
- To study and understand the latest construction techniques applied to engineering construction for sub structures, super structures and special structures .
- To learn about rehabilitation and strengthening techniques and demolition techniques.

UNIT I

Box jacking - Pipe jacking - Under water construction of diaphragm walls and basement - Tunneling techniques - Piling techniques - Driving well and caisson - sinking cofferdam - cable anchoring and grouting - Driving diaphragm walls, Sheet piles - Laying operations for built up offshore system - Shoring for deep cutting - Large reservoir construction - well points - Dewatering for underground open excavation.

UNIT II

Vacuum dewatering of concrete flooring – Concrete paving technology – Techniques of construction for continuous concreting operation in tall buildings of various shapes and varying sections – Erection techniques of tall structures, Large span structures – launching techniques for heavy decks – in-situ pre-stressing in high rise structures, Post tensioning of slab- aerial transporting – Handling and erecting lightweight components on tall structures.

UNIT III

Erection of lattice towers - Rigging of transmission line structures – Construction sequence in cooling towers, Silos, chimney, sky scrapers - Bow string bridges, Cable stayed bridges – Launching and pushing of box decks – Construction of jetties and break water structures – Construction sequence and methods in domes – Support structure for heavy equipment and machinery in heavy industries – Erection of articulated structures and space decks.

UNIT IV

Seismic retrofitting - Strengthening of beams - Strengthening of columns - Strengthening of slab - Strengthening of masonry wall, Protection methods of structures, Mud jacking and grouting for foundation – Micro piling and underpinning for strengthening floor and shallow profile - Sub grade water proofing, Soil Stabilization techniques.

UNIT V

Demolition Techniques, Demolition by Machines, Demolition by Explosives(implosion), Advanced techniques using Robotic Machines, Demolition Sequence, Dismantling Techniques, Safety precautions in Demolition and Dismantling.

TEXT BOOKS

1. Jerry Irvine, “Advanced Construction Techniques”, CA Rocketr, 1984.
2. Patrick Powers. J., “Construction Dewatering: New Methods and Applications”, John Wiley & Sons, 1992.

REFERENCES

1. Peter H. Emmons, “Concrete repair and maintenance illustrated”, Galgotia Publications Pvt. Ltd., 2001.
2. Robertwade Brown, “Practical foundation engineering hand book”, McGraw Hill Publications, 1995.
3. Sankar, S.K. and Saraswati, S., “Construction Technology”, Oxford University Press, New Delhi, 2008.
4. Jha.J & Sinha S.K., “Building Construction” Khanna Publishers.

COURSE OUTCOMES

At the end of the course students will be able to

1. Know the modern construction techniques to be used in the construction of buildings and special structures
2. Understand rehabilitation and strengthening techniques and demolition.
3. Aware of safety precautions in Demolition and Dismantling.
4. Gain a knowledge on retrofitting of structural elements and sub grade water proofing and soil stabilization
5. Understand the demolition techniques by using advanced demolition machines and explosion.

Mapping of COs with POs												
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓		✓		✓	✓	✓			✓
CO2					✓			✓		✓	✓	
CO3		✓		✓			✓	✓		✓	✓	✓
CO4			✓			✓			✓		✓	
CO5					✓	✓	✓				✓	

CEPESCN	MEMBRANE TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- Necessity and advantages of Membrane technology in place of conventional systems for water and wastewater treatment
- Membrane Types, Proprietary data and Expert systems for planning and designing of Membrane based treatment plants
- Operation and maintenance of membrane based plants.

UNIT-I

Solids removal suspended solids and dissolved solids – organic, inorganic and inert solids – membrane processes – principle and theory – materials of membranes – proprietary products – selectivity modules – concentration polarization – membrane fouling and cleaning – applications.

UNIT-II

Mechanism of membrane transport – RO/UF transport – solution diffusion model – dual sorption model – free volume theory – pore flow model – resistance model - boundary layer film model – Membrane modules; flat cartridge, spiral wound, tubular hollow fibre – Design equations – Expert systems of proprietary products.

UNIT- III

Membrane preparation techniques – isotropic membranes anisotropic membranes metal membranes, ceramic membranes liquid membranes and biomembranes.

UNIT-IV

Hierarchy of Membranes- Landscape of Membrane-MF UF, NF and RO – Proprietary products- specific applications and limitations – Applications.

UNIT-V

Engineering aspects of membranes; Hybrid membrane techniques; membrane reactor, membrane distillation membrane extraction and osmotic distillation – Design equations – Applications.

TEXT BOOKS

1. Mihir K. Purkait, Randeep Singh “Membrane technology in separation science” 1st edition, CRC Press.
2. Richard W.Naker, Membrane Technology and Applications. John Wiley and Sons, 2004

REFERENCES

1. Christie J. Geankoplis,, Transport Process and UNIT Operations, 3rdEdn., Prentice Hall of India Pvt. Ltd.
2. Sun, Tak, Hwang and Karl Kammermayer, Membranes in separations, John Wiley and Sons, New York.
3. Richard W.Naker, Membrane Technology and Applications. John Wiley and Sons, 2004
4. Separation Process Principles by J.D. Seader and Ernest J.Henley, John John Wiley and Sons, 2000.
5. Coulson J.M and Richardson, Chemical Engineering – Particle Technology and Separation Process Vol.2 th edition. Asian Books Pvt. Ltd. New Delhi 1998.
6. Warren L.McCabe, Julian Smith and Peter Harriot, UNIT Operations of Chemical Engineering, th edition. 2004.
7. Judson King .C Separation Process, McGraw Hill Inc., 1980.
8. Hoffman E.J, Membrane separations Technology Single stage, multi stage and Differential permeation, Gulf Professional Publishing.

COURSE OUTCOMES

At the end of the course students will be able to

1. Understand the principles of different membrane manufacturing methods.
2. Ability to know which materials are most suitable for membrane separation/purification of various liquid streams depending on the liquid composition and selected process parameters such as temperature and pressure.
3. Gain knowledge of membrane capabilities and constraints in the aspects of Engineering.
4. Develop skills to choose appropriate membrane process for a specific application.
5. Understand the principles and application of reverse osmosis microfiltration and ultra filtration.
- 6.

Mapping of COs with POs												
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓			✓	✓		✓	✓	✓	✓	✓	✓
CO2	✓			✓	✓							✓
CO3	✓			✓				✓		✓	✓	✓
CO4	✓	✓	✓					✓	✓			
CO5	✓	✓				✓				✓	✓	✓

CEPESCN	CONSTRUCTION PLANNING & MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce the practices of various stages of construction.
- To learn elements of management, project planning and cost analysis.
- To acquire knowledge on PERT and CPM.

UNIT I

Introduction – Classification of Construction work – Stages in Construction – Construction Team – Resources for construction – Objectives and Functions of Construction Management and its Applications.

UNIT II

Types of organisation – principles – site organization – Scrutiny of site documents – Job layout – principles of storing materials – Organisation of labour – Construction labour – Organization of PWD and related departments – Functions – Method of executing work – Miscellaneous Topics.

UNIT III

Project planning – Contract Planning, Scheduling and Control – Material Handling – Constructional practices – Contract – types of contract – contract document – specification – important conditions of contract – tender and tender document – Deposits by the contractor – Arbitration – Negotiation – M.Book – Muster roll – stores – Lab components: Introduction to Microsoft projects and Primavera – Preparation of schedule for a project by using Microsoft projects and Primavera.

UNIT IV

Project management – Bar charts and Milestone charts – Network methods – PERT – CPM – Comparison of PERT and CPM – Cost and Time optimization – development and elements of network – Activity time – estimate events times – concept of floats – critical activities and critical path – Cost analysis – direct and indirect cost– normal and crash duration– cost slope – cost optimisation – updating – resources smoothing – resources levelling.

UNIT V

Construction quality – inspection, quality control and quality assurance – total quality management and their techniques – cost of quality – ISO standards – audit – evaluation of safety – accident causation theories – foundation of a major injury – health and safety act and regulations – cost of accidents – principles of safety – safety and health management systems.

TEXT BOOKS

1. Harpal Singh, "Construction Management and Accounts", Tata McGraw Hill Publishing Company Ltd., New Delhi, 2007.
2. Vazirani, V.N. and Chandola, S.P., "Construction Management and Accounts", Khanna Publishers, New Delhi, 2011.

REFERENCES

1. Subramanya, K., "Construction Management", Tata McGraw Hill Publishing Company Ltd., New Delhi, 1989.
2. Punmia, B.C. and Khandelwal, K.K., "Project Planning and Control with PERT and CPM", Laxmi Publications (P) Ltd., New Delhi, 2009.
3. Sharma, S.C., "Construction Engineering and Management", Khanna Publishers, New Delhi, 2008.
4. Murugesan .G, "Total Quality Management", Laxmi Publications, New Delhi, 2013.
5. CADD Centre Manual, "Project planning and management by using MS Project", CADD Centre Training Services Pvt. Ltd., 2010.
6. CADD Centre Manual, "Primavera Training Manual", CADD Centre Training Services Pvt. Ltd., 2010.

COURSE OUTCOMES

At the end of the course students will be able to

1. Develop the ability to influence project design and to manage pre-construction activities.
2. Understand method of control of project schedule, cost, quality and risks.
3. Realize ethics of project management.
4. Acquire knowledge on Tenders and related procedures.
5. Recognize the significance of safety and health management.

Mapping of COs with POs												
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						✓					✓	✓
CO2	✓	✓					✓	✓				
CO3		✓		✓		✓	✓	✓				
CO4			✓				✓	✓		✓		
CO5					✓			✓	✓	✓		✓

CEPESCN	INDUSTRIAL WASTEWATER ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To make the students conversant with basic principles of wastewater engineering.
- To impart knowledge on sources and characteristics of various industrial wastes and strategies for its prevention and control
- To learn about collection, conveyance, characterization, treatment and disposal of domestic wastewater.

UNIT I

Definitions: Sewage, Sewer and Sewerage – Collection & Conveyance of sewage – Classification of sewerage systems – Quantity of sewage – Fluctuation of sewage flow – Hydraulics of sewers – Self cleaning velocity – Shapes of sewers – Hydraulic design of sewers –Hydraulic design of storm water drains.

UNIT II

Materials for sewers – Joints in sewers – Laying & testing of sewers –Ventilation – Cleaning of sewers – Sewer appurtenances – Pumps – Types of pumps – Pumping station. Principles and layout of house drainage systems – Sanitary fixtures and fittings – one pipe systems and two pipe systems.

UNIT III

Characteristics and composition of wastewater – Analysis of physical, chemical and biological characteristics – B.O.D. and its significance – Population Equivalent – Domestic, Municipal and Industrial wastewater – Objectives of wastewater disposal – Methods of disposal – discharge into bodies of water – Hydraulic of sewers: Self cleansing velocity, Decomposition cycles.

UNIT IV

Septic tanks and disposal arrangements – Imhoff tank – Intermittent sand filters – Oxidation Pond & Ditch – Aerobic, Anaerobic and combinations of processes – Primary & Secondary Treatment – UNIT operation & processes in wastewater treatment: Screens, Grit chamber, Skimming tank and Settling tanks.

UNIT V

Aerobic Methods: Activated Sludge Process – Methods of Aeration – Trickling Filters –Anaerobic Methods: Digesters – Disinfection for reuse – Sludge treatment – Sludge digesters – Methods of sludge disposal – Operation and maintenance aspects.

TEXT BOOKS

1. Punmia, B.C., Ashok Kumar Jain and Arun Kumar Jain, “Environmental Engineering – Wastewater Engineering”, Laxmi Publications, 2004.
2. Rangwala, S.C., “Water Supply and Sanitary Engineering”, Charotar Publication House Pvt. Ltd., Gujarat, 2013.

REFERENCES

- 1.Garg, S.K., “Sanitary Engineering”, Khanna Publishers, 2005.
- 2.Duggal, K.N., “Environmental Engineering”, S.Chand & Company, 2004.
- 3.Metcalf, L. and Eddy, H.P., “Wastewater Engineering, Collection, Treatment, and Disposal”, McGraw Hill Publishers, 4th Edition, 2003.
- 4.DAVIS & CORWELL, “ENVIRONMENTAL ENGINEERING”, MCGRAW-HILL SERIES IN CIVIL AND ENVIRONMENTAL ENGINEERING, 2012.
- 5.Gerald Kiely, “Environmental Engineering”, Tata McGraw-Hill Education, 2007.

COURSE OUTCOMES

At the end of the course students will be able to

1. Apply the main procedures and methods of treatment for wastewater.
2. Develop on Environmental Management Systems.
3. Explain different methodologies for collection and conveyance of wastewater.
4. Examine the physical, chemical and biological characteristics of wastewater.
5. Suggest suitable methods for treatment and disposal.

Mapping of COs with POs												
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓					✓				✓
CO2		✓	✓		✓				✓	✓		
CO3				✓		✓		✓				
CO4			✓		✓				✓		✓	
CO5		✓		✓		✓				✓		✓

CEPESCN	REMOTE SENSING & GIS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce the basic concepts of remote sensing.
- To learn the fundamentals of photogrammetric and image interpretation.
- To understand the techniques involved in cartography and GPS.
- To impart knowledge on applications of RS and GIS in resource mapping.

UNIT I

Definition of RS and its components – Electromagnetic spectrum – wavelength regions important to remote sensing – Wave theory, Particle theory, Stefan-Boltzman and Wein’s Displacement Law – Atmospheric scattering, absorption – Atmospheric windows – spectral signature concepts – typical spectral reflective characteristics of water, vegetation and soil – types of platforms – orbit types – Sun-synchronous and Geosynchronous – Passive and Active RS – Parameters of Sensors.

UNIT II

Types of data products – types of image interpretation – basic elements of image interpretation – visual interpretation keys – Digital Image Processing – Pre-processing – image enhancement techniques – image classification – Supervised and Unsupervised.

UNIT III

Maps – Definitions – Map coordinate systems – Map projections – types of map projections – Fundamentals of GPS – components of GPS – GPS data collection methods – application of GPS – GIS definition – basic components of GIS – standard GIS software – Data type – Spatial and non-spatial (attribute) data – measurement scales – Types of files – Data Base Management Systems (DBMS) types.

UNIT IV

IS Data models – vector and raster data – Raster data compression – data input by digitization and scanning – GIS data errors and remedial measures – attribute data analysis – integrated data analysis.

UNIT V

Modeling in GIS: Highway alignment studies – Land Information System – Change Detection – Land use/ Land cover mapping – Watershed management – Water quality mapping – surface and groundwater resources mapping.

TEXT BOOKS

1. Lillesand, T.M., Kiefer, R.W. and Chipman, J.W., "Remote Sensing and Image Interpretation", John Wiley and Sons (Asia) Private Limited, New York, 2007
2. Kang-tsung Chang, "Introduction to Geographical Information System", Tata McGraw-Hill Edition, 2009

REFERENCES

1. Basudeb Bhatta, "Remote Sensing and GIS", Second Edition, Oxford University Press, 2011.
2. Agarwal, C.S. and Garg, P.K., "Remote Sensing in Natural Resources Monitoring and Management", Wheeler Publishing Company, 2000.
3. Peter A. Burrough and Rachael A. McDonnell, "Principles of Geographical Information systems for land resource assessment", Clarendon Press, Oxford University Press, 2004.
4. Anji Reddy, M., "Textbook of Remote Sensing and Geographical Information System", 2nd Edition, BS Publications, Hyderabad, 2001.
5. Ian Heywood, Sarah Cornelius, Steve Carver and Srinivasa Raju, "An Introduction to Geographical Information Systems", Pearson Education, 2nd Edition, 2007.
6. Wolf Paul, "Elements of Photogrammetry", McGraw-Hill Edition, New Delhi, 1998.
7. Clarke Parks and Crane, "Geographical Information Systems and Environmental Modelling", Prentice Hall of India, 2005.

COURSE OUTCOMES

At the end of the course students will be able to

1. Identify the concepts and characteristics of Remote Sensing.
2. Acquire knowledge of appropriate map projection and coordinate systems.
3. Understand GIS, its structure, quality and standards.
4. Get exposure to several applications of RS and GIS in the various fields of Civil engineering especially resource mapping.
5. Apply GIS and LIS techniques to highway alignment, watershed management, Water quality mapping and surface & groundwater resources.

Mapping of COs with POs												
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓				✓						
CO2		✓	✓		✓			✓			✓	✓
CO3				✓		✓		✓				
CO4				✓				✓		✓		
CO5				✓	✓	✓	✓				✓	

CEPESCN	TRANSPORTATION ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To give an overview of Transportation engineering with respect to the development, planning and design.
- To impart knowledge on transportation economics and the public transportation system
- To expose students to the basics of global view of transportation system and intelligent system

UNIT I Introduction to transportation engineering

History and development - Transportation system, Major disciplines and other important disciplines - Role of transportation in society - Economic role, Social role, Political role, Environmental role- Factors affecting transportation – Human factor, Vehicle factor, Road user and Road factors.

UNIT II Transportation Planning

Introduction, System approach and Stages – Transportation surveys – Zoning and types of surveys – Trip generation and trip distribution – Modal split, Evaluation techniques and Land use transport models – Lowry derivative models - Quick response techniques - Transportation planning for small and medium sized cities.

UNIT III Transportation Economics

Introductory Concepts – Economic evaluation of transportation plans – Need, Cost and benefits of transportation projects and Methods; Benefit-cost ratio, First year rate of return, Net present value and internal rate of return – Vehicle operating cost – Value of travel time – Accidents cost - Economics of traffic congestion - Financing of road projects - methods – Private Public Partnership (PPP) - Toll collection - Economic viability of Design-Build-Operate-Transfer Schemes

UNIT IV Public Transportation Systems

Public Transport: Definitions, modes of public transport and comparison - road, rail, rapid transit systems - Design of Facilities: Design of bus stops, design of terminals – Promotion of public transport –Present difficulties in urban traffic condition

UNIT V Intelligent Transportation Systems

Introduction to Intelligent Transportation Systems (ITS) –Telecommunications in ITS - ITS functional areas –ITS User Needs and Services Automated Highway Systems - Global ITS Programs – Logistics in transportation

TEXT BOOKS

1. Kadiyali.L.R., “Traffic Engineering and Transport Planning”, Khanna Publishers, New Delhi, 2013
2. Khanna.S.K. and Justo. C.E.G., “Highway Engineering”, NemChand & Brothers, Roorkee, 2005

REFERENCES

1. Bindra.S.P., “Basic Highway Engineering”, Dhanpat Rai & Sons, New Delhi, 1977
2. Vazirani. V.N. and Chandola.S.P., “Transportation Engineering Volume I & II”, Khanna Publishers, New Delhi, 2000
3. Kadiyali. L. R. and Lal. N. B., “Principles and Practices of Highway Engineering”, Khanna Publishers, New Delhi, 2008.
4. Paul K Wright and Karen K. Dixon, “Highway Engineering”, Replica Press Limited, Kundli, Seventh Edition. Indian Roads Congress (IRC) Specifications, “Guidelines and Special Publications on Traffic Planning and Management”, 1994
5. Papacostas. C.S. and Prevedouros. P.D., “Transportation Engineering & Planning”, Prentice Hall of India, Third Edition, 2001
6. Rao. G.V., “Principles of Transportation and Highway Engineering”, TataMcGraw Hill Company, 2004
7. Chakraborty and Das, “Principles of Transportation Engineering”, Prentice Hall of India, 2005
8. Narasimha Murthy. A.S. and Henry R. Mohle, “Transportation Engineering Basics”, ASCE Press, 2000

COURSE OUTCOMES

At the end of the course students will be able to

1. Classify the different types of transportation systems.
2. Plan a transport system for urban and rural system
3. Understand the economic evaluation of transportation
4. Plan various public transportation systems
5. Demonstrate various application of intelligent transport system.

Mapping of COs with POs												
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓								✓		
CO2				✓		✓				✓	✓	
CO3	✓					✓					✓	
CO4			✓	✓								
CO5			✓	✓	✓				✓		✓	

CEPESCN	ARCHITECTURE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce various Architectural aspects.
- To understand the history of Architecture.
- To realize the impact of climate on Architecture Buildings.

UNIT I

Review of History of Architecture – Egyptian Mesopotamia classical and Indian Buddhist Architecture – Evolution of Hindu temple Architecture-Islamic and Mughal Architecture– Influences of Architecture on Nature, Climate, Topography and Materials – Represented plan – Growth of mass from plan – Space organization – Principles of composition, contrast, proportion, scale, balance, UNITY, character of composition.

UNIT II

Shelter or form – Climate and thermal comfort in India – Passive heating and cooling strategies – settlement patterns and site planning – Openings in Hot climates – Wind, Sun and Shading – Day lighting– Natural ventilation of buildings in India – Appropriate Technology for a Climatically Responsive Energy Architecture – Projects and Case studies.

UNIT III

Planning of residential buildings – Space UNITS of Living, Dining, Sleeping areas, Kitchens and Bathrooms – Single storied, double storied Residential buildings with different roofing systems – Multiple accommodations – Apartments – Group Housing – Housing for Handicapped – Housing for Elders – Youth Hostels.

UNIT IV

Planning concept of commercial buildings – Requirements of Spaces – Parking standards – Shopping centre – Banks – Super Markets - Hotel / Motel – Planning concept of Health Structures – requirements of spaces depends on specialty of disease – Medical Centres – Sub Health Centres – Laboratories – Medical Institutions – Concept Line Drawings – Projects.

UNIT V

Planning concept of Institutional Structures –Planning Concept of Play way / Kinder Garden Schools, Elementary, Secondary and Senior Secondary Schools, Library buildings – Technical Institutions – Institutionsfor Humanities Studies – Gymnasium and Swimming Pools – Planning concepts of Industrial Structures – General – Workshop – Ware Houses – MachineHousings.

TEXT BOOKS

1. Pramar. V.S. “Design fundamental in Architecture”, Somaiya Publications Pvt. Ltd., New Delhi, 1997.
2. Arvind Krishnan, Nick Baker, Simos Yannas, Szokolay.S.V., “Climate Responsive Architecture”., A Design Hand Book for Energy Efficient Building, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2007.

REFERENCES

1. Ernest Pickering “Architecture Design”, John Wiley & Sons.
2. Muthu Shoba Mohan.G.”Principles of Architecture”., Oxford University Press., New Delhi, 2006.
3. M. Pratap Rao “Architectural Design - Theory & Design”.
4. Arvind Krishnan, Nick Baker, Simos Yannas, Szokolay.S.V., “Climate Responsive Architecture”., A Design Hand Book for Energy Efficient Building, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2007.
5. National Building Code of India., SP7 (Group 1) Bureau of Indian Standards, New Delhi, 2005.

COURSE OUTCOMES

At the end of the course students will be able to

1. Recognize the different qualities of Architecture.
2. Understand that Architecture can enhance the building in terms of appearance and utility.
3. Realize that Architectural design can improve comfort in living conditions of buildings.
4. Apply Architectural concept and design buildings according specific requirements.
5. Concept of Institutional Structures

Mapping of COs with POs												
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓									✓
CO2		✓	✓	✓	✓	✓	✓	✓				
CO3							✓	✓		✓	✓	✓
CO4						✓	✓	✓	✓			
CO5		✓		✓						✓		

CEPESCN	RAILWAYS, AIR PORTS AND HARBOUR ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce the students about Railways planning, design, construction and maintenance.
- Planning design principles of airport and harbour.

UNIT I Railway Planning and Construction

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 Construction and Maintenance

Earthwork – Stabilization of track on poor soil - Track drainage – Calculation of Materials required for track laying - Construction and maintenance of tracks – Railway Station and yards and passenger amenities-Signalling

UNIT III Airport Planning

Air transport characteristics - airport classification – ICAO - airport planning: Site selection typical Airport Layouts, Case Studies, parking and Circulation Area

UNIT IV Airport Design

Runway Design: Orientation, Wind Rose Diagram, Problems on basic and Actual Length, Geometric Design – Elements of Taxiway Design – Airport Zones – Passenger Facilities and Services – Runway and Taxiway Markings.

UNIT V Harbour Engineering

Definition of Basic Terms: Harbour, Port, Satellite Port, Docks, Waves and Tides – Planning and Design of Harbours: Harbour Layout and Terminal Facilities – Coastal Structures: Piers, Break waters, Wharves, Jetties, Quays, Spring Fenders, Dolphins and Floating Landing Stage – Inland Water Transport – Wave action on Coastal Structures and Coastal Protection Works

TEXTBOOKS

1. Subramanian K.P., Highways, Railways, Airport and Harbour Engineering, V Scitech Publications (India), Chennai, 2010
2. Khanna.S.K. Arora.M.G and Jain.S.S, Airport Planning and Design, Nemachand and Bros, Roorkee, 1994

REFERENCES

1. Saxena Subhash, C.and Satyapal Arora, A Course in Railway Engineering, Dhanapat Rai and Sons, Delhi, 1998
2. Venkatramaiah. C., Transportation Engineering-Vol.2 Railways, Airports, Docks and Harbours, Bridges and Tunnels.,Universities Press (India) Private Limited, Hyderabad, 2015.
3. Mundry J S, Railway Track Engineering, McGraw Hill Education (India) Private Ltd, New Delhi, 2013.
4. Srinivasan R. Harbour, "Dock and Tunnel Engineering", 26th Edition 2013.

COURSE OUTCOMES: Students who successfully complete this course will be able to:

1. Understand the methods of route alignment and design elements in Railway Planning and Constructions.
2. Understand the Construction techniques and Maintenance of Track laying and Railway stations.
3. Gain an insight on the planning and site selection of Airport Planning and design.
4. Analyze and design the elements for orientation of runways and passenger facility systems.
5. Understand the various features in Harbours and Ports, their construction, coastal protection works and coastal Regulations to be adopted.

Mapping of COs with POs												
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓						✓		✓	
CO2		✓	✓	✓		✓		✓				
CO3			✓			✓	✓			✓		
CO4	✓		✓			✓			✓			
CO5		✓	✓			✓	✓			✓		

CEPESCN	URBAN PLANNING & DEVELOPMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To enable students to develop knowledge on Urban and rural planning.
- To introduce the regulations and laws related to urban planning.
- To educate the importance of zoning in planning.
- To get to know the principles involved in planning public buildings.

UNIT I

Objects of town planning – Economic justification – Principles of Town Planning – Necessity of Town Planning – Growth of Towns – Natural and planned growth – stages in Town Development – Distribution of Landuse – Forms of planning – Development of Town Planning in Ancient India – Concepts of Modern Town Planning and its stages.

UNIT II

Types of surveys – Collection of Data – Importance of zoning – Classification of Zoning – Use of zoning – Height zoning – Density zoning – Housing – Planning of neighborhood UNITS – Types of Layouts – Classification of housing – Housing problems in India.

UNIT III

Parks and Playgrounds – Schools – Public buildings and Town Centres – Industries – Industrial Estates – Communication and Traffic system – Traffic surveys – Traffic congestions – Types of road junctions – Parking facilities – Street lighting.

UNIT IV

Urban Renewal – Replanning of the existing towns – Objects of replanning – Necessity of Replanning – Advantages of Master plan – Data and Maps – Features of Master plan – Implementation of Master Plan – Planning law and Legislation in India – Building Bye laws – Functions of Local authority – Development – Control Rules for Metropolitan and District Municipalities.

UNIT V

Concept of rural planning – Urban and Rural differences – Urbanization – Principles of Rural planning – Village redevelopment – Integral Rural development program – Rural

housing – Principles – Design of Rural Housing – Rural Housing schemes – Group housing – Environmental Sanitation in Rural planning – Usage of low cost materials.

TEXT BOOKS

1. Rangwala. S.C., “Town Planning”, Charotar Publications House Pvt. Ltd., Gujarat, 26th Edition, 2013
2. Thooyavan. K.R., “Human Settlements – A Planning Guide to Beginners”, M.A. Publications, Chennai, 2005

REFERENCES

1. Chennai Metropolitan Development Authority, “Second Master Plan for Chennai”, Government of Tamilnadu, Chennai, 2008.
2. “Tamilnadu Town and Country Planning Act 1971”, Government of Tamilnadu, Chennai, 1971.
3. Goel. S.L.,”Urban Development and Management”, Deep and Deep Publications, New Delhi, 2002.
4. Thooyavan, K.R., Human Settlements – A Planning Guide to Beginners, M.A Publications, Chennai, 2005.

COURSE OUTCOMES

At the end of the course students will be able to

1. Describe basic issues in urban planning.
2. Formulate plans for Urban and rural development.
3. Plan and analyze socio-economic aspects of Urban and rural planning.
4. Understand functions of local authority with a clear idea of control rules.
5. Understand the concept of rural planning and sanitation.

Mapping of COs with POs												
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓					✓				
CO2		✓	✓	✓	✓	✓		✓		✓	✓	✓
CO3		✓	✓			✓	✓	✓	✓			
CO4		✓	✓					✓		✓		
CO5	✓						✓				✓	

CEPESCN	CLIMATE CHANGE ADAPTATION & MITIGATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To understand the earth's climate change and its system classification.
- To introduce the observed changes in the climate and concept of modeling and Institutional arrangements existing for monitoring this phenomenon.
- To understand Climate Change Adaptation and Mitigation Measures.

UNIT I Earth's Climate System

Introduction – Climate in the spotlight - The Earth's Climate Machine – Climate Classification – Global wind systems – Trade Wind Systems– Trade Winds and the Hadley Cell – The Westerlies – Cloud formation and Monsoon Rains – Storms and Hurricanes – The Hydrological Cycle – Global Ocean Circulation – El Nino and its Effect – Solar Radiation – The Earth's Natural Green House Effect – Green House Gases and Global Warming – Carbon Cycle.

UNIT II Observed Changes and Its Causes

Observation of Climate Change – Changes in pattern of temperature, precipitation and sea level rise – Observed effects of Climate Changes – Patterns of Large Scale Variability – Drivers of Climate Change – Climate Sensitivity and Feedbacks – The Montreal Protocol – UNFCCC – IPCC – Evidences of Changes in Climate and Environment – on a Global Scale and in India – Climate Change modeling.

UNIT III Impacts Of Climate Change

Impacts of Climate Change on various sectors – Agriculture, Forestry and Ecosystem – Water resources – Human Health – Industry, Settlement and Society – Methods and Scenarios – Projected Impacts for different regions – Uncertainties in the Projected Impacts of Climate Change – Risk of irreversible changes.

UNIT IV Climate Change Adaptation and Mitigation Measures

Adaptation Strategy/options in various sectors – Water – Agriculture – Infrastructure and Settlement including coastal zones. Human Health – Tourism – Transport – Energy – Key Mitigation Technologies and practices – Energy supply – Transport – Buildings – Industry – Agriculture – Forestry – Carbon sequestration – Carbon Capture and Storage (CCS) – Waste (MSW & Biowaste, Biomedical, Industrial waste – International and Regional co-operation.

UNIT V Clean Technology and Energy

Clean Development Mechanism – Carbon Trading – Examples of future Clean Technology – Biodiesel – Natural Compost – Eco-friendly Plastic – Alternate Energy –

Hydrogen – Bio-fuels – Solar Energy – Wind – Hydroelectric Power – Mitigation Efforts in India and Adaptation funding

TEXT BOOKS

1. Mridula Ramesh “ The climate solution”, Hachette India Publisher.
2. Alka Sen, “Global Warming and Climate Change” Academic Publication.

REFERENCES

1. Al core ‘Inconvenient Truth’ – video form
2. Dash Sushil Kumar, “Climate Change – An Indian Perspective”, Cambridge University Press India Pvt. Ltd, 2007.
3. IPCC Fifth Assessment Report – www.ipcc.ch
4. Jan C. van Dam, “Impacts of Climate Change and Climate Variability on Hydrological Regimes”, Cambridge University Press, 2003.

COURSE OUTCOMES

At the end of the course students will be able to

1. Understand the earth’s climate change and its system classification.
2. Introduce the observed changes in the climate and concept of modelling and Institutional arrangements existing for monitoring the phenomenon.
3. Show the impact of climate change on various sectors and its irreversibility.
4. Prepare the adaptation and mitigation measures of climate change on various sectors.
5. Choose the clean Technology for the Fuel and energy through natural and eco friendly techniques.

Mapping of COs with POs												
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓		✓		✓	✓	✓		
CO2	✓					✓			✓			✓
CO3			✓	✓	✓		✓			✓	✓	
CO4	✓					✓			✓			
CO5		✓			✓			✓				

OPEN ELECTIVES

CEOE SCN	AIR POLLUTION MONITORING & CONTROL	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To impart knowledge on air quality measurement in compliance with the standards.
- To enable students to learn about various air pollution control systems, related theory, working principles, engineering design and management.
- To impart knowledge on the principles and design of control of indoor/particulate/gaseous air pollutant and its emerging trends

Composition and structure of atmosphere-Definition-Air Pollution-Sources-Classification-Types - On meteorological conditions-Ozone layer disturbance, green house effects.

UNIT I Introduction- Standards-ambient air quality standards-emission standards-Air sampling methods-Modern air pollution measurement sensors-working principle-Emission inventory- Air quality index-Measurement-ambient and source sampling-pressure-gas flow rate-relative humidity-Sample train-determination particle size distribution-Gas stream calculations and conditioning.

UNIT II Air Pollution Control – General-Gravitational settling chambers-Inertial separators-Cyclone-introduction-industrial application-multiple cyclone-Fabric filtration-introduction-principle and theory-application-engineering design-operation. *Electrostatic precipitation*-introduction-principles of operation-design methodology and considerations-application-problems and corrections-Dry and wet Scrubbing-introduction-dry scrubbers-wet scrubbers.

UNIT III Condensation-introduction-pre and post treatment-engineering consideration and design-management .Flare process-introduction-pretreatment-engineering consideration and design-management. *Thermal and Catalytic oxidation*-introduction- pretreatment and engineering consideration-supplementary fuel requirements-design and operation-management. Gas-phase activated carbon adsorption-introduction and definitions-adsorption theory-carbon adsorption pretreatment-design and operation.

UNIT IV Gas Phase Bio-filtration-introduction-types of air treatment systems-operational consideration-design consideration/parameters-case studies-process control and monitoring-limitations of the technology. Emerging air Pollution Control Technologies-introduction-process modification-vehicle air pollution and its control-mechanical particulate collectors-Entrainment separation- IC engines-Membrane process-UV photolysis-High efficiency particulate air filters-Technical and economical feasibility of selected emerging technologies.

UNIT V Indoor air quality management: Measurement, control and preventive measures of indoor air quality measures and management. Control Measures for Industrial Applications: Control methods – Processes based control mechanisms – mineral products – asphaltic concrete, cement plants and glass manufacturing plants; Thermal power plants,

Petroleum refining and storage plants, Fertilizers, Pharmaceuticals and wood processing industry.

TEXT BOOKS

1. Anjaneyulu. Y, „Air Pollution & Control Technologies“ Allied Publishers (P) Ltd.,India, 2002.
2. David H.F. Liu, Bela G. Liptak „Air Pollution“, Lweis Publishers, 2000.

REFERENCES

1. Lawrence K.Wang, Norman C.Pereira and Yung-Tse Hung. “Air Pollution Control Engineering”, Humana Press, New Jersey, 2004.
2. Noel De Nevers, “Air Pollution control Engineering”, McGraw-Hill International Edition, Civil Engineering Series, Singapore, 2000.
3. Arthur C.Stern, “Air Pollution”, Volume-III, Academic Press, New Delhi, 2006.
4. Wayne T.Davis, “Air Pollution Engineering Manual”, John Wiley & Sons Inc., New Delhi, 2000.
5. J.R.Mudakavi, “Principles and Practices of Air Pollution Control and Analysis”, I.K. International Publishing House Pvt. Ltd., New Delhi, 2012.
6. Louis Theodore, “Air Pollution Control Equipment Calculation”, John Wiley & Sons Inc, New Delhi, 2006.
7. “Programme Objective Series (PROBES)”, Open Source of Central Pollution Control Board, Ministry of Environment, Forest and Climate Change, Govt. of India (www.cpcb.nic.in).

COURSE OUTCOMES

At the end of the course students will be able to

1. Conduct air quality monitoring programme for routine or site specific air quality parameters with conventional as well as modern sensors.
2. Design air pollution control systems.
3. Select the appropriate cost effective control system with high efficiency to be adopted in any type of air polluting industry.
4. Gain the knowledge on air pollution control techniques.
5. Understand the indoor air quality management system.

Mapping of COs with POs												
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓		✓		✓	✓	✓		
CO2	✓					✓			✓			✓
CO3			✓	✓	✓		✓			✓	✓	
CO4	✓					✓			✓			
CO5		✓			✓			✓				

CEOE SCN	MUNICIPAL SOLIDWASTE MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To gain an insight regarding sources, characteristics and composition of solid waste.
- To understand the rate of generation of solid waste and its present status in india.
- To know the method of collection, transfer, and transport of municipal solid waste.
- To Understand the role and applicability of physical, chemical, thermal and biological processing techniques.
- To acquire substantial knowledge in the field of resource recovery, waste-to-energy and on composting facility.

UNIT I

Introduction - goals and objectives of solid waste management - social aspects – legal aspects health factors - generation of solid wastes – sampling – characterization - method of disposal as a factor dependent upon the quality of refuse.

UNIT II

Storage system - dust bins at the streets - collection facility - frequency of collection - method of transport – transfer stations – types – design requirements.

Volume reduction - methods - compaction and balling - grinding of garbage - disposal methods.

Incinerators - design and operation - dust and air pollution problems - use -cost considerations.

UNIT III

Sanitary land fill - methods - machineries involved - site selection – Geoenvironmental investigations - Design and operation - liners and covers - phases of waste digestion - leachate control and treatment, gas recovery and control, landfill post closure monitoring - cost consideration - environmental factors such as odours, flies and vectors and leachate and groundwater pollution.

UNIT IV

Recovery and Reuse – ocean disposal - impact assessment - precautions required for the operation of the project - cost considerations.

UNIT V

Composting – types - methods – factors influencing composting - recommended procedures - impact assessment - cost consideration - disposal of industrial solid waste and

hazardous refuse – - types - sources - characteristics - precautions needs – treatment and disposal.

TEXT BOOKS

1. George Tchobanoglous, Hilary Theisen and Samuel A, Vigil, Integrated Solid Waste Management, McGraw- Hill, New York, 1993.
2. CPHEEO, Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organization, Government of India, New Delhi, 2000.

REFERENCES

1. Handbook of Solid Waste Management by Frank Kreith , George Tchobanoglous McGraw Hill Publication.
2. Solid Waste Management - Haggerty, D.J., Von Nostrand Reinhold company, New York, 1973.
3. Municipal Refuse Disposal - NY American Public Works Association, 1966.
4. Refuse Collection Practice - by American Public Works Association, 1967.
5. Management of Solid Wastes in Developing Countries - Flintoff, F., WHO Publication, 1972.

COURSE OUTCOMES

At the end of the course students will be able to

1. Apply the procedures and methods for MSW Collection, segregation, processing and disposal
2. Develop an Environmental Management System.
3. Explain different methodologies for Environmentally sound solutions
4. Examine the process by which legal systems are adopted and enforced.
5. Gain a knowledge on composting methods of municipal solid waste.

Mapping of COs with POs												
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		✓	✓	✓		✓		✓	✓	✓		
CO2	✓					✓		✓	✓			✓
CO3			✓	✓	✓		✓	✓			✓	
CO4	✓					✓			✓			✓
CO5		✓		✓				✓			✓	

CEOE SCN	ECONOMICS & FINANCE FOR CIVIL ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- Prepare students to take advanced courses in systems engineering, financial engineering and managerial accounting.
- Prepare students to become financially conversant in their professional careers and personal lives
- To learn the basics of economics, finance and accounting necessary for a Civil Engineering enterprise to be successful and profitable.

UNIT I

Economics – Role of Civil Engineering in Industrial development - Support matters of economy as related to engineering - Market demand & supply - Choice of technology Quality control and production - Audit in economic law of returns governing production.

UNIT II

Land and construction economics - Urban land use and values - Construction development in housing, transport and other infrastructures - Economics of ecology, environment, energy resources, local material selection, form and functional designs - Construction workers - Urban problems - Poverty - Migration - Unemployment- Pollution.

UNIT III

Financing - Need for financial management - Types of financing - Short-term and Long term borrowing - Leasing - Equity financing - Internal generation of funds - External commercial borrowings - Assistance from government - International financial corporations - Analysis of financial statements - Balance sheet - Profit and loss account - Funds flow statement - Ratio analysis - Investment and Financing decision - Financial control - Job control - Centralized management.

UNIT IV

Accounting method - General - Cash basis of accounting - Accrual basis of accounting - Percentage completion method - Completed contract method - Accounting for tax reporting purposes and financial reporting purposes.

UNIT V

Cost estimating of Civil Engineering equipment – Depreciation and Interest – Maintenance and Repair costs – Degree of utilization – equivalent annual cost – operating cost standards – exercises. Project Benefit Cost analysis – least cost – Net Present Value (NPV) – equivalent annual cost method – Internal Rate of Return method (IRR) – Benefit – Cost Ratio – exercises.

TEXT BOOKS

1. Joy, P. K. “Total Project Management-the Indian context”
2. Tenah K. A. & J., M.Guevara, “Fundamentals of Construction Management and Organisation”

REFERENCES

1. Warner Z.Hirsch, “Urban Economics” Telford Publishers, London, UK, 1997.
2. Mitchel, Robert L., “Engineering Economics”, John Wiley & Sons, UK, 1980.
3. Alan A.Smith, Ernest Hinton and Roland W. Lewis “Civil Engineering Systems Analysis and Design”, John Wiley and Sons, UK, 1983.
4. Charles S.Revelle, E.Earl Whitlach and Jeff.R.Wright, “ Civil and Environmental Systems Engineering”, Pearson Prentice Hall Inc., New Jersey, USA, 2004.

COURSE OUTCOMES

At the end of the course students will be able to

1. Perceive the power of economics techniques and finance.
2. Demonstrate the applications of these techniques to problems drawn from industry, management and other engineering fields.
3. Apply cost estimation methods to get close approximate solutions to complex Engineering problems.
4. Understand the financial concept and analysis.
5. Perceive a knowledge on accounting methods applied in Civil Engineering.
- 6.

Mapping of COs with POs												
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓		✓	✓		✓		✓			✓	
CO2				✓	✓		✓		✓	✓	✓	✓
CO3	✓											
CO4		✓		✓			✓		✓		✓	
CO5					✓						✓	

CEOE SCN	ENVIRONMENTAL IMPACT ASSESSMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To understand the evolution, role, application and the general procedure for EIA
- To impart the concept of Environmental Management Systems (EMS).
- To impart / inculcate the knowledge of Environmental Auditing, Life cycle Assessment (LCA).
- To introduce the concept and role of Cleaner Production, Sustainable Development and ISO 14000 series.
- To understand the rules and regulations governing EIA and EIA case studies.

UNIT I

Evolution of EIA – Concepts – Methodologies – Screening – Scoping – Base line Studies – mitigation – Matrices – Checklist.

UNIT II

Rapid EIA – Comprehensive EIA – Legislative and Environmental Clearance procedure in India – prediction tools for EIA.

UNIT III

Assessment of Impact on Air – Soil – Water – Noise – Biological – Socio-Cultural Environment. Public participation – Resettlement and Rehabilitation procedures – Sustainable Development.

UNIT IV

Documentation of EIA – EMP – Post project Monitoring – EIA case studies. Environmental Auditing – Various types of Audit – Philosophy - concepts – rules and relevant methodologies.

UNIT V

Concept of Cleaner production - Role of ISO and ISO 14000 in Environmental Management.

TEXT BOOKS

1. Canter R.L., “Environmental Impact Assessment”, McGraw Hill Inc., New Delhi, 1997.
2. Anjaneyalu Y., “Environmental Impact Assessment Methodologies”, B.S. Publications, Hyderabad, 2002.

REFERENCES

1. Lohani B., Evans J.W., Ludwig H., Everitt R.R., Richard A. Carpenter and Tu S.L., “Environmental Impact Assessment for Developing countries in Asia”, Volume 1 – Overview, Asian Development Bank, 1997.
2. Peter Morris and Riki Therivel, “Methods of Environmental Impact Assessment”, Routledge Publishers, 2009.
3. Barry Sadler and Mary McCabe, “Environmental Impact Assessment Training Resource Manual”, UNITED Nations Environment Programme, 2002.
4. Judith Petts, “Handbook of Environmental Impact Assessment Volume I and II”, Blackwell Science, New York, 1999.
5. Ministry of Environment and Forests, “EIA Notification and Sectoral Guides”, Government of India, New Delhi, 2010.
6. The World Bank, “Environmental Impact Assessment Source book, Volume I, II and III”, Washington D.C., 2011.

COURSE OUTCOMES

At the end of the course students will be able to

1. Apply the main procedures and methods which are adopted at different stages in EIA process.
2. Develop on Environmental Management Systems.
3. Explain different methodologies for Environmental Impact prediction and assessment.
4. Evaluate EIA reports
5. Examine the process by which legal systems are adopted and enforced.

Mapping of COs with POs												
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓									
CO2		✓	✓	✓		✓			✓		✓	
CO3			✓			✓		✓				✓
CO4					✓	✓	✓	✓		✓		
CO5	✓									✓	✓	

CEOE SCN	COASTAL ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To develop an understanding of basic concepts in coastal engineering such as the linear wave theory, energy propagation in waves, shoaling, refraction, diffraction, and breaking.
- To help the student develop an intuitive feeling about design concepts in coastal engineering based on wave spectra, prediction of waves in fetch limited seas, wave forces on piles and wall type structures.
- The students to the diverse topics as wave mechanics, wave climate, shoreline protection methods and laboratory investigations using model studies.

UNIT I

Indian Scenario - Classification of Harbours. 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, Introduction to Tsunami

UNIT II

Behaviour of waves in shallow waters, Introduction to non-linear waves and their properties - Waves in shallow waters - Wave Refraction, Diffraction and Shoaling -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

Dynamic beach profile; cross-shore transport; along shore transport (Littoral transport), sediment movement

UNIT IV

Field measurement; models, groins, sea walls, offshore breakwaters, artificial nourishment - planning of coast protection works - Design of shore defense structures

UNIT V

Physical modeling in Coastal Engineering - Limitations and advantages - Role of physical modeling in coastal engineering - Numerical modeling - Modeling aspects - limitations - Tsunami mitigation measures –

CEOE SCN	TOTAL QUALITY MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To evaluate the principles of quality management and to explain how these principles can be applied within quality management systems.
- To appraise the organisational, communication and teamwork requirements for effective quality management.
- Critically analyse the strategic issues in quality management, including current issues and developments and to devise and evaluate quality implementation plans.

UNIT I

Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention.

UNIT II

Leadership - Quality Statements, Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating.

UNIT III

The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types.

UNIT IV

Quality Circles - Cost of Quality - Quality Function Deployment (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures.

UNIT V

Introduction—Benefits of ISO Registration—ISO 9000 Series of Standards—Sector-Specific Standards—AS 9100, TS16949 and TL 9000 - ISO 9001 Requirements—Implementation—Documentation—Internal Audits—Registration- Environmental management System: Introduction—ISO 14000 Series Standards—Concepts of ISO 14001—Requirements of ISO 14001—Benefits of EMS.

CEOE SCN	COMPUTER AIDED DESIGN OF STRUCTURES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To understand the need and concepts of design optimization.
- To introduce the students about computer graphics, structural analysis, design and optimization and expert systems, applications in analysis.
- To use conventional and modern optimization methods in structural applications.

UNIT I

Fundamental reason for implementing CAD - Software requirements – Hardware components in CAD system – Design process - Applications and benefits.

UNIT II

Graphic Software – Graphic primitives - Transformations - 2 Dimensional and 3 Dimensional transformations – Concatenation - Wire frame modeling - Solid modeling - Graphic standards - Drafting packages .

UNIT III

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

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

Introduction to artificial intelligence - Knowledge based expert systems – Applications of Knowledge Based Expert Systems - Rules and decision tables - Inference mechanisms - simple applications

TEXTBOOKS

1. Groover M.P. and Zimmers E.W. Jr., “CAD/CAM, Computer Aided Design and Manufacturing”, Prentice Hall of India Ltd, New Delhi, 1993.
2. Krishnamoorthy C.S.Rajeev S., “Computer Aided Design”, Narosa Publishing House, New Delhi, 2001

HONOR ELECTIVES

CEHE SCN	SPECIAL CONCRETE STRUCTURES	L	T	P	C
		4	0	0	4

COURSE OBJECTIVES

- To expose the students to the design practices of complicated RCC structures like Deep beams, R.C.poles, storage containers and elevated water tanks.
- To understand the significance of various code specifications in design of special concrete structures.
- To introduce the different types of philosophies related to design of special concrete structures.

UNIT I

Analysis and Design of Building frames - Analysis for vertical and horizontal loads - Method of substitute frames – Portal method - Cantilever method - Factor method. Design of portal frames with vertical loads – Design of gable frames with vertical loads - Design of deep beams using strut and tie concept – Design of Concrete Corbels for crane loads – Design of Grid floors - Detailing of reinforcement as per relevant standards.

UNIT II

Design of Concrete Poles as per IS 785: 1965 – Design of Concrete Hume Pipes as per IS 458:1971 – Design of R.C. Chimneys as per IS 4998 (Part I): 1992 – Design of Portal frames as per SP 43: 1987 –Detailing of reinforcement as per relevant standards.

UNIT III

Design of Concrete Bunkers as per IS 4995 (Part I,II): 1974 – Design of Concrete Silos as per IS 5503 (Part I) :1969 - Detailing of reinforcement as per relevant standards.

UNIT IV

Design of Elevated Concrete water tanks - Circular tanks - Rectangular tanks - Intze type tanks - Design of staging – Design of Underground Rectangular and Circular Water tanks - Design of Domes – Detailing of reinforcement as per IS 11992: 1995, IS 3370 (Part IV): 1967 and IS 3370 (Part I): 2009.

UNIT V

Design of Bridge deck Slab - I.R.C.loadings - Design of solid slab bridges – Pigeaud's curves – General design requirements as per IRC: 6-2014 and IRC 21: 2000.

TEXT BOOKS

1. Krishnaraju, N., “Advanced R.C.Design”, CBS Publishers & Distributors Pvt. Ltd., 2012.
2. Punmia, B.C., Ashok Kumar Jain and Arun Kumar Jain, “R.C.Structures - Vol. I & II”, Laxmi Publications (P) Ltd., 1992.

REFERENCES

1. Mallick, S.K. & Gupta, A.P., “Reinforced Concrete”, Oxford I B H, 1987.
2. Park and Paulay, T., “R.C.Structures”, Tata McGraw Hill Publications, 1975.
3. Ramamrutham, S. and Narayan, R., “Design of R.C. Structures”, Dhanpat Rai and Sons, 1992.
4. Dayaratnam, P., “Design of RC Structures”, Oxford & IBH Publishing Co., 2000.
5. Punmia, B. C., “R.C.Structures – Vol. II”, Standard Publishers, 1991.

STANDARDS

1. IS 456: 2000, Code of Practice for Plain and Reinforced Concrete, Bureau of Indian Standards, New Delhi.
2. IS 13920: 1993, Ductile Detailing of Reinforced Concrete structures subjected to Seismic Forces - Code of Practice
3. SP 34: 1987, Handbook on Concrete Reinforcement and Detailing.
4. IRC: 6-2014, Standard Specifications and Code of Practice for Road Bridges Section: II (Loads And Stresses).
5. IRC 21: 2000, Standard Specifications and Code of Practice for Road Bridges Section: III [Cement Concrete (Plain And Reinforced)].
6. IS 1343:1980, Code of Practice for Pre-stressed Concrete, Bureau of Indian Standards, New Delhi, 2012.
7. IS 2974 (Part I):1982, Code of Practice for Design and Construction of Machine Foundations (Foundation for Reciprocating Type Machines).
8. IS 2974 (Part II):1980, Code of Practice for Design and Construction of Machine Foundations [Foundations for Impact Type Machines (Hammer Foundations)].
9. IS 2974 (Part III): 1992, Design and Construction of Machine Foundations - Code of Practice [Foundations for Rotary Type Machines (Medium and High Frequency)].
10. IS 2974 (Part IV):1979, Code of Practice for Design and Construction of Machine Foundations (Foundations for Rotary Type Machines of Low Frequency).
11. IS 4995 (Part I): 1974, Criteria for Design of Reinforced Concrete Bins for the Storage of Granular and Powdery Materials (General Requirements and Assessment of Bin Loads).
12. IS 4995 (Part II):1974, Criteria for Design of Reinforced Concrete Bins for Storage of Granular and Powdery Materials (Design Criteria).
13. IS 9178 (Part II):1979, Criteria for Design of Steel Bins for Storage of Bulk Materials (Design Criteria).
14. IS 5503 (Part I) :1969, General Requirements for Silos for grain storage (Construction requirements)

15. IS 4998 (Part I): 1992, Criteria for Design of Reinforced (Assessment of Loads).
16. IS 3370 (Part IV): 1967, Code Of Practice for Concrete Structures for the Storage of Liquids.
17. IS 11992: 1995, Criteria for Design Of RCC Staging For Overhead Water Tanks.
18. IS 3370 (PART I): 2009, Concrete Structures for Storage of Liquids - Code of Practice.
19. IRC: 6-2014, Standard Specifications and Code of Practice for Road Bridges Section: II (Loads And Stresses).
20. IRC 21: 2000, Standard Specifications and Code of Practice for Road Bridges Section III [Cement Concrete (Plain And Reinforced)].

CEHE SCN	EARTH QUAKE ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To provide a coherent development to the students for the courses in sector of earthquake engineering.
- To involve the application of scientific and technological principles of planning, analysis, design of buildings according to earthquake design philosophy.
- To understand that these loadings will enable design engineers to ensure the safety and serviceability of structures.

UNIT I

Elements of Earth, core, mantle and crust- Engineering Seismology, Plate tectonic theory , originations of earthquake - Volcanic and tectonic origins, Faults, Dips, slips in crust, seismic zoning map of India & its use.

Earthquake Effects: Land and rock slides, Liquefaction, Fires, Tsunamis, Floods, Release of poisonous gases and Radiation.

Earthquake Phenomenon: - Focus epicentre, Seismic waves, Magnitude, intensity, Richter scale, MM scale, Earthquake recording instruments, and Seismic resistant design guidelines

UNIT II

Dynamics: Vibration, frequency, D'Alembert's Principle, Dynamic equilibrium equation, inertial force, Damping force, Stiffness force, Mathematical models, and Discrete (lumped parameter) systems: SDOF, MDOF systems, Continuous systems, Formulations of equations of motions for two and three storey building. Free vibration analysis of SDOF systems with and without viscous damping, Experimental methods of assessing viscous damping present in the dynamic systems: logarithmic decrement method, Half power band width method, and simple problems.

UNIT III

Forced Vibration Analysis (Harmonic loading) of Single Degree of freedom systems with and without damping under harmonic excitations, Forced vibration response to harmonic base excitation. Formulation of Response Spectrum, Design Response spectrum as per IS:1893, simple problems using the above response spectrums. Forced vibration analysis of multi Degrees of freedom systems (restricted to two degrees of freedom only) using modal superposition technique.

UNIT IV

Analysis of building frames, Equivalent static method as per IS: 1893- Dynamic analysis using mode superposition concept- Push over analysis. Modelling of Building Frames with Brick and Concrete Walls- Centre of Mass locations- Centre of Stiffness locations- Orientation of Shear walls.

UNIT V

Philosophy and Principles of Earthquake Resistant design- Strength and Stiffness, Ductility Design and Detailing (IS:13920), Concept of Energy Absorbing Devices, Concepts of Seismic Base isolation technique and Seismic Active control methods. Lessons learnt from the Past Earthquakes - Case studies of important Indian Earthquakes, Major world Earthquakes.

TEXT BOOKS

1. Dowrick, D.J., "Earthquake Resistant Design", John Wiley & Sons, Winchester, U.K., 1977.
2. Paulay, T. and Priestley, M. J. N., "Seismic Design of Reinforced and Masonry Buildings", John Wiley & Sons, Inc., New York, 1992.

REFERENCES

1. Anil K. Chopra, "Dynamics of Structures", McGraw-Hill International Edition, 1998.
2. Clough, R.W. and Penzien, J., "Dynamics of Structures", Second Edition, McGraw-Hill International Edition, 1993.
3. Kiyoshi Muto, "Earthquake Resistant Design of Tall Buildings in Japan", University of California, 1973.
4. Beskos. D. E., "Computer Analysis & Design of Earthquake Resistant Structures- A Handbook of Advances in Earthquake Engineering", Computational Mechanics Inc, 1997.
5. Hiroshi Akiyama, "Earthquake Resistant Limit State Design for Buildings", University of Tokyo Press, 1985.
6. Paz, M. and Leigh.W. "Structural Dynamics – Theory & Computations", 4th Edition, CBS Publishers & Distributors, New Delhi, 2006.

LIST OF CODES

1. IS 1893: 2002 — Criteria for Earthquake Design of Structures, Bureau of Indian Standards, New Delhi.
2. IS 4236: 1976 — Code of Practice for Earthquake Resistant Design and Construction of Buildings, Bureau of Indian Standards, New Delhi.
3. IS 13920: 1993 — Ductile Detailing of Reinforced Concrete Structures Subjected to Seismic Forces — Code of Practice, Bureau of Indian Standards, New Delhi.
4. Explanatory Handbook on Codes for Earthquake Engineering, Special Publication SP 22, Bureau of Indian Standards, New Delhi.
5. IS 13827: 1993, Indian Standard Guidelines for Improving Earthquake Resistance of Earthen Buildings.

6. IS 13828: 1993, Indian Standard Guidelines for Improving Earthquake Resistance of Low Strength Masonry Buildings.
7. IS 13935: 1993, Indian Standard Guidelines for Repair and Seismic Strengthening of Buildings.
8. IS 456: 2000, Explanatory Handbook on Indian Standard Code of Practice for Plain and Reinforced Concrete, Special Publication SP: 24, Bureau of Indian Standards, New Delhi.

CEHE SCN	ADVANCED WATER TREATMENT	L	T	P	C
		4	0	0	4

COURSE OBJECTIVES

- To realize the principle and concept of physico- chemical treatment.
- To understand the concept of conventional water treatment system.
- To design the advanced water treatment system.

UNIT I Physical Treatment Principles

Principles of screening – mixing, equalizations –sedimentation – filtration –modeling – backwashing –evaporation-incineration- gas transfer-mass transfer coefficients. Adsorption-isotherms-principles, equilibrates and kinetics, reactors, regeneration, membrane separation, reverse osmosis, nano filtration ultra filtration and hyper filtration – electro dialysis, distillation – stripping and crystallization-recent advances

UNIT II Chemical Treatment Principles

Principles of chemical treatment – coagulation flocculation – precipitation –floatation, solidification and stabilization- disinfection .ion exchange, electrolytic methods -Solvent extraction –advanced oxidation / reduction –recent advances.

UNIT III Water Treatment

UNIT operations and processes - Principles, functions design and drawing of Chemical feeding, Flash mixers, flocculators, sedimentation tanks and sand filters - Disinfection-Residue Management - Construction and Operation & Maintenance aspects of Water Treatment Plants.

UNIT IV Advanced Water Treatment

Principles and functions of Aeration - Iron and manganese removal, Defluoridation and demineralization -Water softening - Desalination - Membrane Systems - Recent advances.

UNIT V Design of Conventional Treatment Plants

Selection of UNIT operation and processes – design of conventional water treatment plant UNITs –aerators –chemical feeding –flocculation –clarifier – filters –rapid sand filter, slow sand filter, pressure filter-chlorinators. Displacement and gaseous types and layouts-flowcharts –hydraulic profile –O & M aspects- case studies , residue management – up gradation of existing plants – recent advances.

TEXT BOOKS

1. Modi, P.N. "Water Supply Engineering", Vol. I Standard Book House, New Delhi, 2005.
2. Bhole A.G, "Design of water treatment plants". Indian Water Works Association Publisher.

REFERENCES

1. David W. Hand, Kerry J. Howe, Water treatment Principals and Design, John C.Crittenden, R.Rhodes Trussell, George Techobanoglous. Third Eddition.
2. Rangwala.S.C.,Water supply and sanitary Engineering-
3. David.G. Stevensan.,Water treatment UNIT Process.
4. Santhosh kumar Garg, Water supply Engineering.

CEHE SCN	WATERSHED MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To understand different watershed behavior.
- To be able to interpret runoff data and quantify erosion by using various modelling methods
- To emphasize the need for water conservation.

UNIT I

Watershed-Concept-Classification-Characteristics-Watershed Programmes-Need for Watershed Management- Factors affecting watershed management Planning of Watershed Works-Watershed Management Practices

UNIT II

Erosion- History and Types -Erosion Problems in India-Soil Erosion-Types of Soil Erosion-Controlling Soil Erosion-Soil Erosion by Wind and Water-Soil Conservation Practices-Structural and Non-Structural Measures – Soil loss estimation models

UNIT III

Need for Water Conservation-Water Conservation Measures-Water Harvesting-Principles and Techniques-Flood Water Harvesting

UNIT IV

Joint forest Management –Grassland Farming and Management-Range and Pastures-Grazing Practices-Waste Land Development – Drought Management – Integrated Watershed Management

UNIT V

Watershed Modelling-Standard Modelling Approaches and Classification, System Concept for Watershed Modelling, Rainfall – Runoff modeling - Applications of Remote Sensing and Geographical Information System

TEXT BOOKS

1. Suresh, R., “Soil and Water Conservation Engineering”, Standard Publishers & Distributors, New Delhi, 2000.
2. Ghanshyam Das, “Hydrology and Soil conservation Engineering”, Prentice-Hall India, New Delhi, 2000.

REFERENCES

1. Tideman, E. M., "Watershed Management - Guidelines for Indian Conditions", Omega Scientific Publishers, New Delhi, 1996.
2. Murty J V S, "Watershed Management" New Age International, 1998.
3. Madan Mohan Das and Mimi Das Saikia, "Watershed Management" PHI Learning Pvt. Ltd.
4. Ranga Reddy A., "Watershed Management for Sustainable Development" Published by Mittal, New Delhi, 2005.

CEHE SCN	GEO ENVIRONMENTAL ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- The student acquires the knowledge on the Geotechnical engineering problems.
- To acquire knowledge on soil contamination and safe disposal of waste.
- Student to give remediation for the contaminated soils by different techniques.

UNIT I

Introduction to Geo environmental engineering – Environmental cycle – Sources, production and classification of waste – Causes of soil pollution – Factors governing soil pollution interaction clay minerals - Failures of foundation due to waste movement.

UNIT II

Safe disposal of waste – Site selection for landfills – Characterization of land fill sites and waste – Risk assessment – Stability of landfills – Current practice of waste disposal – Monitoring facilities – Passive containment system – Application of geosynthetics in solid waste management – Rigid or flexible liners.

UNIT III

Contaminant transport in sub surface – Advection, Diffusion, Dispersion – Governing equations – Contaminant transformation – Sorption – Biodegradation – Ion exchange – Precipitation – Hydrological consideration in land fill design – Ground water pollution.

UNIT IV

Stabilization - Solidification of wastes – Micro and macro encapsulation – Absorption, Adsorption, Precipitation – Detoxification – Mechanism of stabilization – Organic and inorganic stabilization – Utilization of solid waste for soil improvement – case studies.

UNIT V

Exsitu and Insitu remediation-Solidification, bio-remediation, incineration, soil washing, phyto remediation, soil heating, vetrification, bio-venting.

TEXTBOOKS

1. Hari D. Sharma and Krishna R. Reddy, "Geo-Environmental Engineering" –John Wiley and Sons, INC, USA, 2004.
2. Daniel B.E., "Geotechnical Practice for waste disposal", Chapman & Hall, London 1993.
- 3.

REFERENCES

1. Westlake, K, "Landfill Waste pollution and Control", Albion Publishing Ltd., England, 1995.
2. Wentz, C.A., "Hazardous Waste Management", McGraw Hill, Singapore, 1989.
3. Manoj Datta, "Waste Disposal in Engineered landfills", Narosa Publishing House, 1997.
4. Manoj Datta, B.P. Parida, B.K. Guha, "Industrial Solid Waste Management and Landfilling Practice", Narosa Publishing House, 1999.

CEHE SCN	INTELLECTUAL PROPERTY RIGHTS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To give an idea about IPR, registration and its enforcement.
- To understand the basic concepts and need for Intellectual Property.
- To understand IP Laws, Enforcement Measures and Emerging issues.

UNIT I

Introduction to IPRs, Basic concepts and need for Intellectual Property - Patents, Copyrights, Geographical Indications, IPR in India and Abroad – Genesis and Development – the way from WTO to WIPO –TRIPS, Nature of Intellectual Property, Industrial Property, technological Research, Inventions and Innovations – Important examples of IPR.

UNIT II

Meaning and practical aspects of registration of Copy Rights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design registration in India and Abroad

UNIT III

International Treaties and Conventions on IPRs, TRIPS Agreement, PCT Agreement, Patent Act of India, Patent Amendment Act, Design Act, Trademark Act, Geographical Indication Act.

UNIT IV

Digital Innovations and Developments as Knowledge Assets – IP Laws, Cyber Law and Digital Content Protection – Unfair Competition – Meaning and Relationship between Unfair Competition and IP Laws – Case Studies.

UNIT V

Infringement of IPRs, Enforcement Measures, Emerging issues – Case Studies.

TEXTBOOKS

1. V. Scople Vinod, Managing Intellectual Property, Prentice Hall of India pvt Ltd, 2012
2. S. V. Satakar, “Intellectual Property Rights and Copy Rights, Ess Ess Publications, New Delhi, 2002

REFERENCES

1. Deborah E. Bouchoux, "Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets", Cengage Learning, Third Edition, 2012.
2. Prabuddha Ganguli, "Intellectual Property Rights: Unleashing the Knowledge Economy", McGraw Hill Education, 2011.
3. Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property, Edward Elgar Publishing Ltd., 2013.
4. Ahuja V K, "Law Relating to Intellectual Property Rights".

CEHE SCN	SUSTAINABLE ENGINEERING AND TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To have an increased awareness among students on issues in areas of sustainability
- To know the methods, tools, and incentives for sustainable product-service system development
- To establish a clear understanding of the role and impact of various aspects of engineering and engineering decisions on environmental, societal, and economic problems.

UNIT I

Sustainability - Introduction, Need and concept of sustainability, Socialenvironmental and economic sustainability concepts. Sustainable development, Nexus between Technology and Sustainable development, Challenges for Sustainable Development. Multilateral environmental agreements and Protocols - Clean Development Mechanism (CDM), Environmental legislations in India - Water Act, Air Ac

UNIT II

Air Pollution, Effects of Air Pollution; Water pollution- sources, Sustainable wastewater treatment, Solid waste - sources, impacts of solid waste, Zero waste concept, 3 R concept. Global environmental issues- Resource degradation, Climate change, Global warming, Ozone layer depletion, Regional and Local Environmental Issues. Carbon credits and carbon trading, carbon foot print.

UNIT III

Environmental management standards, ISO 14000 series, Life Cycle Analysis (LCA) - Scope and Goal, Bio-mimicking, Environment Impact Assessment (EIA) - Procedures of EIA in India

UNIT IV

Basic concepts of sustainable habitat, Green buildings, green materials for building construction, material selection for sustainable design, green building certification, Methods for increasing energy efficiency of buildings.Sustainable cities, Sustainable transport.

UNIT V

Energy sources: Basic concepts-Conventional and non-conventional, solar energy, Fuel cells, Wind energy, Small hydro plants, bio-fuels, Energy derived from oceans, Geothermal energy Green Engineering, Sustainable Urbanisation, industrialisation and poverty reduction; Social and technological change, Industrial Processes: Material selection, Pollution Prevention, Industrial Ecology, Industrial symbiosis.

TEXT BOOKS

1. Purohit, S. S., Green Technology - An approach for sustainable environment, Agrobios publication.
2. Peter P. Rogers, Kazi F. Jalal, John A. Boyd, "An Introduction To Sustainable Development", Glen Educational Foundation, 2008.

REFERENCES

1. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
2. Bradley. A.S; Adebayo,A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning
3. Environment Impact Assessment Guidelines, Notification of Government of India, 2006
4. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998
5. ECBC Code 2007, Bureau of Energy Efficiency, New Delhi Bureau of Energy Efficiency Publications-Rating System, TERI Publications - GRIHA Rating System
6. Ni bin Chang, Systems Analysis for Sustainable Engineering: Theory and Applications, McGraw-Hill Professional.
7. Twidell, J. W. and Weir, A. D., Renewable Energy Resources, English Language Book Society (ELBS).

MINOR ENGINEERING ELECTIVES

CEHE SCN	ADVANCED WATER TREATMENT	L	T	P	C
		4	0	0	4

COURSE OBJECTIVES

- To realize the principle and concept of physico- chemical treatment.
- To understand the concept of conventional water treatment system.
- To design the advanced water treatment system.

UNIT I Physical Treatment Principles

Principles of screening – mixing, equalizations –sedimentation – filtration –modeling – backwashing – evaporation-incineration- gas transfer-mass transfer coefficients. Adsorption-isotherms-principles, equilibrates and kinetics, reactors, regeneration, membrane separation, reverse osmosis, nano filtration ultra filtration and hyper filtration – electro dialysis, distillation – stripping and crystallization-recent advances

UNIT II Chemical Treatment Principles

Principles of chemical treatment – coagulation flocculation – precipitation –floatation, solidification and stabilization- disinfection .ion exchange, electrolytic methods -Solvent extraction –advanced oxidation / reduction –recent advances.

UNIT III Water Treatment

UNIT operations and processes - Principles, functions design and drawing of Chemical feeding, Flash mixers, flocculators, sedimentation tanks and sand filters - Disinfection-Residue Management - Construction and Operation & Maintenance aspects of Water Treatment Plants.

UNIT IV Advanced Water Treatment

Principles and functions of Aeration - Iron and manganese removal, Defluoridation and demineralization -Water softening - Desalination - Membrane Systems - Recent advances.

UNIT V Design of Conventional Treatment Plants

Selection of UNIT operation and processes – design of conventional water treatment plant UNITs –aerators –chemical feeding –flocculation –clarifier – filters –rapid sand filter, slow sand filter, pressure filter-chlorinators. Displacement and gaseous types and layouts-flowcharts –hydraulic profile –O & M aspects- case studies , residue management – up gradation of existing plants – recent advances.

TEXT BOOKS

1. Modi, P.N. "Water Supply Engineering", Vol. I Standard Book House, New Delhi, 2005.
2. Bhole A.G, "Design of water treatment plants". Indian Water Works Association Publisher.

REFERENCES

1. John C. Crittenden, R.Rhodes Trussell, David W. Hand, Kerry J. Howe, George Tchobanoglous "Water treatment Principals and Design", Third Eddition.
2. Rangwala.S.C. "Water supply and sanitary Engineering".
3. David.G. Stevensan,"Water treatment UNIT Process".
4. Santhosh kumar Garg."Water supply Engineering".

CEME SCN	CLIMATE CHANGE ADAPTATION & MITIGATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To understand the earth's climate change and its system classification.
- To introduce the observed changes in the climate and concept of modeling and Institutional arrangements existing for monitoring this phenomenon.
- To understand Climate Change Adaptation and Mitigation Measures.

UNIT I Earth's Climate System

Introduction – Climate in the spotlight - The Earth's Climate Machine – Climate Classification – Global wind systems – Trade Wind Systems– Trade Winds and the Hadley Cell – The Westerlies – Cloud formation and Monsoon Rains – Storms and Hurricanes – The Hydrological Cycle – Global Ocean Circulation – El Niño and its Effect – Solar Radiation – The Earth's Natural Green House Effect – Green House Gases and Global Warming – Carbon Cycle.

UNIT II Observed Changes and its Causes

Observation of Climate Change – Changes in pattern of temperature, precipitation and sea level rise – Observed effects of Climate Changes – Patterns of Large Scale Variability – Drivers of Climate Change – Climate Sensitivity and Feedbacks – The Montreal Protocol – UNFCCC – IPCC – Evidences of Changes in Climate and Environment – on a Global Scale and in India – Climate Change modeling.

UNIT III Impacts of Climate Change

Impacts of Climate Change on various sectors – Agriculture, Forestry and Ecosystem – Water resources – Human Health – Industry, Settlement and Society – Methods and Scenarios – Projected Impacts for different regions – Uncertainties in the Projected Impacts of Climate Change – Risk of irreversible changes.

UNIT IV Climate Change Adaptation and Mitigation Measures

Adaptation Strategy/options in various sectors – Water – Agriculture – Infrastructure and Settlement including coastal zones. Human Health – Tourism – Transport – Energy – Key Mitigation Technologies and practices – Energy supply – Transport – Buildings – Industry – Agriculture – Forestry – Carbon sequestration – Carbon Capture and Storage (CCS) – Waste (MSW & Biowaste, Biomedical, Industrial waste – International and Regional co-operation.

UNIT V Clean Technology and Energy

Clean Development Mechanism – Carbon Trading – Examples of future Clean Technology – Biodiesel – Natural Compost – Eco-friendly Plastic – Alternate Energy – Hydrogen – Bio-fuels – Solar Energy – Wind – Hydroelectric Power – Mitigation Efforts in India and Adaptation funding

TEXT BOOKS

1. Mridula Ramesh “ The climate solution”, Hachette India Publisher.
2. Alka Sen, “Global Warming and Climate Change” Academic Publication.

REFERENCES

1. Al core ‘Inconvenient Truth’ – video form
2. Dash Sushil Kumar, “Climate Change – An Indian Perspective”, Cambridge University Press India Pvt. Ltd, 2007.
3. IPCC Fifth Assessment Report – www.ipcc.ch
4. Jan C. van Dam, “Impacts of Climate Change and Climate Variability on Hydrological Regimes”, Cambridge University Press, 2003.

CEME SCN	ENVIRONMENTAL IMPACT ASSESSMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To understand the evolution, role, application and the general procedure for EIA
- To impart the concept of Environmental Management Systems (EMS).
- To impart / inculcate the knowledge of Environmental Auditing, Life cycle Assessment (LCA).
- To introduce the concept and role of Cleaner Production, Sustainable Development and ISO 14000 series.
- To understand the rules and regulations governing EIA and EIA case studies.

UNIT I

Evolution of EIA – Concepts – Methodologies – Screening – Scoping – Base line Studies – mitigation – Matrices – Checklist.

UNIT II

Rapid EIA – Comprehensive EIA – Legislative and Environmental Clearance procedure in India – prediction tools for EIA.

UNIT III

Assessment of Impact on Air – Soil – Water – Noise – Biological – Socio–Cultural Environment. Public participation – Resettlement and Rehabilitation procedures – Sustainable Development.

UNIT IV

Documentation of EIA – EMP – Post project Monitoring – EIA case studies. Environmental Auditing – Various types of Audit – Philosophy - concepts – rules and relevant methodologies.

UNIT V

Concept of Cleaner production - Role of ISO and ISO 14000 in Environmental Management.

TEXT BOOKS

1. Canter R.L., “Environmental Impact Assessment”, McGraw Hill Inc., New Delhi, 1997.
2. Anjaneyalu Y., “Environmental Impact Assessment Methodologies”, B.S. Publications, Hyderabad, 2002.

REFERENCES

1. Lohani B., Evans J.W., Ludwig H., Everitt R.R., Richard A. Carpenter and Tu S.L., “Environmental Impact Assessment for Developing countries in Asia”, Volume 1 – Overview, Asian Development Bank, 1997.
2. Peter Morris and Riki Therivel, “Methods of Environmental Impact Assessment”, Routledge Publishers, 2009.
3. Barry Sadler and Mary McCabe, “Environmental Impact Assessment Training Resource Manual”, UNITED Nations Environment Programme, 2002.
4. Judith Petts, “Handbook of Environmental Impact Assessment Volume I and II”, Blackwell Science, New York, 1999.
5. Ministry of Environment and Forests, “EIA Notification and Sectoral Guides”, Government of India, New Delhi, 2010.
6. The World Bank, “Environmental Impact Assessment Source book, Volume I, II and III”, Washington D.C., 2011.

CEME SCN	TOTAL QUALITY MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To evaluate the principles of quality management and to explain how these principles can be applied within quality management systems.
- To appraise the organisational, communication and teamwork requirements for effective quality management.
- Critically analyse the strategic issues in quality management, including current issues and developments and to devise and evaluate quality implementation plans.

UNIT I

Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention.

UNIT II

Leadership - Quality Statements, Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating.

UNIT III

The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types.

UNIT IV

Quality Circles - Cost of Quality - Quality Function Deployment (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures.

UNIT V

Introduction—Benefits of ISO Registration—ISO 9000 Series of Standards—Sector-Specific Standards—AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements—Implementation—Documentation—Internal Audits—Registration- environmental management System: Introduction—ISO 14000 Series Standards—Concepts of ISO 14001—Requirements of ISO 14001—Benefits of EMS.

TEXT BOOKS

1. Dale H.Besterfield, Carol B.Michna,Glen H. Besterfield, Mary B.Sacre,Hemant Urdhwareshe and Rashmi Urdhwareshe, "Total Quality Management", Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression, 2013.
2. Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.

REFERENCES

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2012.
2. Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.
3. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.
4. ISO9001-2015 standards

CEME SCN	URBAN PLANNING & DEVELOPMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To enable students to develop knowledge on Urban and rural planning.
- To introduce the regulations and laws related to urban planning.
- To educate the importance of zoning in planning.
- To get to know the principles involved in planning public buildings.

UNIT I

Objects of town planning – Economic justification – Principles of Town Planning – Necessity of Town Planning – Growth of Towns – Natural and planned growth – stages in Town Development – Distribution of Landuse – Forms of planning – Development of Town Planning in Ancient India – Concepts of Modern Town Planning and its stages.

UNIT II

Types of surveys – Collection of Data – Importance of zoning – Classification of Zoning – Use of zoning – Height zoning – Density zoning – Housing – Planning of neighborhood UNITS – Types of Layouts – Classification of housing – Housing problems in India.

UNIT III

Parks and Playgrounds – Schools – Public buildings and Town Centres – Industries – Industrial Estates – Communication and Traffic system – Traffic surveys – Traffic congestions – Types of road junctions – Parking facilities – Street lighting.

UNIT IV

Urban Renewal – Replanning of the existing towns – Objects of replanning – Necessity of Replanning – Advantages of Master plan – Data and Maps – Features of Master plan – Implementation of Master Plan – Planning law and Legislation in India – Building Bye laws – Functions of Local authority – Development – Control Rules for Metropolitan and District Municipalities.

UNIT V

Concept of rural planning – Urban and Rural differences – Urbanization – Principles of Rural planning – Village redevelopment – Integral Rural development program – Rural housing – Principles – Design of Rural Housing – Rural Housing schemes – Group housing – Environmental Sanitation in Rural planning – Usage of low cost materials.

TEXT BOOKS

1. Rangwala. S.C., “Town Planning”, Charotar Publications House Pvt. Ltd., Gujarat, 26th Edition, 2013
2. Thooyavan. K.R., “Human Settlements – A Planning Guide to Beginners”, M.A. Publications, Chennai, 2005

REFERENCES

1. Chennai Metropolitan Development Authority, “Second Master Plan for Chennai”, Government of Tamilnadu, Chennai, 2008
2. “Tamilnadu Town and Country Planning Act 1971”, Government of Tamilnadu, Chennai, 1971.
3. Goel. S.L.,”Urban Development and Management”, Deep and Deep Publications, New Delhi, 2002
4. Wellmann and Marcus, ‘Urban Infrastructure and Finance Management, Wiley Blackwell, UK 2012.

CEHE SCN	SPECIAL CONCRETE STRUCTURES	L	T	P	C
		4	0	0	4

COURSE OBJECTIVES

- To expose the students to the design practices of complicated RCC structures like Deep beams, R.C.poles, storage containers and elevated water tanks.
- To understand the significance of various code specifications in design of special concrete structures.
- To introduce the different types of philosophies related to design of special concrete structures.

UNIT I

Analysis and Design of Building frames - Analysis for vertical and horizontal loads - Method of substitute frames – Portal method - Cantilever method - Factor method. Design of portal frames with vertical loads – Design of gable frames with vertical loads - Design of deep beams using strut and tie concept – Design of Concrete Corbels for crane loads – Design of Grid floors - Detailing of reinforcement as per relevant standards.

UNIT II

Design of Concrete Poles as per IS 785: 1965 – Design of Concrete Hume Pipes as per IS 458:1971 – Design of R.C. Chimneys as per IS 4998 (Part I): 1992 – Design of Portal frames as per SP 43: 1987 –Detailing of reinforcement as per relevant standards.

UNIT III

Design of Concrete Bunkers as per IS 4995 (Part I,II): 1974 – Design of Concrete Silos as per IS 5503 (Part I) :1969 - Detailing of reinforcement as per relevant standards.

UNIT IV

Design of Elevated Concrete water tanks - Circular tanks - Rectangular tanks - Intze type tanks - Design of staggering – Design of Underground Rectangular and Circular Water tanks - Design of Domes – Detailing of reinforcement as per IS 11992: 1995, IS 3370 (Part IV): 1967 and IS 3370 (Part I): 2009.

UNIT V

Design of Bridge deck Slab - I.R.C.loadings - Design of solid slab bridges – Pigeaud's curves – General design requirements as per IRC: 6-2014 and IRC 21: 2000.

TEXT BOOKS

1. Krishnaraju, N., “Advanced R.C.Design”, CBS Publishers & Distributors Pvt. Ltd., 2012.
2. Punmia, B.C., Ashok Kumar Jain and Arun Kumar Jain, “R.C.Structures - Vol. I & II”, Laxmi Publications (P) Ltd., 1992.

REFERENCES

1. Mallick, S.K. & Gupta, A.P., “Reinforced Concrete”, Oxford I B H, 1987.
2. Park and Paulay, T., “R.C.Structures”, Tata McGraw Hill Publications, 1975.
3. Ramamrutham, S. and Narayan, R., “Design of R.C. Structures”, Dhanpat Rai and Sons, 1992.
4. Dayaratnam, P., “Design of RC Structures”, Oxford & IBH Publishing Co., 2000.
5. Punmia, B. C., “R.C.Structures – Vol. II”, Standard Publishers, 1991.

STANDARDS

1. IS 456: 2000, Code of Practice for Plain and Reinforced Concrete, Bureau of Indian Standards, New Delhi.
2. IS 13920: 1993, Ductile Detailing of Reinforced Concrete structures subjected to Seismic Forces - Code of Practice
3. SP 34: 1987, Handbook on Concrete Reinforcement and Detailing.
4. IRC: 6-2014, Standard Specifications and Code of Practice for Road Bridges Section: II (Loads And Stresses).
5. IRC 21: 2000, Standard Specifications and Code of Practice for Road Bridges Section: III [Cement Concrete (Plain And Reinforced)].
6. IS 1343:1980, Code of Practice for Pre-stressed Concrete, Bureau of Indian Standards, New Delhi, 2012.
7. IS 2974 (Part I):1982, Code of Practice for Design and Construction of Machine Foundations (Foundation for Reciprocating Type Machines).
8. IS 2974 (Part II):1980, Code of Practice for Design and Construction of Machine Foundations [Foundations for Impact Type Machines (Hammer Foundations)].
9. IS 2974 (Part III): 1992, Design and Construction of Machine Foundations - Code of Practice [Foundations for Rotary Type Machines (Medium and High Frequency)].
10. IS 2974 (Part IV):1979, Code of Practice for Design and Construction of Machine Foundations (Foundations for Rotary Type Machines of Low Frequency).
11. IS 4995 (Part I): 1974, Criteria for Design of Reinforced Concrete Bins for the Storage of Granular and Powdery Materials (General Requirements and Assessment of Bin Loads).
12. IS 4995 (Part II):1974, Criteria for Design of Reinforced Concrete Bins for Storage of Granular and Powdery Materials (Design Criteria).

13. IS 9178 (Part II):1979, Criteria for Design of Steel Bins for Storage of Bulk Materials (Design Criteria).
14. IS 5503 (Part I) :1969, General Requirements for Silos for grain storage (Construction requirements)
15. IS 4998 (Part I): 1992, Criteria for Design of Reinforced (Assessment of Loads).
16. IS 3370 (Part IV): 1967, Code Of Practice for Concrete Structures for the Storage of Liquids.
17. IS 11992: 1995, Criteria for Design Of RCC Staging For Overhead Water Tanks.
18. IS 3370 (PART I): 2009, Concrete Structures for Storage of Liquids - Code of Practice.
19. IRC: 6-2014, Standard Specifications and Code of Practice for Road Bridges Section: II (Loads And Stresses).
20. IRC 21: 2000, Standard Specifications and Code of Practice for Road Bridges Section III [Cement Concrete (Plain And Reinforced)].