Puducherry Technological University, Puducherry – 605014

(A Technological University of Government of Puducherry)

Curriculum and Syllabi

for

B.Tech.(Civil Engineering)

(Effective from Academic year 2024-25)

(Subject to the Approval of the Fifth Academic Council meeting of Puducherry Technological University)

CURRICULUM AND SYLLABUS

The Curriculum of B.Tech. (Civil Engineering) is designed to fulfil the Program Educational Objectives (PEO) and the Program Outcomes (PO) listed below.

PROGRAM EDUCATIONAL OBJECTIVES (PEO)

PEO1	To prepare and train students in the fundamentals of mathematical and physical sciences and the fundamentals of other engineering disciplines, to help them to formulate and understand various Civil Engineering problems.
PEO2	To prepare and train students with comprehensive technical knowledge in all the domains of Civil Engineering, which will help them to understand, analyse, design, and execute various Civil Engineering Projects and Problems, throughout their professional life.
PEO3	To appreciate and encourage students, the needs of society and tackle real-life problems, and provide novel/ innovative solutions.
PEO4	To highlight to the students the managerial and organizational skills, ethics and the soft skills that are needed to become an entrepreneur/professional engineer, either individually or in collaboration with other engineers.
PEO5	To Train students in such a way that they can pursue higher studies so that they can contribute to the teaching professionals/research and development of Civil Engineering and other allied fields.

PROGRAM OUTCOMES (PO)

PO1	**Engineering Knowledge:** Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.
PO2	**Problem Analysis:** Identify, formulate, review research literature and analyse complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)
PO3	**Design/Development of Solutions:** Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)
PO4	**Conduct Investigations of Complex Problems:** Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).
PO5	**Engineering Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)
PO6	**The Engineer and The World:** Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).

PO7	**Ethics**: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)
PO8	**Individual and Collaborative Team work:** Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
PO9	**Communication:** Communicate effectively and inclusively within the Engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences
PO10	**Project Management and Finance:** Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.
PO11	**Life-Long Learning:** Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

PROGRAM SPECIFIC OUTCOMES (PSO)

PSO1	Graduates of the Programme should have complete technical knowledge in all the fields of Civil Engineering to Prepare for Competitive examinations namely GATE, IES etc. for placement in the government sectors.
PSO2	Graduates of the programme should be multi-disciplinary, ethical and have managerial skill to excel in the entrepreneurship in design and construction either individually or a team work.
PSO3	Graduates of the programme should have specific knowledge of Civil Engineering to pursue higher education or instil research capabilities.

Distribution of credits among the subjects grouped under various categories

Courses are grouped under various categories and the credits to be earned in each category of courses are as follows:

Sl. No.	Category	Credits	Course Category Code (CCC)
1	Basic science courses	20	BSC
2	Engineering science courses	6	ESC
3	Professional core courses	94	PCC
4	Professional elective courses	12	PEC
5	Ancillary Stream Courses	12	ANC
6	Ability enhancement courses	10	AEC
7	Skill enhancement courses	6	SEC
8	Value added courses	4	VAC
	Total	**164**	

Semester-wise Courses and Credits

Semester I

Group-II (CS1, CS2, IT1, EE1, EI1, CE1, CE2)

Course Code	Course	CCC	Periods			Credits
			L	T	P	
	3 weeks compulsory Induction Program					
MAUC101	Mathematics I	BSC	3	1		4
CEUC101	Applied Mechanics	PCC	3	1		4
CYUC101	Chemistry	BSC	3			3
CSUC101	Programming for Problem Solving	ESC	2			2
HSUA101	English for Communication	AEC	2			2
GEUS102	Basic Engineering Skills Laboratory - II	SEC	1		4	3
GEUV102	Essence of Indian Traditional Knowledge	VAC	1			1
CYUC102	Chemistry Laboratory	BSC			2	1
CSUC102	Computer Programming Laboratory	ESC			2	1
Total			15	2	8	
			25			21

CCC - Course Category Code, L-Lecture, T – Tutorial, P – Practical

Semester II

Group-II (CS1, CS2, IT1, EE1, EI1, CE1, CE2)

Course Code	Course	CCC *	Periods			Credits
			L	T	P	
MAUC102	Mathematics II	BSC	3	1		4
CEUC102	Building Technology	PCC	3	1		4
PHUC101	Physics	BSC	3			3
MEUC101	Engineering Graphics	ESC	1		4	3
HSUA102	Professional English	AEC	2			2
GEUS102	Basic Engineering Skills Laboratory - I	SEC	1		4	3
GEUV101	NSS, Yoga and Health	VAC			2	1
PHUC102	Physics Laboratory	BSC			2	1
Total			13	2	12	
			27			21

CCC - Course Category Code, L-Lecture, T – Tutorial, P – Practical

Exit option for the students who opt to exit after completion of first year of B.Tech Programme and have secured a minimum of 42 credits will be awarded a UG certificate in a discipline if, in addition they complete one vocational course of 4 credits during the summer vacation of the first year.

Semester III

Course Code	Course	CCC	Periods			Credits
			L	T	P	
CEUC103	Mechanics of Fluids	PCC	3	1		4
CEUC104	Surveying and Geomatics	PCC	3			3
CEUC105	Mechanics of Solids	PCC	3	1		4
CEUC106	Concrete Technology	PCC	3			3
HSUA103	Entrepreneurship	AEC	2			2
GEUV104	Universal Human Values	VAC	1			1
CEUC107	Computer-Aided Civil Engineering Drawing	PCC			3	1.5
CEUC108	Surveying Laboratory	PCC			3	1.5
Total			15	2	6	-
			23			20

Semester IV

Course Code	Course	CCC	Periods			Credits
			L	T	P	
CEUC109	Mechanics of Materials	PCC	3	1		4
MAUC103	Numerical Methods and Statistics	BSC	3	1		4
CEUC110	Geotechnical Engineering	PCC	3			3
CEUC111	Hydraulics Engineering	PCC	3			3
CEUC112	Environmental Engineering	PCC	3			3
HSUA104	Design Thinking	AEC	2			2
GEUV103	Environmental Education	VAC	1			1
CEUC113	Materials Testing and Evaluation Laboratory-I	PCC			3	1.5
CEUC114	Fluid Mechanics Laboratory	PCC			3	1.5
Total			18	2	6	
			26			23

Course Code	Course	CCC	Periods			Credits
			L	T	P	
CEXXXXX	Ancillary stream course 1	ASC	3			3
CEUH101	Advanced Surveying	HNC	3	1		4

Exit Option for the students who opt to exit after completion of second year of B.Tech Programme and have secured a minimum of 88 credits will be awarded a UG Diploma in a discipline if, in addition, they complete one vocational course of 4 credits during the summer vacation of the second year.

Semester V

Course Code	Course	CCC	Periods			Credits
			L	T	P	
CEUC115	Structural Analysis	PCC	3	1		4
CEUC116	Structural Concrete Design	PCC	3	1		4
CEUC117	Transportation Engineering	PCC	3			3
HSUA105	Industrial Economics and Management	AEC	2			2
CEUEXXX	Professional Elective 1	PEC	3	1		4
CEUC118	Material Testing and Evaluation Laboratory-II	PCC			3	1.5
CEUC119	Geotechnical Engineering Laboratory	PCC			3	1.5
Total			14	3	6	
			23			20

Course Code	Course	CCC	Periods			Credits
			L	T	P	
CEXXXXX	Ancillary stream course 2	ASC	3			3
CEUH102	Environmental Impact Assessment and Audit	HNC	3	1		4

Semester VI

Course Code	Course	CCC	Periods			Credits
			L	T	P	
CEUC120	Hydrology Water Resources and Irrigation Engineering	PCC	3			3
CEUC121	Estimation Costing and Valuation	PCC	1		2	3
CEUC122	Design of Steel Structural Elements	PCC	3	1		4
CEUEXXX	Professional Elective 2	PEC	3	1		4
CEUC123	Environmental Engineering Laboratory	PCC			3	1.5
CEUC124	Transportation Engineering Laboratory	PCC			3	1.5
CEUC125	Internship	PCC				2
Total			10	2	8	
			20			19

Course Code	Course	CCC	Periods			Credits
			L	T	P	
CEXXXXX	Ancillary stream course 3	ASC	3			3
CEUH103	Coastal and Offshore Structures	HNC	3	1		4

Exit Option for the students who opt to exit after completion of third year of B.Tech Programme and have secured a minimum of 133 credits will be awarded a B.Sc. (Engg.) in a discipline.

Semester VII

Course Code	Course	CCC	Periods			Credits
			L	T	P	
CEUC126	Foundation Engineering	PCC	3	1		4
CEUC127	Construction Management	PCC	3	1		4
CEUC128	Industrial Waste Disposal and Treatment	PCC	3			3
CEUEXXX	Professional Elective 3	PEC	3	1		4
CEUC129	Computer Aided Analysis, Design and Detailing of RC Structural Elements	PCC	1		3	2
CEUC130	Mini project	PCC			4	2
CEUC131	Comprehensive viva	PCC				1
Total			13	3	7	
			23			20

Course Code	Course	CCC	Periods			Credits
			L	T	P	
CEXXXXX	Ancillary stream course 4	ASC	3			3
CEUH104	Highway and Airport Pavement Design	HNC	3	1		4

Semester VIII

Course Code	Course	CCC	Periods			Credits
			L	T	P	
CEUC132	Project work	PCC			16	8
Total					16	
			16			8

Course Code	Course	CCC	Periods			Credits
			L	T	P	
CEUH105	Seminar	HNC	3			2

List of Professional Elective Courses

Professional Elective	Course code	Course	Semester
Professional Elective I	CEUE101	Disaster Management	V
	CEUE102	Design of Prestressed Concrete Structures	
	CEUE103	Construction Equipment's and Resource Planning	
	CEUE104	Environmental Geotechnology	
	CEUE105	Formwork for Concrete Structures	
Professional Elective II	CEUE106	Safety Practices in Construction	VI
	CEUE107	Advanced Structural Analysis	
	CEUE108	Geotechnical Processes and Application	
	CEUE109	Irrigation Engineering	
	CEUE110	Advanced Reinforced Concrete Structures	
Professional Elective III	CEUE111	Bridge Engineering	VII
	CEUE112	Earthquake Resistant Structures	
	CEUE113	Railways, Airport and Harbour Engineering	
	CEUE114	Design and Construction of Prefabricated Structures	
	CEUE115	Advanced Steel Design	

Ancillary Stream Elective Course:

Ancillary stream title: GREEN CONCEPTS & ENVIRONMENT (Offered to Other Department students)	
Course code	**Course Name**
CEUN101	Ecofriendly Building Materials for Construction
CEUN102	Disaster Management
CEUN103	Air, Water and Noise Pollution
CEUN104	Environmental Health and Safety

Ancillary stream title: EMERGING TECHNOLOGIES (Interdisciplinary-For students of CE Department)	
Course code	**Course Name**
CEUI101	Robotics and Automation
EIUC151	Instrumentation and Sensor Technologies for Civil Engineering Applications
CEUI103	Non-Destructive Testing
CEUI104	3D Printing and Advanced Material Science

Courses offered under various categories:

CCC	Course Code	Course	Semester	Credit	Total Credit
BSC	MAUC101	Mathematics – I	I	4	20
	PHUC101	Physics	II	3	
	CYUC101	Chemistry	I	3	
	PHUC102	Physics laboratory	II	1	
	CYUC102	Chemistry Laboratory	I	1	
	MAUC102	Mathematics –II	II	4	
	MAUC103	Numerical Methods and Statistics	IV	4	
ESC	CSUC101	Programming for Problem Solving	I	2	6
	CSUC102	Computer Programming Laboratory	I	1	
	MEUC101	Engineering Graphics	II	3	
PCC	CEUC101	Applied Mechanics	I	4	94
	CEUC102	Building Technology	II	4	
	CEUC103	Introduction to Fluid Mechanics	III	4	
	CEUC104	Surveying and Geomatics	III	3	
	CEUC105	Introduction to Solid Mechanics	III	4	
	CEUC106	Concrete Technology	III	3	
	CEUC107	Computer-Aided Civil Engineering Drawing	III	1.5	
	CEUC108	Surveying Laboratory	III	1.5	
	CEUC109	Mechanics of Materials	IV	4	
	CEUC110	Geotechnical Engineering	IV	3	
	CEUC111	Hydraulics Engineering	IV	3	
	CEUC112	Environmental Engineering	IV	3	
	CEUC113	Materials Testing and Evaluation Laboratory-I	IV	1.5	
	CEUC114	Fluid mechanics Laboratory	IV	1.5	
	CEUC115	Structural Analysis	V	4	
	CEUC116	Structural Concrete Design	V	4	
	CEUC117	Transportation Engineering	V	3	
	CEUC118	Material Testing and Evaluation Laboratory-II	V	1.5	
	CEUC119	Geotechnical Engineering Laboratory	V	1.5	
	CEUC120	Hydrology and Water Resources Engineering	VI	3	
	CEUC121	Estimation costing and Valuation	VI	4	
	CEUC122	Design of Steel Structural Elements	VI	4	
	CEUC123	Environmental Engineering Laboratory	VI	1.5	
	CEUC124	Transportation Engineering Laboratory	VI	1.5	
	CEUC125	Internship	VI	2	
	CEUC126	Foundation Engineering	VII	4	
	CEUC127	Construction Management	VII	4	
	CEUC128	Industrial Waste Disposal and Treatment	VII	3	
	CEUC129	Computer Aided Analysis, Design of Structures with detailed drawing	VII	2	
	CEUC130	Mini project	VII	2	
	CEUC131	Comprehensive viva	VII	1	
	CEUC132	Project work	VIII	8	
PEC	CEUE1xx	Professional Elective – I	VI	4	12

	CEUE1xx	Professional Elective – II	VI	4	
	CEUE1xx	Professional Elective – III	VII	4	
AEC	HSUA101	English for Communication	I	2	**10**
	HSUA102	Professional English	II	2	
	HSUA103	Entrepreneurship	III	2	
	HSUA104	Design Thinking	IV	2	
	HSUA105	Industrial Economics and Management	V	2	
SEC	GEUS101	Basic Engineering Skills Laboratory – I	II	3	**6**
	GEUS102	Basic Engineering Skills Laboratory – II	I	3	
VAC	GEUV101	NSS, Yoga and Health	II	1	**4**
	GEUV102	Essence of Indian Traditional Knowledge	I	1	
	GEUV103	Environmental Education	IV	1	
	GEUV104	Universal Human Values	III	1	
ANC	CEXXXXX	Ancillary Stream Elective course	IV-VII	12	**12**
Total					**164**

Department: Civil Engineering			Programme: **B.Tech.**						
Semester : Third			Course Category Code: PCC				Semester Exam Type: TY		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
CEUC103	**Mechanics of Fluids**		3	1	-	4	40	60	100
Prerequisite:									
Course Outcome	**CO1**	Understand the various properties of fluids for the computation of hydrostatic pressures on the hydraulics structures and checking the stability of the floating and submerged bodies							
	CO2	Understand the different types of flow and apply the continuity equation.							
	CO3	Apply Bernoulli's equation to fluid flow problems and boundary layer theory to determine lift and drag forces on a submerged body.							
	CO4	Apply appropriate equations and principles to analyse pipe flow problems.							
	CO5	Understand the use of different fluid flow measuring devices in industries.							
UNIT-I	**Fluid properties**								**Periods: 12**
Density, Specific Weight, Specific Volume, Specific gravity, Compressibility, Viscosity, surface tension, capillarity, vapour pressure. Fluid Statics: Pressure in a fluid, pressure head, Measurement of pressure. Hydrostatic forces on submerged plane and curved surfaces, Buoyancy, Metacenter, stability of floating and submerged bodies.									**CO1**
UNIT-II	**Fluid Kinematics**								**Periods: 12**
Stream line, streak line, path line and stream tube. Types of flow, steady, unsteady, uniform, non- uniform, laminar, turbulent, rotational and irrotational flows. Equation of continuity for one, two, three dimensional flows, stream function and velocity potential function, flow net analysis.									**CO2**
UNIT-III	**Dynamics of Flow & Boundary Layer Theory**								**Periods: 12**
Dynamics of flow: Euler's equation of motion, Bernoulli's equation, simple applications of Bernoulli's equation, Momentum equation. Kinetic energy and Momentum correction factors Boundary Layer thickness, Displacement thickness, Momentum thickness, Energy thickness, Boundary layer growth and separation.									**CO3**
UNIT-IV	**Flow through Pipes**								**Periods: 12**
Laminar flow: Laminar flow through pipes, Hagen Poissuille flow, energy loss. Turbulent flow: Turbulent flow through pipes, Darcy's equation, Minor losses, Energy and Hydraulic gradients, pipes in series and parallel.									**CO4**
UNIT-V	**Flow measurement**								**Periods: 12**
Venturimeter, Orificemeter, Pitot tube, Flow nozzle, and mouthpieces, Flow over notches and weirs, Venturiflume and standing wave flume, Velocity measurement in open channel.									**CO5**
Lecture Periods: 45	**Tutorial Periods: 15**		**Practical Periods:-**				**Total Periods: 60**		

Reference Books:

1. Modi,P.N.,and Seth, S.M., Hydraulics, Fluid Mechanics and Hydraulic Machines, Standard Book House, New Delhi, 2014.
2. Rajput,R.K., Text Book of fluid Mechanics and Hydraulic Machinery, S.Chand& Company, (P)Ltd., New Delhi, 2014.Douglas,J.F., Gasiorek,J.M and Swaffield,J.A., Fluid Mechanics 4thEdn.Pearson Education India,2008.
3. Das M.M Fluid Mechanics and Turbo machines, Prentice Hall of India (P) Ltd New Delhi, 2008.
4. SukumarPati, Text book of Fluid Mechanics & Hydraulic Machines, Tata McGraw-Hill, 2012.
5. Rajput, R.K., Fluid Mechanics & Hydraulic Machines, S.Chand Group, 2014.

CO-PO Mapping

Course Name: **Mechanics of Fluids** Course Code: **CEUC103**

Course outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO1	PSO 2	PSO3
CO1	3	3	2	2	2	2	2	-	1	3	3	3	-	2
CO2	3	3	2	2	2	2	2	-	1	3	3	3	-	2
CO3	3	3	2	2	2	2	2	-	1	3	3	3	-	2
CO4	3	3	2	2	2	2	2	-	1	3	3	3	-	2
CO5	3	3	3	2	2	2	3	-	1	3	3	3	-	2

Score: 3 – High; 2 – Medium; 1 – Low

Department :Civil Engineering			Programme: **B.Tech.**						
Semester : Third			Course Category Code: PCC				Semester Exam Type: TY		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
CEUC104	**Surveying and Geomatics**		3			3	40	60	100
Prerequisite:	NIL								
Course Outcome	**CO1**	Understand the basics of Surveying and its related field application							
	CO2	Utilize the survey knowledge to solve field-associated problems							
	CO3	Carry out preliminary surveying in the field of civil engineering applications such as							
	CO4	structural, highway engineering and geotechnical engineering							
	CO5	Plan a survey, taking accurate measurements, field booking, plotting and adjustment of traverse using various conventional instruments involved in surveying with respect to utility and precision, plan a survey for applications such as road alignment and height of the building undertake measurement and plotting in civil Engineering							
UNIT-I	**Fundamentals of Surveying and Levelling**							**Periods: 9**	
Classification and basic principles of surveying: Chain: Chaining and accessories for ranging methods of ranging – Compass: Terminology – Types of compass – Types of bearing- Levelling: Principle of Levelling – Temporary and Permanent Adjustments – sources of errors in Levelling – Curvature and refraction - Methods of levelling – Booking.									**CO1**
UNIT-II	**Theodolite and Tachometric Surveying Contouring**							**Periods: 9**	
Theodolite: Horizontal and vertical angle measurements – temporary and permanent adjustments – heights and distances – Tacheometers: stadia constants - Analytic lens – Tangential and stadia Tacheometry surveying. Contour – Characteristics of contours – methods of contouring – Tachometric contouring – Contour gradient – uses of contour plan and map.									**CO2**
UNIT-III	**Control Surveying and Adjustments**							**Periods: 9**	
Triangulation – baseline measurement – horizontal and vertical control – satellite stations – reduction to centre – single and reciprocal observations- traversing – adjustment of sample triangulation networks.									**CO3**
UNIT-IV	**Errors and Adjustments**							**Periods: 9**	
Errors sources: precautions and corrections classification of errors – true and most probable values weighed observations - method of equal shifts – principle of least squares – normal equation – correlates – level nets.									**CO4**
UNIT-V	**Modern Surveying and Equipment.**							**Periods: 9**	
GPS surveying: different segments – space, control and user segments – satellite configuration – signal structure – orbit determination and representation – hand held and geodetic receivers – data processing. GIS: remote sensing and different platforms – sources of EMD – application of GIS in different fields. Modern equipment: total station – advantages – fundamental and working principle – parts and accessories - on board calculation – field procedure - errors and correction									**CO5**
Lecture Periods: 45	**Tutorial Periods: -**		**Practical Periods:-**				**Total Periods: 45**		

Reference Books:

1. Punmia .B.C . , et .al..” Surveying “, Vols, I, Laxmi Publications, 2002
2. SK Duggal.,”Surveying “,VolI,McGraw Hill Education fourth edition
3. Kanetkar, T.P. ,Surveying and leveling, Vols. I & II, United book corporation, Pune.James
4. M. Anderson and Edward M. Mikhail, “Introduction to Surveying”,McGraw-Hill Book Company, 1985.
5. Kanetkar, T.P., and Kulkarni,S.V., Surveying and Levelling, Part I, United book Corporation, Pune. 1998.
6. Shahani, P.B., Text book of Surveying, Vol.I, Oxford &IBH Publications, 1998
7. HeribertKahmen and Wolfgang Faig, “Surveying”, Walter de Gruyter, 1995.

CO-PO Mapping

Course Name: **Surveying and Geomatics** Course Code: **CEUC104**

Course outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO3
CO1	3	3	3	3	3	2	2	-	3	3	3	3	3	2
CO2	3	3	3	3	3	2	2	-	3	3	3	3	3	2
CO3	3	3	3	3	3	2	2	-	3	3	3	3	3	2
CO4	3	3	3	3	3	2	2	-	3	3	3	3	3	2
CO5	3	3	3	3	3	2	2	-	3	3	3	3	3	2

Score: 3 – High; 2 – Medium; 1 – Low

Department : Civil Engineering		Programme: **B.Tech.**						
Semester : Third		Course Category Code: PCC				Semester Exam Type: TY		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
CEUC105	**Mechanics of Solids**	3	1	0	4	40	60	100
Prerequisite:								
Course Outcome	**CO1**	Understand and evaluate the stress and strain of a given solid material subjected to the elastic loads.						
	CO2	Calculate, describe, and estimate the axial load, shear force, bending, and torsion on the elastic bodies.						
	CO3	Evaluate the internal stresses and strains through the application of stress transformation equations and Mohr's circle						
	CO4	Understand the mechanism of torsion on the structural elements and the design of shells subjected to internal and external pressures.						
	CO5	Understand stability and buckling phenomena of the slender member subjected to axial load.						

UNIT – I	**Stresses & strains**	**Periods: 12**
Simple Stresses and Strains – Tension, compression and shear stresses - Hooke's law - Working stress – Factor of safety – Lateral strain, Poisson's ratio and volumetric strain Elastic constants, Relationship between Elastic constants- compound stresses -thermal stresses – Compound bars. Strain Energy – Resilience – Gradual, sudden, impact and shock loadings – simple applications.		**CO1**
UNIT – II	**Analysis of beams, frames and trusses**	**Periods: 12**
Shear force and bending moment diagrams for beams and frames- Analysis of trusses by methods of joints, method of sections and Tension Coefficient method.		**CO2**
UNIT – III	**Bending stress and Shear stress**	**Periods: 12**
Theory of simple bending –Bending stress distribution at sections (point of contra flexure). Beams of uniform strength. Shear stress distribution due to bending –Complex stresses – Two dimensional system, stress at a point on a plane - Principal planes and stresses-Mohr's circle.		**CO3**
UNIT – IV	**Torsion**	**Periods: 12**
Theory of simple Torsion – Torsional rigidity –torsion of circular shafts. Thin cylinder, shells and Thick cylinders. Springs – open & closed coil springs- leaf springs, Shear Centre of Angle and Channel sections		**CO4**
UNIT – V	**Columns**	**Periods: 12**
Columns – Euler's theory – Rankine – Jordon formula – Columns with initial curvature and eccentric loads–Long columns- Laterally loaded columns, Combined direct and bending stresses. Application to masonry dams and retaining walls		**CO5**

Lecture Periods: 45	**Tutorials Periods: 15**	**Practical Periods: -**	**Total Periods: 60**

Reference Books:

1. Bhavikatti. S.S., Strength of Materials, Vikas Publishing House (P) Ltd., New Delhi, Second Edition, 2012.
2. Hearn, E. J., Strength of Materials, Pergamon Press, Oxford, 1997.
3. Punmia. B. C., Jain, A. K., and Jain, A. K., Strength of Materials and Theory of Structures,Vols. I & II, XI Edition, Laxmi Publications (P) Ltd, New Delhi, 2002
4. Shah.H.J. and Junnarkar.S.B., Mechanics of structures- Vol.I, Charotar Publishing house, Ltd,, 2012.
5. Surendra Singh, Strength of Materials, Vikas Publishing House, 2013
6. R.Subramaniam, Strength of Materials, Oxford University Press. 2012
7. Rattan, S.S., Strength of Materials, Tata McGraw-Hill, 2011.
8. Arbind Kumar Singh., Mechanics of solids, Printice Hall of India, 2007.

CO-PO Mapping

Course Name: **Mechanics of Solids** Course Code: **CEUC105**

Course outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO1	PSO 2	PSO3
CO1	3	3	3	3	2	2	3	2	3	1	3	3	3	3
CO2	3	3	3	3	2	2	3	2	3	1	3	3	3	3
CO3	3	3	3	3	2	2	3	2	3	1	3	3	3	3
CO4	3	3	3	3	2	2	3	2	3	1	3	3	3	3
CO5	3	3	3	3	2	2	3	2	3	1	3	3	3	3

Department : Civil Engineering		Programme : **B.Tech.**						
Semester : Third		Course Category Code: PCC				Semester Exam Type: TY		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
CEUC106	**Concrete Technology**	3	0	0	3	40	60	100
Prerequisite:								

Course Outcome	**CO1**	Describe the various quality tests to be conducted on the ingredients of concrete namely cement, aggregates, water and the admixtures.
	CO2	Describe the various quality tests to be conducted on the concrete in fresh and hardened state condition.
	CO3	Classify the various types, causes of deterioration of concrete and recommend its durability improvement technique.
	CO4	Design the concrete mix as per the field conditions and evaluate its strength and quality by the non-destructive approach.
	CO5	Recommend and design the various types of concrete to be used for various applications in the construction industry.

UNIT-I	**Materials for Concrete**	**Periods:9**
Portland cement- chemical composition- hydration of Portland cement- heat of hydration- Types of Portland cement- Aggregates- characteristics of aggregate and their significance- chemical & mineral admixtures for concrete		**CO1**
UNIT-II	**Fresh and Hardened Concrete**	**Periods:9**
Properties of fresh concrete- Transition zone- Workability of concrete & its tests- early Volume changes- factors influencing compressive strength- elastic behavior of concrete- drying shrinkage and creep.		**CO2**
UNIT-III	**Durability**	**Periods:9**
Durability of concrete- significant- causes of concrete deterioration- alkali-aggregate reaction- deterioration by chemical actions		**CO3**
UNIT-IV	**Mix Design**	**Periods:9**
Concept of proportioning concrete mixes- mix design- IS code method & ACI method- Exercises. Testing evaluation and control of concrete quality.		**CO4**
UNIT-V	**Special Concrete**	**Periods:9**
Heavy density concrete, underwater concrete, self-compacting concrete, light weight concrete, ready mix concrete, mass concrete, fibre reinforced concrete, Polymer concrete composites		**CO5**

Lecture Periods: 45	**Tutorial Periods:**	**Practical Periods:**	**Total Periods: 45**

Reference Books:

1. Shetty,M.S, Concrete Technology; Theory & Practice, S.Chand& Group, New Delhi, 2014.
2. Santhakumar.A.R, Concrete Technology, Oxford University Press, 2013
3. Gambhir.M.I, Concrete Technology: Theory & Practice, Tata McGraw Hill Co., New Delhi,2013.
4. Gupta. Yp, Concrete Technology& Good Construction Practices, New Age International (p)Ltd., 2013.
5. Neville.Am.&BrooksJi.,Concrete Technology, Pearson Education Ltd., 2013.
6. Krishna Raju.N, Design of Concrete Mixes, CBS Publishers, New Delhi, 2013.

CO-PO Mapping

Course Name: **Concrete Technology** Course Code: **CEUC106**

Course outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO1	PSO 2	PSO3
CO1	3	2	1	2	1	3	1	1	3	3	3	3	3	1
CO2	3	2	1	2	1	3	1	1	3	3	3	3	3	1
CO3	3	3	1	2	1	3	1	1	3	3	3	3	3	1
CO4	3	3	3	2	3	3	1	1	3	3	3	3	3	1
CO5	3	2	2	2	1	3	1	1	3	3	3	3	3	1

Department : Common to all			Programme: **B.Tech.**						
Semester : Third			Course Category Code: AEC			Semester Exam Type:			
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
HSUA103	**Entrepreneurship**		2	-	-	2	40	60	100
Prerequisite:									
Course Outcome	**CO1**	Understand entrepreneurial mindset, problem identification, customer segmentation, and value proposition development.							
	CO2	Develop and validate business models, test solutions, and create a Minimum Viable Product (MVP) through iterative feedback.							
	CO3	Analyze financial planning, revenue models, pricing strategies, and investor expectations for startup funding.							
	CO4	Apply sales, branding, digital marketing, automation, and teamwork strategies to successfully launch and scale a venture.							
UNIT-I	**Problem Identification and Customer Discovery**							**Periods: 6**	
Entrepreneurial mindset – Identifying business opportunities – Effectuation principles – Design Thinking for problem-solving – Consumer segmentation and customer persona – Value Proposition Canvas (VPC) – Unique Value Proposition (UVP) – Market research techniques – Emerging trends: AI in market research.								**CO1**	
UNIT-II	**Business Model and Lean Startup**							**Periods: 6**	
Types of business models – Lean Canvas vs. Business Model Canvas – Competitor analysis – Blue Ocean Strategy – Building and testing Minimum Viable Product (MVP) – Build-Measure-Learn feedback loop – Digital Prototyping tools – Rapid Experimentation – Agile startup methodology.								**CO1, CO2**	
UNIT-III	**Revenue Models, Costing, and Financial Planning**							**Periods: 6**	
Revenue models: Subscription, Freemium, and Pay-per-use – Unit economics: Cost structures and pricing strategies – Funding sources: Bootstrapping, Crowdfunding, Venture Capital – Investor expectations and funding rounds – Pitching to investors – Financial forecasting and break-even analysis – Government startup incentives.								**CO2, CO3**	
UNIT-IV	**Digital Marketing and Sales Strategies**							**Periods: 6**	
Brand positioning and storytelling – Social media marketing and digital presence – SEO, SEM, and paid advertising – Data-driven marketing strategies – Sales funnels – Unique Sales Proposition (USP) – B2B vs. B2C sales – CRM tools for customer engagement – Customer retention strategies.								**CO3, CO4**	
UNIT-V	**Team Building, Compliance, and Scaling**							**Periods: 6**	
Building and managing startup teams – Remote collaboration tools – Business registration and legal compliance – Intellectual Property Rights (IPR) for startups – Growth hacking and automation – Scaling strategies: Expansion and franchising – Emerging trends: AI in entrepreneurship, blockchain applications – Exit strategies: Mergers, acquisitions, IPOs.								**CO5**	
Lecture Periods: 30	**Tutorial Periods:**		**Practical Periods:**			**Total Periods: 30**			

Reference Books:

1. **Eric Ries,** *The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses* by Crown Business, **1st Edition (2011)**.
2. **Alexander Osterwalder & Yves Pigneur,** *Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers*, Wiley, **1st Edition (2010)**.
3. **Ash Maurya,** *Running Lean: Iterate from Plan A to a Plan That Works*, O'Reilly Media, **2nd Edition (2019)**.
4. **Steve Blank** and **Bob Dorf**, *The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company*, K&S Ranch, **1st Edition (2012)**.

CO-PO Mapping

Course Name: **Entrepreneurship** Course Code: **HSUA103**

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PSO 1	PSO 2	PSO 3
CO1	2	3	2	1	3	2	2	2	2	1	1			
CO2	3	3	3	2	3	2	2	3	3	2	2			
CO3	1	2	3	3	2	1	1	2	3	3	2			
CO4	2	2	2	3	2	2	2	3	3	2	2			

Score: 3 – High; 2 – Medium; 1 – Low

Department :Common to all			Programme: **B.Tech.**						
Semester : Third			Course Category Code: VAC			Semester Exam Type:			
Course Code	Course Name:		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
GEUC104	**Universal Human Values**		1	0	0	1	100	0	100
Prerequisite:	-								
Course Outcome	CO1	Develop a Holistic Understanding of Value Education							
	CO2	Foster Personal and Social Harmony							
	CO3	Enhance Awareness of Universal Co-existence							
	CO4	Apply Ethical and Humanistic Principles in Professional and Personal Life							
Module--I	**Introduction to Value Education**							**Periods: 3**	
Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education) Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, Happiness and Prosperity – Current Scenario, Method to Fulfil the Basic Human Aspirations								**CO1**	
Module-II	**Harmony in the Human Being**							**Periods: 3**	
Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Programme to ensure self-regulation and Health								**CO2**	
Module-III	**Harmony in the Family and Society**							**Periods: 3**	
Harmony in the Family – the Basic Unit of Human Interaction, 'Trust' – the Foundational Value in Relationship, 'Respect' – as the Right Evaluation, Other Feelings, Justice in Human-to Human Relationship, Understanding Harmony in the Society, Vision for the Universal Human Order								**CO2**	
Module-IV	**Harmony in the Nature/Existence**							**Periods: 3**	
Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels, The Holistic Perception of Harmony in Existence								**CO3**	
Module-V	**Implications of the Holistic Understanding**							**Periods: 3**	
A Look at Professional Ethics : Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics Holistic Technologies, Production Systems and Management Models-Typical Case Studies, Strategies for Transition towards Value-based Life and Profession								**CO4**	
Lecture Periods: 15	**Tutorial Periods: 0**		**Practical Periods: 0**				**Total Periods: 15**		

Reference Books:

1. Student Induction Program Handbook v2 by AICTE NCC-IP sub-committee: Dr. Rajneesh Arora, Chairman NCC-IP, Dr. Shishir Gaur, Convener NCC-IP, Dr. Ruchir Gupta, Member NCC-IP.
2. A foundation course in R R Gaur R Asthana G P Bagaria HUMAN VALUES and professional ethics , R R Gaur R Asthana G P Bagaria
3. Understanding Human Being, Nature and Existence Comprehensively By UHV Team (https://uhv.org.in/uhve)
4. Teachers' Manual for A Foundation Course in Human Values and Professional Ethics RR Gaur, R Asthana, GP Bagaria

CO-PO Mapping

Course Name: **Universal Human Values** Course Code: **GEUV104**

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	2	2	3	3	2	2	2	3		
CO2	2	2	2	2	2	3	3	3	3	2	3		
CO3	3	2	2	2	2	3	3	2	2	2	3		
CO4	3	2	2	2	3	3	3	2	2	3	3		

Score: 3 – High; 2 – Medium; 1 – Low

Department : Civil Engineering			Programme: **B.Tech.**						
Semester : Third			Course Category Code: PCC				Semester Exam Type: LB		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
CEUC107	**Computer Aided Civil Engineering Drawing**				3	1.5	40	60	100
Prerequisite:	-								
Course Outcome	**CO1**	Use different Commands of selected drafting software to draw Conventional signs and brick bonds, Plan, Section and Elevation of buildings.							
	CO2	Develop Parametric design and the conventions of formal engineering drawing							
	CO3	Draw section and elevation of panelled doors and Windows.							
	CO4	Draw and detail the different components of Stair cases.							
	CO5	Ability to draw Building Drawing as per NBC guidelines in AutoCAD.							

Theory **CO1**

1. Functional planning – Introduction to anthropometrics and ergonomics – Occupancy classification of Buildings –Essentials of National Building Code – Essentials of Building and development rules – Introduction to green building. **CO2**
2. Building Physics : Sun's movement and building: Sun control devices –Exposed walls and Openings
3. Lighting and acoustics **CO3**

Introduction to AutoCAD – Draw and modify tools- Dimensioning-Layers- Blocks-Printing- Two dimensional drawing *3D commands* .

List of Experiments: **CO4**

1. Planning Aspects of Building systems as per National Building Code (NBC).
2. Developing plan and section of doors
3. Developing plan and section of windows and ventilators
4. Developing plan and section of staircase.
5. Developing plan and section of shallow foundations **CO5**
6. Developing section and elevation of single storied residential building.
7. Developing plan of single /two storied Residential building as per Building by-laws.
8. Developing plan of public building like office, dispensary, post office, bank as per building by-laws.

Lecture Periods: -	**Tutorial Periods: -**	**Practical Periods:45**	**Total Periods: 45**

Reference Books:

1. **https://help.autodesk.com/view/ACD/2024/ENU/**
2. Computer Aided Design Laboratory by M. N. Sesha Praksh & Dr. G. S. Servesh –Laxmi Publications 2021

CO-PO Mapping

Course Name: **Computer Aided Civil Engineering Drawing** Course Code: **CEUC107**

Course outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO1	PSO 2	PSO3
CO1	1	2	3	-	-	-	-	3	3	3	3	-	3	-
CO2	2	1	3	-	-	-	1	3	3	3	3	-	2	-
CO3	2	1	3	-	-	-	-	3	3	3	3	-	2	-
CO4	2	-	3	-	-	-	-	3	3	3	3	-	2	-
CO5	2	-	3	-	3	3	-	3	3	3	3	-	3	-

Department : Civil Engineering			Programme: **B.Tech.**						
Semester : Third			Course Category Code: PCC				Semester Exam Type: LB		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
CEUC108	**Surveying Laboratory**		0	0	3	1.5	40	60	100
Prerequisite:	Nil								
Course Outcome	**CO1**	Understand the basics of field-oriented problems in surveying							
	CO2	Understand and utilize the instruments for the appropriate field-oriented							
	CO3	Understand and Utilize the instruments for the measurement of levels of desired points on the ground.							
	CO4	Plan a traverse and plot the selected points on the ground.							
	CO5	Use the appropriate survey instruments for Measuring the distances and height of objects.							
UNIT-I	**Linear and Angular Surveying**					**Periods:**			
1. Chain Traversing. 2. Compass Traversing. 3. Fly levelling using Dumpy level. 4. Check levelling. 5. LS and CS. 6. Contouring. 7. Measurement of horizontal angles by Reiteration method and Repetition method 8. Measurement of vertical angles 9. Tachometry - Stadia system. 10. Tachometry - Tangential system. 11. Setting out works - Foundation marking. 12. Study of Total Station. Setting out works - Simple curve									**CO1** **CO2** **CO3** **CO4** **CO5**
Lecture Periods: -	**Tutorial Periods: -**		**Practical Periods:45**				**Total Periods: 45**		
Reference Books:									
1. Surveying Manual, prepared by Dept of Civil Engg, PTU									

CO-PO Mapping

Course Name: **Surveying Laboratory** Course Code: **CEUC108**

Course outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO1	PSO 2	PSO3
CO1	3	3	3	3	3	3	3	3	3	3	3	1	2	-
CO2	3	3	3	3	3	3	3	3	3	3	3	1	3	-
CO3	3	3	3	3	3	3	3	3	3	3	3	1	3	-
CO4	3	3	3	3	3	3	3	3	3	3	3	1	3	-
CO5	3	3	3	3	3	2	3	3	3	3	3	1	3	-

Score: 3 – High; 2 – Medium; 1 – Low

Department : Civil Engineering		Programme : **B.Tech.**						
Semester : Fourth		Course Category Code: PCC				Semester Exam Type: TY		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
CEUC109	**Mechanics of Materials**	3	1	0	4	40	60	100
Prerequisite:								

Course Outcome	**CO1**	Apply the Various Elastic methods of analysis for calculating the deflections of beams
	CO2	Understand the strain energy due to various types of loads and apply its theorems to find the deflections of beams.
	CO3	Apply the Strain Energy theorems to calculate the deflection in trusses and frames.
	CO4	Analyse the continuous beams for different support conditions subjected to loads and evaluate the bending stresses in the Unsymmetrical sections.
	CO5	Calculate the principal strains using strain rosettes and understand the failure analysis of the materials.

UNIT-I	**Deflection of beams**	**Periods: 12**
Deflection of beams – Double Integration method - Macaulay's method, moment area method –conjugate beam method		**CO1**
UNIT-II	**Energy methods**	**Periods: 12**
Strain energy due to axial, bending, shear and torsional forces – Impact loads. Principle of virtual displacement – principle of minimum potential energy – Castigliano's Theorems – Maxwell – Betti's theorem.		**CO2**
UNIT-III	**Deflection of trusses**	**Periods: 12**
Deflection of trusses and frames **–** strain energy and dummy/unit load methods.		**CO3**
UNIT-IV	**Analysis of continuous beams& unsymmetrical bending**	**Periods: 12**
Analysis of continuous beams using generalized theorem of three moments – shear force and bending moment diagrams. Unsymmetrical bending – principal moments of inertia – stresses due to unsymmetrical bending.		**CO4**
UNIT-V	**Complex strain & Theories of failure**	**Periods: 12**
Complex strains – linear strains for tri-axial state of stress – principle strains in terms of stress – Mohr's strain circle – relationship between Mohr's strain and stress circles. Theories of failure – Brittle and Ductile materials.		**CO5**

Lecture Periods: 45	**Tutorial Periods: 15**	**Practical Periods:**	**Total Periods: 60**

Reference Books:

1. Bhavikatti. S. S., Strength of Materials, Vikas Publishing House (P) Ltd., New Delhi, 2012.
2. Bhavikatti. S. S., Structural Analysis – I, Vikas Publishing House (P) Ltd., New Delhi, 2012.
3. Shah.H.J. and Junnarkar.S.B., Mechanics of structures- Vol.I&Vol.II, Charotar Publishing house, Ltd, 2012.
4. Rattan, S.S., Strength of Materials, Tata McGraw-Hill, 2011.Ramasamy.V, PurushothamaRaj.P, Strength of Materials, Pearson Education Ltd., 2012.
5. Jindal.Uc., Strength of Materials, Pearson Education Ltd.,2012
6. Negi.L.S., Strength of Materials, Tata McGraw-Hill, 2012

CO-PO Mapping

Course Name: **Mechanics of Materials** Course Code: **CEUC109**

Course outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	1	3	-	1	-	-	-	-	2	3	2	3
CO2	3	3	1	2	-	2	-	-	-	-	1	3	-	3
CO3	3	3	2	2	-	2	-	-	-	-	2	3	3	3
CO4	3	3	1	2	-	1	-	-	-	-	2	3	3	3
CO5	3	3	3	2	-	2	-	-	-	-	-	3	2	3

Department : Mathematics		Programme : B. Tech.(Civil)						
Semester: Fourth		Course Category Code: BSC				Exam Type: TY		
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
MAUC103	Numerical Methods and Statistics	3	1	0	4	40	60	100
Prerequisite	Basic Differentiation and Probability Concepts							
Outcome:	CO1	Apply various numerical techniques to solve algebraic and transcendental equations						
	CO2	Solve simultaneous linear equations by make use of direct and iterative methods						
	CO3	Identify intermediate value of a given set of evenly or unevenly spaced data. Solve problems of numerical differentiation and integration						
	CO4	Examine the solution of first order ODE by different numerical method						
	CO5	Understand basic statistics and distributions						

UNIT – I	Algebraic and Transcendental Equations	Periods: 12
Solution of algebraic and transcendental equation by the method of bisection, the method of false position, Newton- Raphson method and Horner's method. Eigen value problem by power method and Jacobi method.		CO1
UNIT – II	Solution of System of Linear Equations	**Periods: 12**
Solution of linear algebraic equation: Gauss and Gauss-Jordan elimination methods and Crout's method. Iterative methods: Gauss-Jacobi, Gauss-Seidel and Relaxation methods. Matrix inversion by Gauss - Jordan elimination.		CO2
UNIT – III	Interpolation, Numerical Differentiation and Integration	**Periods: 12**
Finite Differences, Relation between operators – Interpolation - Newton's forward, backward and divided difference methods and Lagrange's method for unequal intervals. Numerical differentiation in one variable. Numerical integration by Trapezoidal and Simpson's 1/3 rule.		CO3
UNIT – IV	Solution of Ordinary Differential Equations	**Periods: 12**
Single step methods: Taylor series method, Euler, Modified Euler and Improved Euler methods, Runge - Kutta method of fourth order only. Multistep methods: Milne and Adams - Bash forth Predictor –Corrector methods.		CO4
UNIT – V	Probability and Statistics	**Periods: 12**
Probability, Events, Sample space, Axioms of probability, Random variable (Discrete and Continuous), Expectation, Variance, Covariance, Correlation, Regression and Rank correlation.		CO5

Lecture Periods: 45	Tutorial Periods: 15	Practical Periods:	Total Hours: 60

Reference Books:

1. P. Kandasamy, K. Gunavathy and K. Thilagavathy, "Numerical Methods", S. Chand & Company Ltd, New Delhi, 2014
2. M.K. Venkataraman, "Numerical methods in Science and Engineering",National Publishing Company, Madras, 2013
3. B.S. Grewal, "Numerical methods in Engineering & Science", Khanna Publishers, New Delhi, 2013
4. S.S.Sastry: Introductory Methods of Numerical Analysis, Printice Hall publishers , NewDelhi, 2008
5. S.C.Gupta and V.K.Kapoor, Fundamentals of Mathematical Statistics, 10th Edition, Sultan Chand &Sons, New Delhi, 2000.

CO-PO Mapping

Course Name: **Numerical Methods and Statistics** Course Code: **MAUC103**

Course outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	2	1	1	2	-	-	-	1	1	1	3	-	2
CO2	3	2	1	1	2	-	-	-	1	1	1	3	-	2
CO3	3	2	1	1	2	-	-	-	1	1	1	3	-	2
CO4	3	2	1	1	2	-	-	-	1	1	1	3	-	2
CO5	2	1	1	1	2	-	-	-	1	1	1	3	-	2

Department : Civil Engineering		Programme : **B.Tech.**						
Semester : Fourth		Course Category Code: PCC				Semester Exam Type: TY		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
CEUC110	**Geotechnical Engineering**	3	0	0	3	40	60	100
Prerequisite:								
Course Outcome	**CO1**	Understand the soil properties and the minerals for the classification.						
	CO2	Evaluate the permeability of soil to solve any practical problems such as seepage analysis and the flow pressure calculations.						
	CO3	Evaluate the stresses developed in the soil mass due to different loads on the foundation.						
	CO4	Understand the principles of compaction and solve practical problems related to consolidation settlement and time rate of settlement.						
	CO5	Determine the soil shear strength parameters for the field conditions.						

UNIT-I	**Index Properties**	**Periods: 9**
Soil formation – soil minerals – soil structure - three phase system – definitions- inter-relationships (derivations and problems) – Index properties determinations – Grain size analysis-sieve and hydrometer methods- consistency limits and indices- IS soil classification – soil deposits in India.		**CO1**
UNIT-II	**Permeability**	**Periods:9**
Permeability - one dimensional flow, Darcy's law; Seepage through soils - two-dimensional flow, factors affecting permeability, Insitu permeability tests (pumping in and pumping out test), flow nets, uplift pressure.		**CO2**
UNIT-III	**Effective stress and stress Analysis**	**Periods:9**
Principle of effective stress, capillarity, seepage force and quicksand condition Stress due to concentrated load, due to uniformly loaded area, line load strip load- pressure distribution diagrams - contact stress - Westergarrd's analysis. (Derivations and problems)		**CO3**
UNIT-IV	**Soil Compressibility**	**Periods:9**
Compaction in laboratory and field conditions; One-dimension consolidation-consolidation process - consolidation theory – laboratory test – pre-consolidation pressure.		**CO4**
UNIT-V	**Shear Strength**	**Periods:9**
Shear strength- Mohr – coulomb theory – shear strength parameter – laboratory and field tests – pore pressure parameters - stress path - insitu shear strength - factors affecting shear strength - shearing characteristics of sand and clay (problems).		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Reference Books:

1. Purushothama Raj. P, Soil Mechanics and Foundation Engineering, Pearson Education, 2010
2. Ashok Kumar Jain, Punmia, B.C., Soil Mechanics and foundations, Lakshmi Publications ,2013.
3. Braja M. Das Textbook of Geotechnical Engineering, Cengage Leaning, 2009
4. Venkataramiah. C., Geo Technical Engineering, NAIP, 2012.
5. Murthy. V.N.S., A Text Book of Soil Mechanics & Foundation Engineering, CBS publishers, 2013
6. Venkatramaiah.C, Geotechnical Engineering, New Age International (p) Ltd., 2014.

CO-PO Mapping

Course Name: **Geotechnical Engineering** Course Code: **CEUC110**

Course outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	2	2	3	1	1	2	1	2	3	3	2	3
CO2	3	3	3	2	3	1	1	2	1	2	3	3	2	3
CO3	3	3	3	2	2	1	1	2	1	2	3	3	2	3
CO4	3	3	3	2	2	1	1	1	1	2	3	3	3	3
CO5	3	3	2	2	2	1	1	1	1	1	3	3	3	3

Department : Civil Engineering		Programme: **B.Tech.**						
Semester : Four		Course Category Code: PCC				Semester Exam Type: TY		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
CEUC111	**Hydraulics Engineering**	3	0	0	3	40	60	100
Prerequisite:	Nil							
Course Outcome	**CO1**	Understand the concept of flow through open channel, its analysis and channel section design.						
	CO2	Understand and describe the concept of Gradually varied flow and Rapidly varied flow.						
	CO3	Understand the basics and mechanism of centrifugal and reciprocating pump their efficiencies and limitations						
	CO4	Understand the basics and mechanism of various types of turbines and their performance, efficiencies and limitations						
	CO5	Understand and acquire knowledge in designing the model and prototype from the concepts of dimension and model analysis pertaining to hydraulic machineries						
UNIT-I	**Uniform flow**						**Periods: 9**	
Open Channel flow: Types of channel, Velocity distribution, Chezy, Manning and Basin formulae, for uniform flow, most economical section.							**CO1**	
UNIT-II	**Non- Uniform flow**						**Periods: 9**	
Non-uniform flow, critical flow, specific energy, specific force, Dynamic equation for Gradually Varied flow, computation for length of backwater curve, rapidly varied flow- hydraulic jump, types, uses.							**CO2**	
UNIT-III	**Pumps**						**Periods: 9**	
Centrifugal pumps: Classification, work done, minimum starting speed, losses and efficiencies, specific speed, multistage pumps, specific speed, characteristic curves, NPSH, cavitation in pumps. Reciprocating pumps: Types, effects of acceleration and frictional resistance, separation, Air Vessels, work saved by fitting air vessels.							**CO3**	
UNIT-IV	**Turbines**						**Periods: 9**	
Classification, impulse and reaction turbines, characteristic curves, draft tubes, governing of turbines, specific speed, unit quantities concept, similarity, and cavitation.							**CO4**	
UNIT-V	**Dimensional Analysis and Similitude**						**Periods: 9**	
Dimensionless numbers, Dimensional analysis- Rayleigh's method, Buckingham's Laws of similitude, Model Analysis, Distorted models, Principles of analogy.							**CO5**	
Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods:-**				**Total Periods: 45**		

Reference Books:

1. Modi,P.N.,and Seth, S.M., Hydraulics, Fluid Mechanics and Hydraulic Machines, Standard Book House, New Delhi, 2014.
2. Rajput,R.K., Text Book of fluid Mechanics and Hydraulic Machinery, S.Chand& Company, (P)Ltd., New Delhi, 2014.
3. Gupta.S.C, Fluid Mechanics & Hydraulic Machines, Pearson Education Ltd., 2013.
4. Bansal,R.K., Text Book of fluid Mechanics and Hydraulic Machines, Lakshmi Publications(P)Ltd., 2013.
5. Subramanya.K., Fluid Mechanics & Hydraulic Machines-Problems & Solutions, Tata McGraw-hill, 2013
6. Khurmi,R.S., A Text book of Hydraulics Fluid Mechanics & Hydraulic Machines, S.Chand& Company,2014

CO-PO Mapping

Course Name: **Hydraulics Engineering** Course Code: **CEUC111**

Course outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	3	2	2	-	2	3	3	3	-	2
CO2	3	3	3	3	3	2	2	-	2	3	3	3	-	2
CO3	3	3	3	3	3	2	2	-	2	3	3	3	-	-
CO4	3	3	3	3	3	2	2	-	2	3	3	3	2	2
CO5	3	3	3	3	3	2	2	-	2	3	3	2	2	2

Score: 3 – High; 2 – Medium; 1 – Low

Department: Civil Engineering		Programme: **B.Tech.**						
Semester: Four		Course Category Code: PCC				Semester Exam Type: TY		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
CEUC112	**Environmental Engineering**	3	0	0	3	40	60	100
Prerequisite:	Nil							
Course Outcome	**CO1**	Evaluate the water supply demand and sources of water, types of intake structures						
	CO2	Understand the quality of water and treatment system						
	CO3	Develop the analytical skills for design of distribution system						
	CO4	Evaluate the sewage characteristics and sewerage systems						
	CO5	Understand the sewage treatment unit and re-use applications						

UNIT-I	**Sources of Water and Intake Structures**	**Periods:9**
Water Supply Scheme - Objectives and Requirements - Domestic, industrial, commercial and public requirements - Various methods of estimating population - Variations in rate of demand and its effects on design - Surface and groundwater sources - Intake structures, Tube Wells - Sanitary protection of wells		**CO1**
UNIT-II	**Quality of Water and Treatment system**	**Periods:9**
Indian And W.H.O. Standards for Drinking Water - Impurities in Water - Physical, Chemical and Bacteriological Analysis of Water - Quality of Water for Trade Purpose and Swimming Pools. Unit Process of Water Treatment – Principles, Functions and Design of Flocculators, Sedimentation Tanks, Sand Filters, Principles of Disinfection, Water Softening, Aeration, Iron and Manganese removal		**CO2**
UNIT-III	**Distribution System**	**Periods:9**
Service Reservoir Location, Determination of Capacity – Method of Distribution -Layout of Distribution Systems- Design of Distribution System, Analysis of Pipe Networks by Different Methods, Pipe Appurtenance for Distribution System – Pipe Flow Formulae – Pipe Materials- Laying of Pipes-Testing of Pipes- Plumbing Works and Layout of Water Supply System for Buildings, Waste Detection and Prevention, Effects of Corrosion and its Prevention – Water Balance -Water Recharge Methods & Application		**CO3**
UNIT-IV	**Waste Water Engineering**	**Periods:9**
Definitions - General Considerations- Interdependence of Water Supply and Wastewater Disposal– Source and Nature of Wastewater - Combined and Separate System – Surface Drainage - Storm Water Flow – Design of Sewerage Schemes –Design of Flow Rate for Separate, Storm and Combined Systems. Collection and Transport of Sewage - Materials for Sewers - Self Cleansing of Sewers - Full and Partial Flow Conditions - Sewer Sections. Storm Drains and Combined Sewer Systems. - Design Principles and Procedures, Sewer Construction: Sewer Laying under Various Conditions, – Tests for Sewers - Sewer Appurtenances - Manholes - Sewage Characteristics D.O and B.O.D & COD And its Significance, Sampling, Population Equivalent.		**CO4**
UNIT-V	**Sewage Treatment methods and disposal**	**Periods: 9**
Primary Treatment: Basic Principles of Sewage Treatment - Screens, Grit Chamber - Principles of Sedimentation - Design of Settling Tanks - Chemical Precipitation- Biological Treatment and Unit Processes: Contact Beds - Trickling Filter – Design and Operation of Biofilters- Activated Sludge Process: Oxidation Ditch - Principles and Design of Waste Stabilization Lagoon -Principle of Sludge Digestion – Design for Optimum Conditions - Drying Beds. Septic Tanks. Wastewater Disposal and Reuse - Land Disposal - Discharge into Rivers Lakes, 4Rs-Reduce, Reuse, Recycle and Recovery .		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods :-**	**Total Periods: 45**

Reference Books:

1. Duggal, K.N., Elements of Environmental Engineering, S. Chand &Company , New Delhi 2013.
2. Punmia.B.C., Ashok K Jain and Arun K Jain., Water Supply Engineering: Environmental Engineering 1, Laksmi Publications (P) Ltd., 2013.

3. Peavy.H, Rowe.D, and Tchobanoglous, G., Environmental Engineering, Tata McGraw-Hill, 2013
4. Venugopala Rao.P,Text book of Environmental Engineering, Prentice-hall of India Pvt Ltd., 2012.
5. Santosh Kumar Garg, Water Supply Engineering: Environmental Engineering 1, Khanna Publishers, 2013
6. Modi, P.N, Water Supply Engineering: Environmental Engineering 1, Standard Publishers, 2011.
7. Mackenzie L Davis, Water & Wastewater Engineering, Tata McGraw-Hill, 2013.
8.Sol. J. Arceivala, Shyam R. Asolekar, Wastewater Treatment for Pollution Control and Reuse, Tata McGraw-Hill Education, 2006.

CO-PO Mapping

Course Name: **Environmental Engineering** Course Code: **CEUC112**

Course outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	2	3	-	2	-	-	1	1	-	-	-	2	3	-
CO2	3	3	-	2	-	-	1	1	-	-	-	3	3	2
CO3	3	3	3	-	2	3	2	2	-	2	-	3	3	3
CO4	3	3	3	-	2	3	2	3	-	2	-	3	2	3
CO5	3	3	3	2	2	3	2	3	2	2	3	3	3	3

Department : Common to all			Programme: **B.Tech.**						
Semester : Fourth			Course Category Code: AEC				Semester Exam Type:		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
HSUA104	**Design Thinking**		2			2	40	60	100
Prerequisite:									
Course Outcome	**CO1**	Apply Design Thinking to solve engineering problems							
	CO2	Generate creative solutions for real-world problems using brainstorming and other idea-generation techniques							
	CO3	Build and test prototypes to validate design ideas and improve them based on user feedback.							
	CO4	Work in teams and communicate ideas effectively through presentations, reports, and discussions.							
UNIT-I	**Introduction to Design Thinking**								**Periods: 6**
Understanding the Need for Design Thinking in Engineering - Five-Stage Process: Empathize, Define, Ideate, Prototype, Test - Case Studies: How Engineering Innovations Used Design Thinking - Mindset Shift: From Problem-Solving to Human-Centered Design **Team Exercise:** Identify a real-world engineering problem and discuss how Design Thinking can be applied.									**CO1, CO4**
UNIT-II	**Empathize**								**Periods: 6**
Importance of User Research in Engineering Solutions - Techniques: Interviews, Observations, Surveys, Empathy Mapping - Engineering Constraints vs. User-Centric Needs - Role of Emotional Intelligence in Product Development **Team Exercise:** Conduct field research (interview users or observe a process) and create an Empathy Map for an engineering challenge.									**CO1, CO2**
UNIT-III	**Define & Ideate**								**Periods: 6**
Problem Definition Techniques: How to Frame the Right Problem - Creating Point of View (POV) Statements - Brainstorming & Idea Generation Techniques: SCAMPER, Reverse Thinking, Mind Mapping - Evaluating and Selecting Feasible Engineering Solutions **Team Exercise:** Define a problem statement and conduct a Brainstorming Workshop to generate innovative solutions.									**CO2, CO4**
UNIT-IV	**Prototyping**								**Periods: 6**
Importance of Rapid Prototyping in Engineering - Types of Prototypes: Paper, Digital, Physical Models, Simulation - Tools & Technologies: 3D Printing, CAD, Arduino, Low-Code Development - Iteration & Refinement – Learning from Failures **Team Exercise**: Develop a low-fidelity prototype of an engineering solution and present it to peers for feedback.									**CO3, CO4**
UNIT-V	**Testing, Iteration & Implementation**								**Periods: 6**
Methods of Testing: Usability Testing, A/B Testing, Stress Testing - Gathering Feedback: Stakeholder & User Insights - Iteration Strategies: Continuous Improvement & Agile Thinking - Real-World Engineering Applications of Design Thinking **Team Exercise:** Conduct a user test on the prototype, refine it based on feedback, and present the final solution in a showcase session.									**CO3, CO4**
Lecture Periods: 30	**Tutorial Periods:**		**Practical Periods:**				**Total Periods: 30**		
Reference Books:									

1. Michael Lewrick, Patrick Link, and Larry Leifer, *The Design Thinking Toolbox: A Guide to Mastering the Most Popular and Valuable Innovation Methods*, Wiley, 1st Edition, 2020.
2. Teun den Dekker, *Design Thinking*, Noordhoff Uitgevers bv,International Edition, 2020

3. Angèle M. Beausoleil, *Business Design Thinking and Doing*, Palgrave Macmillan Imprint, Springer, 2022
4. Soni Pavan, *Design your Thinking*, Penguin Random House India Publishing, 2020
5. E Balagurusamy, *Design Thinking*, McGraw Hill; First Edition, 2024

CO-PO Mapping

Course Name: **Design Thinking** Course Code: **HSUA104**

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	2	2	2	2	1	2	1	2	3
CO2	3	3	3	2	2	2	-	2	3	2	3
CO3	3	2	3	3	3	2	1	3	2	3	3
CO4	-	-	3	2	-	2	3	3	3	3	2

Score: 3 – High; 2 – Medium; 1 – Low

Department : Humanities and Social Sciences			Programme: **B.Tech.**						
Semester : **Fourth**			Course Category Code: **VAC**				Semester Exam Type: **-**		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
GEUV103	**Environmental Education**		1	-	-	1	100	-	100
Prerequisite:	**-**								
Course Outcome	**CO1**	Recall the concept of environment ecology and Education.							
	CO2	Summarise the effect of population explosion, degradation of environment and global problem due to the anthropogenic activities.							
	CO3	Justify the need of pollution control and sustainable development for future.							
UNIT-I	**Introduction to Environmental Education**								**Periods: 5**
Concept, scope and importance of Environmental Education - Objectives of Environmental Education - Concept of an Ecosystem: Structure and functions, Types of ecosystem (aquatic and terrestrial) - Biodiversity: Levels, values, threats and conservation - Natural resources: Renewable and Non-renewable resources.									**CO1**
UNIT-II	**Environmental degradation and impact**								**Periods: 5**
Human population growth and its impact on environment - Deforestation: Causes and effects due to expansion of agriculture, firewood, mining and building of new habitats - Pollution: Definition, different types of Pollution - Air and water pollution: Causes and effect on environment - Climate change, Global warming, Ozone layer depletion and impacts on human communities.									**CO2**
UNIT-III	**Conservation of environment**								**Periods: 5**
Control measures for various types of Pollution: use of renewable and alternate source of energy - Environmental laws: Environmental Protection Act (1986), Water Act (1974), Air Act (1981) - International agreements: Montreal and Kyoto Protocol, Paris Agreement - Concept of sustainable development and SDGs - Role of government, NGOs and individual in environmental conservation.									**CO3**
Lecture Periods: 15	**Tutorial Periods:**		**Practical Periods:**				**Total Periods: 15**		

Reference Books:

- Singh, J.S., Singh, S.P. and Gupta, S.R., 2014. "Ecology, Environmental Science and Conservation", S. Chand Publishing, New Delhi.
- Sharma, P. D., 2011. "Ecology and Environment", Rastogi Publications.
- Erach Bharucha, 2010. "Text Book of Environmental Studies", University Grants Commission, Universities Press (India) Pvt.Ltd., Hyderabad.

CO-PO Mapping

Course Name: **Environmental Education** Course Code: **GEUV103**

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1					3	1				1			
CO2	1					3	1				1			
CO3					1	3	2	1			2			

Score: 3 – High; 2 – Medium; 1 – Low

Department : Civil Engineering		Programme : **B.Tech.**						
Semester : Fourth		Course Category Code: PCC				Semester Exam Type:LB		
Course Code	Course	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
CEUC113	**Materials Testing and Evaluation Laboratory - I**	0	0	3	1.5	40	60	100
Prerequisite	-							

	CO1	The course will enable the students to evaluate the mechanical properties of materials subjected to the loads and report and verify the same as per Indian standards available and able to know where the mechanical property is used in the engineering design.
	CO2	To analyze the material properties namely modulus of elasticity and modulus of rigidity
	CO3	To calculate the Ultimate tensile, shear, impact and torsional strength.
	CO4	To calculate the Hardness of metal specimens
	CO5	To analyze the Stiffness of helical springs To analyze the Strength of wood parallel and perpendicular to the grains

1. Tension Test on Mild steel and Tor Steel rod specimens 2. Direct Shear Test on Steel Rod Specimens 3. Bend and Re-bend Test on Steel Rod Specimens	**CO1**
4. Brinell Hardness Test on Metal Specimens 5. Rockwell Hardness Test on Metal Specimens 6. Vickers Hardness Test on Metal Specimens	**CO2**
7. Impact Test on Metal Specimens using Izod arrangement 8. Impact Test on Metal Specimens using Charpy arrangement 9. Ductility Test on Sheet metals using Erichsen Cupping	**CO3**
10. Torsion Test on Metal Specimens- 11. Fatigue Test on Metal Specimens- Demonstration only 12. Spring Test- Demonstration only	**CO4**
13. Compression Test on wood Specimens- Parallel and Perpendicular to the Grains 14. Direct Shear Test on Wood Specimens 15. Direct Tension Test on Wood Specimens Static Bend Test on Wood Specimens-both central and non-central loading	**CO5**

Lecture Periods:	**Tutorial Periods:**	**Practical Periods: 45**	**Total Periods: 45**

Reference Books

1. Laboratory manual , prepared by Dept of Civil Engg,. PTU

CO-PO Mapping

Course Name: **Materials Testing and Evaluation Laboratory - I** Course Code: **CEUC113**

Course outcomes	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	3	2	-	3	-	3	1	3	1	1	2	1	-	2
CO2	3	1	-	-	2	3	1	3	1	1	2	1	-	2
CO3	3	1	2	-	2	-	1	3	1	1	2	1	-	2
CO4	3	1	2	-	-	1	1	3	1	1	2	1	-	1
CO5	3	1	2	2	-	-	1	3	1	1	2	1	-	2

Score: 3 – High; 2 – Medium; 1 – Low

Department :Civil Engineering			Programme: **B.Tech.**						
Semester : Four			Course Category Code: PCC				Semester Exam Type: LB		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
CEUC114	**Fluid Mechanics Laboratory**		0	0	3	1.5	40	60	100
Prerequisite:	--								
Course Outcome	**CO1**	Understand and familiarize with various types of instruments used for discharge measurement.							
	CO2	Understand the procedure for measuring the discharge through the channels and pipes							
	CO3	Understand the concepts of stability check of floating bodies							
	CO4	Assess the performance characteristics of pumps							
	CO5	Understand the selection of pumps for the specific use.							
							Periods: 45		

A. Fluid Flow Laboratory 1. Calibration of rectangular and triangular notches 2. Determination of coefficient of discharge for orifices and mouthpieces 3. Calibration of venture meters and orifice meters	**CO1**
4. Verification of Bernoullis theorem 5. Determination of pipe friction 6. Determination of minor losses in pipe due to bends, elbows, sudden contraction, expansion etc.,	**CO2**
7. Determination of Metacentric height of various ship models 8. Determination of force due to Impact of jet on vanes	**CO3**
B. Fluid Machinery Laboratory 1. Study of performance characteristics of centrifugal pump (constant speed) 2. Study of performance characteristics of Reciprocating pump 3. Study of performance characteristics of Submersible pump	**CO4**
4. Study of performance characteristics of Gear pump 5. Test on Francis and Kaplan Turbine 6. Test on Impulse Turbine	**CO5**

Lecture Periods:	**Tutorial Periods:**	**Practical Periods:45**	**Total Periods: 45**

Reference Books:

1. Fluid Mechanics & Fluid Machinery Manual, prepared by Dept of Civil Engg,. PTU

CO-PO Mapping

Course Name: **Fluid Mechanics Laboratory** Course Code: **CEUC114**

Course outcomes	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	2	2	1	3	3	1	1	2	1	1	2	3	1	2
CO2	3	2	1	3	1	1	1	2	1	1	2	1	2	2
CO3	3	3	2	3	1	1	1	3	1	1	2	2	2	2
CO4	3	3	2	3	1	1	1	3	1	1	2	2	2	2
CO5	3	3	2	3	1	1	1	3	1	1	2	3	2	2

Score: 3 – High; 2 – Medium; 1 – Low

Department :Civil Engineering		Programme: **B.Tech.**						
Semester : Fifth		Course Category Code: PCC				Semester Exam Type: TY		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
CEUC115	**Structural Analysis**	3	1	0	4	40	60	100
Prerequisite:								
Course Outcome	**CO1**	Distinguish between stable and unstable and statically determinate and Indeterminate structures.						
	CO2	Apply the slope-deflection and moment distribution methods to analyze the beams and framed structures						
	CO3	Perform ILD analysis for determinate and indeterminate beams for finding the absolute bending moment and absolute shear force.						
	CO4	Perform the analysis of Arch type of structure for finding the various reactions.						
	CO5	Perform the analysis of suspension cable stayed structure for finding the various reactions.						

UNIT-I	**Force Method of Analysis**	**Periods: 12**
Types of frames- Perfect, Imperfect and Redundant pin jointed frames -Statically indeterminate Structures-Analysis of pinned frames (with two degrees of indeterminacy)- Maxwell's method, unit load method-, Strain energy Method- Trusses with lack of fit - Thermal stresses.		**CO1**
UNIT-II	**Displacement Method of Analysis**	**Periods: 12**
Kinematic indeterminacy -Slope-deflection equation, application to continuous beams and rigid frames with and without settlement of supports. Moment distribution Method- Stiffness and carry over factors – Distribution and carry-over of moments - Analysis of continuous beams with and without settlement of supports- Analysis of Single Bay Single Storey Portal Frames including side Sway.		**CO2**
UNIT-III	**Influence lines and Rolling Loads**	**Periods: 12**
ILD for shear, moment and reactions for cantilever and simply supported beams. Moving loads on simply supported beams –single point load, pair of concentrated load and several point loads, uniformly distributed loads– maximum bending moment and maximum shear force –equivalent UDL - absolute maximum bending moment. Muller Breslau Theorem and its application to continuous beams		**CO3**
UNIT-IV	**Arches**	**Periods: 12**
Introduction – Types of Arches – Comparison between Three hinged and Two hinged Arches. Linear Arch. Eddy's theorem. Analysis of Three hinged arches. Normal Thrust and radial shear in an arch. Geometrical properties of parabolic and circular arch. Three hinged circular arch at different levels. Moving loads on arches- Absolute maximum bending moment diagram for a three hinged arch.		**CO4**
UNIT-V	**Cables and suspension Bridges**	**Periods: 12**
Introduction-Components and their functions, Reactions, Tension and length of Suspension Cable- Effect of temperature in suspension cables. Stiffening Girder-Necessity and types. Influence line for cables with three hinged stiffening girders.		**CO5**

Lecture Periods: 45	**Tutorial Periods: 15**	**Practical Periods:-**	**Total Periods: 60**

Reference Books:

1. Bhavikatti. S. S., Structural Analysis, Vols. I & II, Vikas Publishing House (P) Ltd., New Delhi, second Edition, 2002.
2. Punmia. B. C., Jain, A. K., and Jain, A. K., Strength of Materials and Theory of Structures, Vol. II, Eleventh Edition, Laxmi Publications, New Delhi, 2002.
3. Wang. C. K., Intermediate Structural Analysis, McGraw Hill Publishing Co., Tokyo, Fourth Edition, 1989.

CO-PO Mapping

Course Name: **Structural Analysis** Course Code: **CEUC115**

Course outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	1	3	1	3	2	1	1	3	3	3
CO2	3	3	3	3	1	3	1	3	2	1	1	3	3	3
CO3	3	3	3	3	1	3	1	3	2	1	1	3	3	3
CO4	3	3	3	3	1	3	1	3	2	1	1	3	3	3
CO5	3	3	3	3	1	3	1	3	2	1	1	3	3	3

Department : Civil Engineering			Programme : **B.Tech.**						
Semester : Fifth			Course Category Code: PCC				Semester Exam Type: TY		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
CEUC116	**Structural Concrete Design**		3	1	0	4	40	60	100
Prerequisite:									
Course Outcome	**CO1**	Understand the various methods of RCC Design as per Indian Standard Code: 456-2000 for the practice of R.C.C Design.							
	CO2	Analyse and design the singly reinforced, doubly reinforced and flanged sections of RCC structure as per IS:456:2000.							
	CO3	Analyse and design the one way and two way slabs as per IS:456:2000.							
	CO4	Analyse and design the Columns and Lintel Beams as per IS:456:2000.							
	CO5	Analyse and design the Isolated Footings and Staircases as per IS:456:2000.							
UNIT-I	**Basics of structural design**							**Periods:12**	
Basic design concepts – working stress design, ultimate strength design, probabilistic analysis and design, Limit state design-code recommendations. Behaviour of RCC elements under flexure-modular ratio and cracking moment – Analysis at service loads and at ultimate load level.								**CO1**	
UNIT-II	**Design of Beams**							**Periods:12**	
Design of beams – singly reinforced, doubly reinforced and flanged sections. Design for bond, shear and torsion.								**CO2**	
UNIT-III	**Design of Slabs**							**Periods:12**	
Design of one-way and two-way slabs with simply supported boundary condition, Design of one-way slab with fixed boundary condition, Design of two-way slabs with various boundary conditions as per IS:456:2000, Design of continuous (one-way only) slabs as per IS:456:2000. Reinforcement detailing of slabs.								**CO3**	
UNIT-IV	**Design of Columns and lintels**							**Periods:12**	
Design of column – short and long column. Design of column using interaction diagrams. Design of lintels.								**CO4**	
UNIT-V	**Design of footings and Staircases**							**Periods:12**	
Design of shallow footings subjected to axial load and moments- simple isolated footings, sloped footings ; design of staircases								**CO5**	
Lecture Periods: 45	**Tutorial Periods: 15**		**Practical Periods:**				**Total Periods: 60**		

Reference Books:

1. UnnikrishnaPillai and Devdas Menon, Reinforced Concrete Design, Tata McGraw Hill Publishing Company Ltd., New Delhi, Third edition, 2011
2. Shah V.L. and Karve, S.R, Advanced Reinforced Concrete Design, Structures Publications, Pune, 2002.
3. Sinha, S.N, Reinforced Concrete Design, 2nd Edition, Tata Mc-Graw-Hill Publishing Company Limited, New Delhi, 2002.

4. Punmia, B.C and Jain, A.K, Limit state design of Reinforced Concrete, Lakshmi Publications (P) Ltd., New Delhi, First Edition, 2007

CO-PO Mapping

Course Name: **Structural Concrete Design** Course Code: **CEUC116**

Course outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	1	3	1	3	2	1	2	3	3	3
CO2	3	3	3	3	1	3	1	3	2	1	2	3	3	3
CO3	3	3	3	3	1	3	1	3	2	1	2	3	3	3
CO4	3	3	3	3	1	3	1	3	2	1	2	3	3	3
CO5	3	3	3	3	1	3	1	3	2	1	2	3	3	3

Department : Civil Engineering			Programme : **B.Tech.**						
Semester : Fifth			Course Category Code: PCC				Semester Exam Type: TY		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
CEUC117	**Transportation Engineering**		3	0	0	3	40	60	100
Prerequisite:									
Course Outcome	CO1	Understand the various Geometrical design elements of road.							
	CO2	Evaluate the materials used for road construction by conducting laboratory tests and recommend for the Pavement design.							
	CO3	Understand the construction of different pavements and their performance evaluation for further maintenance.							
	CO4	Evaluate the traffic parameters associated with road and design the signalised intersections							
	CO5	Understand and describe the basic elements of Railway Engineering							
UNIT-I	**Highway Geometry**								**Periods:9**
Importance Road transportation - Highway alignment - Requirement, Engineering surveys for highway location. Cross section element, width - camber, design - Speed, sight distances - requirements and design of horizontal and vertical alignments.									**CO1**
UNIT-II	**Highway Materials**								**Periods:9**
Highway materials - Tests on aggregates, subgrade soil & bituminous materials. Pavement Design Factors in the design of flexible and rigid pavements, Group index and CBR methods.									**CO2**
UNIT-III	**Pavement design**								**Periods:9**
IRC recommendations of rigid & flexible pavement design,Pavement construction techniques - Types of pavements- WBM Road construction. Construction of bituminous and rigid pavements. Pavement failures and their remedies. Surface and subsurface highway drainage. Pavement evaluation – structural, functional, Ultrathin White Topping, design of overlays based on Benkelman beam studies, pavement Maintenance.									**CO3**
UNIT-IV	**Traffic Engineering**								**Periods:9**
Traffic Engineering – Fundamentals of traffic flow, Level of service, analysis of Speed studies. Accident studies and analysis. Principles and design of signalized and un-signalized intersections as per IRC standards.									**CO4**
UNIT-V	**Railways Engineering**								**Periods: 9**
Railway engineering: location surveys and alignment; permanent way – gauges, components of permanent way; points and crossings; stations and yards.									**CO5**
Lecture Periods: 45	**Tutorial Periods:**		**Practical Periods:**				**Total Periods: 45**		

Reference Books:

1. Veeraragavan.A, Khanna. S.K., Ceg Justo, Highway Engineering, Nem Chand & Brothers, 2014
2. Sharma, S.K. " Principles Practice and Design of Highway Engineering ", S. Chand & Co Ltd, 2013
3. Kadiyali, L. R., Traffic Engineering and Transport Planning, Khanna Publishers, New Delhi, 2006
4. Saxena, C.S.and. S. Arora. S.A., course in Railway Engineering, Dhanpat Rai & Sons New ,Delhi. 2007.
5. Banks, J. H., Introduction to Transportation Engineering, McGraw-Hill Book Co., 2005.

6. Papacostas, C. S., and Prevedouros, P. D. Transportation Engineering and Planning, Prentice Hall, 3rd edition, 2002.
7. Agarwal, M. M., Indian Railway Track, 14th Edition, Prabha and Co., New Delhi, 2002. 5. Kristi, Lal, Transportation Engineering, PHI, New Delhi, 2008
8. Gupta B. L and Amith Gupta, Highway and Bridge Engg., Standard publishers, and Distributor New Delhi 2003
9. Partha Chakroborthy and Animesh Das, Principles of Transportation Engineering, Prentice Hall of India Pvt. Ltd., New Delhi,2003.
10. Kadiyali, L. R, Lal, N. B, "Principles and practice of highway engineering", Khanna Publishers New Delhi ,2006
11. Sharma, S. K. "Principles Practice and Design of Highway Engineering", S. Chand & Co Ltd. New Delhi, , 2006 6. Robert Horonjeff, Planning & Design of Airports, McGraw Hill Book Co., NewYork, 2007

CO-PO Mapping

Course Name: **Transportation Engineering** Course Code: **CEUC117**

Course outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	2	3	-	3	2	2	-	3	-	-	3	3	3
CO2	2	-	-	-	3		2	2	3	3	3	3	3	3
CO3	2	2	3	2	2	2	2	-	3	3	3	3	3	3
CO4	3	2	3	-	2	2	2	2	3	3	3	3	3	3
CO5	-	-	1	-	2	-	2	2	3	3	3	3	3	3

Department: Humanities & Social Sciences			Programme: **B.Tech.**						
Semester : **Fifth**			Course Category Code: AEC				Semester Exam Type: **TY**		
Course Code	Course Name		Periods/ Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
HSUA105	**Industrial Economics and Management**		2	-	-	2	40	60	100
Pre-requisite	**Nil**								
Course Outcome	**CO1**	Demonstrate economic theories, revenue and cost concepts and set of analytical techniques applied to a variety of economic (and non-economic) and financial management issues.							
	CO2	Implement various management techniques based on the needs							
	CO3	Apply financial planning and Interpret company's income statements and balance sheets to ascertain the financial position of a company.							
	CO4	Apply production planning, project scheduling and financial analysis to economic investment and project management problems.							
	CO5	Understand fundamental marketing concepts, apply them to real-world scenarios, and develop effective marketing strategies.							
UNIT-I	**Micro and Macro Economics and its Applications**								**Periods:6**
Nature and Scope of Economic science – Micro Economics: Economic decisions and Technical decisions, Demand and Supply concepts, Market Equilibrium, Elasticity of Demand, Various concepts of Cost – Break Even Analysis – Market structure. Macro Economics: Measures of National Income – Inflation – Business Cycle.									**CO1**
UNIT-II	**Management Techniques**								**Periods:6**
Introduction to Management – Functions of Management – F.W.Taylor's Scientific Management – Henry Fayol's Principles of Management. Forms of Business Organization, and Types of (Ownership) of a firm.									**CO2**
UNIT-III	**Industrial Finance**								**Periods:6**
Need for Finance –Types of finance – Sources of finance. Final Accounts - Preparation of Trading, Profit and loss Account and Balance Sheet.									**CO3**
UNIT-IV	**Production Management**								**Periods:6**
Types of Production system – Production Planning and control: Planning, Routing, Scheduling, Inspection and Dispatches. Concepts of Productivity – Measurement of Productivity.									**CO4**
UNIT-V	**Marketing Management**								**Periods:6**
Core Concepts of Marketing – Marketing Vs Selling – Channels of Distribution – Promotion Vs. Advertising – Market Research Vs Marketing Research.									**CO5**
Lecture Periods: 30	**Tutorial Periods:** –		**Practical Periods:** –			**Total Periods: 30**			

Reference Books

1. Varshney Maheswari, Managerial Economics, S Chand & Co, New Delhi, 2011.
2. Dutt & Sundaram, Indian Economy, S Chand & Co, New Delhi, 2015.
3. Pandey I.M, Elements of Financial Management Wiley Eastern Ltd, New Delhi, 2015.
4. H.L. Ahuja, Macro Economics for Business and Management, S Chand & Company Ltd, 2011.
5. O.P Khanna, Industrial Engineering and Management, Dhanpat Rai and Sons, 2009.
6. Philip B Kotler, Marketing Management, Mac Millan, NewYork, 2011.

CO-PO Mapping

Course Name: **Industrial Economics and Management** Course Code: **HSUA105**

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1		1				3					2
CO2										3	2
CO3		1								3	2
CO4										3	2
CO5										3	2

Score: 3 – High; 2 – Medium; 1 – Low

Department : Civil Engineering			Programme : **B.Tech.**						
Semester : Fifth			Course Category Code: PCC			Semester Exam Type: LB			
Course Code	Course		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
CEUC118	**Material Testing and Evaluation Laboratory – II**		0	0	3	1.5	40	60	100
Prerequisite	-								
	CO1	Understanding of the basic properties of construction materials, and presents laboratory standards and testing requirements for these materials.							
	CO2	To familiarize the students to do the experiments as per the guidelines of BIS.							
	CO3	To provide the knowledge on the Concrete mix design for the proportioning of concrete ingrediants as per the guidelines of BIS.							
	CO4	Evaluating and reporting the fresh and hardened properties of concrete as per the guidelines of BIS							
	CO5	Evaluating and reporting the properties of bricks and tiles as per the Guidelines of BIS.							

I. Tests on cement	
1. Determination of specific gravity of cement. 2. Determination of standard consistency of cement. 3. Determination of initial and final setting times of cement. 4. Determination of compressive strength of cement mortar.	**CO1**
II. Tests on aggregates	
1. Determination of Specific gravity and water absorption of fine & coarse aggregates. 2. Determination of Fineness modulus of fine aggregate 3. Determination of Fineness modulus of coarse aggregate.	**CO2**
III. Mix Proportioning & Tests on fresh concrete	
1. Mix proportioning of concrete mixes 2. Determination of degree of workability: Slump test	**CO3**
IV. Tests on hardened concrete	
1. Determination of Compressive strength of concrete 2. Determination of Flexural strength of concrete 3. Determination of Splitting tensile strength of concrete	**CO4**
V. Tests on Bricks &Tiles	
1. Water absorption, compressive strength and efflorescence test on bricks 2. Water absorption and modulus of rupture of tiles	**CO5**

Lecture Periods: -	**Tutorials Periods: -**	**Practical Periods: 45**	**Total Periods: 45**

Reference books:

1. Laboratory Manual, prepared by Dept of Civil Engg, PTU

CO-PO Mapping

Course Name: **Materials Testing and Evaluation Laboratory - II** Course Code: **CEUC118**

Course outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	2	-	3	-	3	1	3	1	1	2	1	-	2
CO2	3	1	-	-	2	3	1	3	1	1	2	1	-	2
CO3	3	1	2	-	2	-	1	3	1	1	2	1	-	2
CO4	3	1	2	-	-	1	1	3	1	1	2	1	-	1
CO5	3	1	2	2	-	-	1	3	1	1	2	1	-	2

Score: 3 – High; 2 – Medium; 1 – Low

Department : Civil Engineering			Programme : **B.Tech.**						
Semester : Fifth			Course Category Code: PCC				Semester Exam Type: LB		
Course Code	Course		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
CEUC119	**Geotechnical Engineering Laboratory**		0	0	3	1.5	40	60	100
Prerequisite	-								
	CO1	Understand and describe the IS classification of soils.							
	CO2	Determine and compute the index properties of soil.							
	CO3	Determine and compute the index properties of soil.							
	CO4	Evaluate the other Geotechnical properties of soil used in the design of Geotechnical Structures.							
	CO5	Evaluate the Safe Bearing Capacity of soil for the design of Foundations.							

1. Specific Gravity of CG and FG Soils 2. In-situ unit weight Determination – Core Cutter Method & Water content Determination	**CO1**
3. Grain Size Analysis – Mechanical Method - Dry Sieve Analysis / Wet Sieve Analysis 4. Grain Size Analysis – Sedimentation Analysis - Hydrometer Method	**CO2**
5. Atterberg Limits: Liquid Limit Test and Plastic Limit Test 6. Atterberg Limit: Shrinkage Limit Test & Free Swell Test	**CO3**
7. Laboratory Permeability Test: Constant and Variable Head 8. Standard Proctor Compaction Test	**CO4**
9. Direct Shear Test 10. Unconfined Compression Test 11. Triaxial Shear test – UU Test 12. Visual Soil Identification as per IS Code 13. Consolidation Test (Demo)	**CO5**

Lecture Periods:	**Tutorial Periods:**	**Practical Periods: 45**	**Total Periods: 45**

Reference Books

1. Laboratory manual , prepared by Dept of Civil Engg,. PTU

CO-PO Mapping

Course Name: **Geotechnical Engineering Laboratory** Course Code: **CEUC119**

Course outcomes	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	3	2	-	3	-	3	1	3	1	1	2	1	-	2

CO2	3	1	-	-	2	3	1	3	1	1	2	1	-	2
CO3	3	1	2	-	2	-	1	3	1	1	2	1	-	2
CO4	3	1	2	-	-	1	1	3	1	1	2	1	-	1
CO5	3	1	2	2	-	-	1	3	1	1	2	1	-	2

Score: 3 – High; 2 – Medium; 1 – Low

Department :Civil Engineering			Programme: **B.Tech.**						
Semester : Sixth			Course Category Code: PCC				Semester Exam Type: TY		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
CEUC120	**Hydrology Water Resources and Irrigation Engineering**		3	0	0	3	40	60	100
Prerequisite:									
Course Outcome	**CO1**	Apply the importance of hydrology and its knowledge for the measurement of Precipitation.							
	CO2	Understand Infiltration, Evaporation and Transpiration and Apply its knowledge to measure Infiltration and Interception.							
	CO3	Evaluate the Technique of the Hydrograph to forecast Flood Discharge at various duration.							
	CO4	Understand Geo-Hydrology term in exploration of ground Water potential and evaluate it using various techniques.							
	CO5	Apply the statistical technique to analyze the flood occurrence and frequency, flood routine and flood forecasting							
UNIT-I	**Precipitation, Evapo-transpiration and Infiltration**							**Periods: 9**	
Hydrologic cycle, precipitation, stream flow, evaporation, transpiration and infiltration, types and measurement of precipitation, gauge networks, hyetographs, average depth of precipitation over the basin, mass rainfall curves, intensity duration curves – estimates of missing data and adjustment of records. **Evapo-transpiration and Infiltration:** Evaporation, factors affecting, measurement and estimation of evaporation, transpiration, factors affecting and determination of transpiration, methods of estimating evapo-transpiration, factors affecting and measurement of infiltration, infiltration indices.									**CO1**
UNIT-II	**Groundwater and Runoff**							**Periods: 9**	
Occurrence and movement of ground water, Darcy's law, aquifers – types and specific yield of aquifers and basin, steady & unsteady flow in wells in confined and unconfined aquifers, well loss and specific capacity of a well. **Runoff** : Factors affecting runoff, Hydrograph analysis – Unit hydrograph theory and analysis, Space distribution and variability of runoff, stream flow measurement – selection of site, velocity and discharge measurements – base flow separation methods. Probability Concepts : Rainfall frequency, Flood frequency, Stream flow synthesis – Elements of stochastic methods.									**CO2**
UNIT-III	**Floods Estimation & Flood Routing**							**Periods: 9**	
Probability Concepts: Rainfall frequency, Flood frequency, Design flood, estimation by empirical and statistical methods, Flood control Measures – Levees and flood walls, Flood control reservoirs, Water shed management, Flood forecasting methods, Flood routing (elementary treatment only).									**CO3**
UNIT-IV	**Irrigation**							**Periods: 9**	
Necessity and Importance of Irrigation, advantages and ill effects of Irrigation, types of Irrigation, methods of application of Irrigation water, Indian agricultural soils, methods of improving soil fertility –Crop Rotation, preparation of land for Irrigation, standards of quality for Irrigation water. Soil-water-plant relationship, vertical distribution of soil moisture, soil moisture constants, soil moisture tension, consumptive use, Duty and delta, factors affecting duty- Design discharge for a water course. Depth and frequency of Irrigation, irrigation efficiencies-Water Logging.									**CO4**
UNIT-V	**Reservoirs and canals**							**Periods: 9**	

Storage Works-Reservoirs - Types of reservoirs, selection of site for reservoir, zones of storage of a reservoir, reservoir yield, estimation of capacity of reservoir using mass curve- Reservoir Sedimentation – Life of Reservoir. Types of dams, factors affecting selection of type of dam, factors governing selection of site for a dam. Classification of canals, Design of Irrigation canals by Kennedy's and Lacey's theories, balancing depth of cutting, IS standards for a canal design canal lining. Design Discharge over a catchment, Computation of design discharge- rational formula, SCS curve number method, flood frequency analysis Introductory Part only. Stream Gauging – measurement and estimation of stream flow.	**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods:-**	**Total Periods: 45**

Reference Books:

1. Santosh kumar Garg, Hydrology and Water Resources Engineering, Khanna Publishers, 2013.
2. Satyanarayanamurthy.C., Water Resources Engineering Principles & Practice, New Age International (P) Ltd, 2014.
3. Subramanya.K, Engineering Hydrology, Tata McGraw-Hill, 2013.

CO-PO Mapping

Course Name: **Hydrology and Water Resources Engineering** Course Code: **CEUC120**

Course outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	2	2	-	2	-	2	-	2	1	-	2	3	-	2
CO2	2	3	2	2	-	2	-	3	1	-	2	3	-	2
CO3	2	3	3	1	1	3	-	2	1	2	3	3	-	2
CO4	2	1	-	1	-	3	2	2	1	-	3	3	-	2
CO5	2	2	3	2	1	3	2	3	1	2	3	3	-	2

Score: 3 – High; 2 – Medium; 1 – Low

Department : Civil Engineering		Programme : **B.Tech.**						
Semester : Sixth		Course Category Code: PCC				Semester Exam Type: TY		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
CEUC121	**Estimation Costing and Valuation**	1	0	2	3	40	60	100
Prerequisite:								

Course Outcome	**CO1**	Carry out the method of measurements, unit of measurement for various item of work
	CO2	Analyze, and assess the quantity of materials required for building works as per specifications.
	CO3	Analyze, and assess the quantity of materials required for other Civil Engineering works as per specifications.
	CO4	Evaluate and estimate the cost of expenditure and prepare a detailed rate analysis report.
	CO5	Construct detailed report on estimation and valuation process

UNIT-I	**Introduction**	**Periods:9**
Estimates – types of estimates – Advantages – Method of measurements – Unit of measurement for various item of work – Method of measurement as per IS 1200, method of estimation; Centre line method of estimation – Examples using above methods.		**CO1**
UNIT-II	**Estimation of buildings**	**Periods:9**
Load bearing and framed structures – Calculation of quantities of brick work, RCC, PCC, Plastering, white washing, Color washing and painting for shops, single room & double room building and simple residential buildings with flat roof.		**CO2**
UNIT-III	**Estimation of other structures**	**Periods:9**
Estimating of septic tank, soak pit – Sanitary and water supply installations – Water supply pipe line – Sewer line – Tube well – Open well – Estimate of bituminous and cement concrete roads – Various types of arches – Calculation of brick work and RCC works in arches - Estimate of retaining walls and box culvert.		**CO3**
UNIT-IV	**Specification and rate analysis**	**Periods:9**
Specification: purpose and basic principles of general and detailed specification of various item of work – Earthwork excavation – Cement concrete – Damp proof course – Form work – Brick and stone masonry – Flooring- Painting of wood work. Analysis of rate – Purpose – Quantity of materials per unit rate of work – Requirement of labour and materials for different works – Obtaining the rate for different works using local schedule of rates – Cement mortar – Cement concrete – RCC- Brick masonry – Plastering – Flooring – Painting.		**CO4**
UNIT-V	**Valuation**	**Periods:9**
Valuation – Purpose, definition of common terms used in valuation such as free and lease hold property – Gross income, net income, outgoings, sinking fund, scrap value, salvage value, market value, book value, capital cost and depreciation methods – Valuation of building using different methods with examples – Fixation of rent for a building - Valuation of land - Introduction to software packages		**CO5**

Lecture Periods: 15	**Tutorial Periods:**	**Practical Periods: 30**	**Total Periods: 45**
Reference Books:			

1. Dutta. B.N., Estimating and Costing in Civil Engineering Practice, S.Dutta & Co. Lucknow, 1999.
2. Rangwala.S.C. Valuation of Real Estate Properties, Charoter Publishing House, Anand, 1997.
3. Puducherry Schedule of Rates (PSR), Pondicherry Region, PWD, Government of Puducherry, 2014-

CO-PO Mapping

Course Name: **Estimation Costing and Valuation** Course Code: **CEUC121**

Course outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	1	3	3	2	2	3	2	3	3	-	3	1
CO2	3	2	3	3	3	3	2	3	2	3	3	-	2	1
CO3	3	3	3	3	3	3	2	3	2	3	3	3	3	1
CO4	3	3	1	1	-	2	2	3	2	2	3	-	3	1
CO5	3	3	1	3	-	3	2	3	2	2	3	3	3	1

Department : Civil Engineering		Programme : **B.Tech.**						
Semester : Sixth		Course Category Code: PCC				Semester Exam Type: TY		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
CEUC122	**Design of Steel Structural Elements**	3	1	0	4	40	60	100
Prerequisite:								
Course Outcome	**CO1**	Understand the behaviour of Tension member and design by various design philosophy in simple practical design.						
	CO2	Understand the behaviour of compression member and able to design of with simple and built up sections						
	CO3	Apply the knowledge of Plastic analysis of beams and simple frames for evaluating the plastic moment of resistance.						
	CO4	Understand the behaviour of Built-up beams and apply it for the design of girders.						
	CO5	Understand the behaviour of beam-column connection and design the seated connections using welding and bolted connectors.						

UNIT – I	**Design Tension Members**	**Periods: 12**
Design of tension members – single and compound sections – tension splices – design of lug angles. Failures in bolted and welded joints – design of joints with bolts and welding.		**CO1**
UNIT – II	**Design of Compression Members**	**Periods: 12**
Design of axially and eccentrically loaded members, Built-up columns, Design of Lacings and Battens, Design of Column Splices. Design of column bases.		**CO2**
UNIT – III	**Plastic Analysis & Flexural Design**	**Periods: 12**
Plastic analysis of beams and simple frames. Laterally supported and unsupported members. Design of purlins.		**CO3**
UNIT – IV	**Design of built-up Beams**	**Periods: 12**
Design of gantry girders and plate girders.		**CO4**
UNIT – V	**Design of Joints**	**Periods: 12**
Design of Connections - simple and eccentric, beam-column connections, eccentric joints by bolting and welding – design of stiffened and unstiffened seated connections.		**CO5**

Lecture Periods: 45	**Tutorial Periods:15**	**Practical Periods:**	**Total Periods: 60**

Reference Books

1. Shiyekar, M.R., Limit State Design in Structural Steel, Second Edition, PHI Learning Private Ltd., Delhi, 2013.
2. Shah, V.L., and Veena Gore, Limit state design of Steel Structures, Structures Publications, Pune, 2012.
3. Subramanian, P., Design of steel structures, Oxford Publishers, New Delhi, 2007
4. Bhavikatti, S.S., Design of Steel Structures, IK International Publishing House Pvt Ltd, New Delhi, 2014.
5. Sai Ram K.S., Design of Steel Structures, Pearson Education Ltd., 2013.
6. VirendraGehlot, Ram Chandra, Design of steel structures, Vol.I& II, Standard Publishers, 2012.

CO-PO Mapping

Course Name: **Design of Steel Structural Elements** Course Code: **CEUC122**

Course outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO1	PSO 2	PSO3
CO1	3	2	-	3	3	-	-	-	-	-	2	3	3	2
CO2	3	2	3	3	3	2	-	-	-	2	2	3	3	3
CO3	3	2	3	3	3	-	-	-	-	2	2	3	2	3
CO4	3	3	2	3	3	-	-	-	1	-	3	3	3	2
CO5	3	3	-	3	3	2	-	-	-	-	2	-	3	3

Department: Civil Engineering			Programme: **B.Tech.**						
Semester: Sixth			Course Category Code: PCC				Semester Exam Type: LB		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
CEUC123	**Environmental Engineering Laboratory**		0	0	3	1.5	40	60	100
Prerequisite:	Environmental Engineering								
Course Outcome	**CO1**	Apply the Knowledge of Water Quality for the drinking water standards.							
	CO2	Understand the various Characteristics of Physical, Chemical and Biological Pollutants							
	CO3	Interpret and acquire the Knowledge to Deduct and Quantify Pollutants							
	CO4	Understand the Application of Experimental Findings.							
	CO5	Understand the Disinfection Procedure and Analysis of Residual Pollutants							

1. Determination of Turbidity, pH and Conductivity. **2.** Determination of Alkalinity. **3.** Determination of Chlorides. **4.** Determination of Hardness.	**CO1**
5. Determination of Iron **6.** Determination of Manganese. **7.** Determination of Fluorides.	**CO2**
8. Determination of Total Solids. **9.** Determination of Suspended Solids. **10.** Determination of Dissolved Oxygen.	**CO3**
11. Jar test for the determination of optimum coagulant dose. **12.** Determination of B.O.D. **13.** Determination of C.O.D. **14.** Demonstration of E-Coli and Fecal Coliform test.	**CO4**
15. Demonstration of Plate count (for bacterial analysis of water) **16.** Determination of Residual Chlorine **17.** Demonstration of Ambient Air Quality Monitoring (TSP, RSPM, SOx, NOx) **18.** Ambient Noise Measurement	**CO5**

Lecture Periods: -	**Tutorial Periods: -**	**Practical Periods:45**	**Total Periods: 45**

Reference Books:

1. Laboratory manual , prepared by Dept of Civil Engg,. PTU

CO-PO Mapping

Course Name: **Environmental Engineering Laboratory** Course Code: **CEUC123**

Course outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	2	1	1	1	2	1	2	1	1	1	3	1	-	2
CO2	2	1	1	1	1	2	2	1	1	2	3	1	-	2
CO3	1	1	1	1	1	2	2	2	2	2	2	1	-	2
CO4	3	3	3	3	3	2	3	3	2	3	2	1	-	1

CO5	2	3	3	3	3	2	3	2	2	2	3	1	2	3

Score: 3 – High; 2 – Medium; 1 – Low

Department :Civil Engineering			Programme: **B.Tech.**						
Semester : Sixth			Course Category Code: PCC				Semester Exam Type: LB		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
CEUC124	**Transportation Engineering Laboratory**		0	0	3	1.5	40	60	100
Prerequisite:	Transportation Engineering								
Course Outcome	**CO1**	Understand the various tests to be conducted for finding the physical properties of aggregates.							
	CO2	Able to appreciate the tests for determination of various properties of aggregates							
	CO3	Evaluating the Subgrade materials by conducting CBR test.							
	CO4	Understand the various tests to be conducted for finding the physical properties of bitumen.							
	CO5	Evaluating the stability of bituminous pavements using Marshall Stability test.							

List of Experiments	
Tests on Road Aggregates 1. Determination of Aggregate Impact Value 2. Determination of Aggregate Abrasion Value 3. Shape tests- Elongation and Flakiness Indices 4. Determination of Aggregate Crushing Value 5. Determination of CBR value for unsoaked Sample 6. Determination of CBR value for soaked Sample **Tests on Bitumen** 7. Determination of Penetration value of bitumen 8. Determination of softening point of bitumen 9. Determination of viscosity of bitumen 10. Marshall stability test	**CO1** **CO2** **CO3** **CO4** **CO5**

Lecture Periods: -	**Tutorial Periods: -**	**Practical Periods:45**	**Total Periods: 45**

Reference Books:

1. Highway Materials and Pavement Testing, S.K. Khanna, C.E.G Justo and A Veeraragavan V Edition Nem Chand &Bro 2009

CO-PO Mapping

Course Name: **Transportation Engineering Laboratory** Course Code: **CEUC124**

Course outcomes	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	3	3	3	3	3	3	3	3	3	3	3	2	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	2	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	2	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	2	3	3

CO5	3	3	3	3	3	2	3	3	3	3	3	2	3	3

Score: 3 – High; 2 – Medium; 1 – Low

Department : Civil Engineering			Programme: **B.Tech.**						
Semester : Sixth			Course Category Code: SEC				Semester Exam Type:		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
CEUC125	**Internship**					2	100		100
Prerequisite:									
Course Outcome:	**CO1**	Apply theoretical knowledge gained during coursework to real-world projects and tasks.							
	CO2	Develop soft skills such as communication, teamwork, problem-solving, and time management.							
	CO3	Demonstrate proficiency in relevant industry technologies of Civil Engineering							
	CO4	Handle the demands and challenges of a professional setting							
	CO5	Understand the Modern Tools used in the Field of Civil Engineering							
The student is required to undergo 'internship' in industry / research laboratory / higher learning institution for a period of at least 4 weeks in a maximum of 2 spells during vacations. Each spell of internship shall be for a period of not less than 2 weeks. The main purpose of internship is to enhance the general professional outlook and capability of the student to advance his chances of improving the career opportunities. The student should get prior approval from the Head of the Department before undertaking the internship and submit a detailed report after completion for the purpose of assessment. A departmental committee shall evaluate the performance of the students.									CO1-CO5

CO-PO Mapping

Course Name: **Internship** Course Code: **CEUC125**

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	2	2	2		2			2		2	2	2		
CO2	2	2	2		2			2		2	2	2		
CO3	2	2	2		2			2		2	2	2		
CO4	2	2	2		2			2		2	2	2		
CO5	2	2	2		2			2		2	2	2		

Score: 3 – High; 2 – Medium; 1 – Low

Department : Civil Engineering			Programme : **B.Tech.**						
Semester : Seventh			Course Category Code: PCC				Semester Exam Type: TY		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
CEUC126	**Foundation Engineering**		3	0	0	3	40	60	100
Prerequisite:	Geotechnical Engineering								
Course Outcome	**CO1**	Understand the soil exploration methods for the preparation of the Geotechnical Reports.							
	CO2	Determine the earth pressures on foundations for the design of retaining structures.							
	CO3	Estimate bearing capacity using IS code methods and design the shallow foundation.							
	CO4	Estimate pile and pile group capacity for any kind of soil including group efficiency and negative friction.							
	CO5	Compute the stability of slopes by Friction Circle Method and Swedish Slip Circle Method along with rectification by diverse slope stability techniques.							

UNIT – I	**Soil Exploration**	**Periods : 9**
Introduction - need, planning, stages - depth and spacing of soil-exploration - methods of exploration – Samples - samplers, sampling method – Insitu tests – SPT, CPT, VST, pressure meter - exploration reports.		**CO1**
UNIT – II	**Lateral earth pressure**	**Periods : 9**
Active, passive and earth pressure at rest, Rankine and Coulomb's theory – Rebhann's Method. Earth pressure due to inclined back fill, line load and earth quake load - Cantilever sheet pile wall in granular and clay soil. (Problems). Design of braced excavation (concept only).		**CO2**
UNIT – III	**Shallow foundation**	**Periods : 9**
Types and selection criteria – Shear failures - Bearing capacity Determination using Terzaghi and IS code formula (problems) – SBC form field tests - proportioning of foundation – BC of foundation subjected to moments and earthquake loading – Elastic and Consolidation settlement. Methods to increase BC (Concept		**CO3**
UNIT – IV	**Pile foundations**	**Periods : 9**
Introduction- classification-selection criteria- Individual carrying capacity- static and dynamic approach (problems) – lateral pile carrying capacity - pile group – group carrying capacity - pile load tests- - Negative skin friction - Under reamed piles-IS Codal provisions.		**CO4**
UNIT – V	**Stability of slopes**	**Periods : 9**
Introduction- slopes failure - stability of infinite slope – landslides. Finite slope analysis - Swedish circle method – stability number (problems) – Reinforced slopes.		**CO5**
Lecture Periods : 45	**Tutorials Periods:**	**Practical Periods : -**	**Total Periods : 45**

Reference Books

1. Braja M. Das Principles of Foundation Engineering, Cengage\Delmar Learning India (P) Ltd., 2013.
2. Purushothama Raj. P, Soil Mechanics and Foundation Engineering, Pearson Education Ltd., 2010
3. Arora.Kr., Soil Mechanics & Foundation Engineering, Standard Publishers, 2012.
4. Varghese P.C. Foundation Engineering**,** Prentice-hall of India Pvt. Ltd, 2012.
5. Murthy. V.N.S., A Text Book of Soil Mechanics & Foundation Engineering, CBS publishers, 2013

6. Ashok Kumar Jain, Punmia, B.C., Soil Mechanics and foundations, Lakshmi Publications ,2013

CO-PO Mapping

Course Name: **Foundation Engineering** Course Code: **CEUC126**

Course outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	3	3	3	1	3	3	3	3	1	2
CO2	3	3	3	3	3	3	3	1	3	3	3	3	1	2
CO3	3	3	3	3	3	3	3	1	3	3	3	3	1	2
CO4	3	3	3	3	3	3	3	1	3	3	3	3	1	2
CO5	3	3	3	3	3	3	3	1	3	3	3	3	1	2

Score: 3 – High; 2 – Medium; 1 – Low

Department : Civil Engineering		Programme: **B.Tech.**						
Semester : Seventh		Course Category Code: PCC				Semester Exam Type: TY		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
CEUC127	**Construction Management**	3	1	0	4	40	60	100
Prerequisite:	Nil							
Course Outcome	**CO1**	Understand construction management importance						
	CO2	Able to become aware on organization, planning, scheduling and analysis						
	CO3	Evaluate the project duration through critical path method and PERT.						
	CO4	Acquire the knowledge on how construction projects are administered with respect to contract structures and issues.						
	CO5	Acquire the knowledge on M.I.S and labour, safety and related regulation						
UNIT-I	**Construction Project Management**					**Periods: 12**		
Construction Project- Project Categories, Management objectives, functions – Project Development Process-Project Life Cycle- Project Team-Role of Project Manager- Management failure. construction projects types and features, phases of a project, agencies involved and their methods of execution;						**CO1**		
UNIT-II	**Organization and Planning**					**Periods: 12**		
Definition, Levels of Organization, Principles of Organization, process of organizing, Span of Control, Authority, Responsibility and Delegation –Forms of Organizations-merits and demerits of each. Planning - Objectives, Advantages, Principals, Stages, Work Break Down.						**CO2**		
UNIT-III	**Scheduling and Network Analysis**					**Periods: 12**		
Scheduling: Definition, objectives, Scheduling and Controlling of Projects. Network Techniques in Construction Management- Techniques of planning- Bar charts, Gantt Charts. Networks: basic terminology, types of precedence relationships, preparation of CPM networks: activity on link and activity on node representation, computation of float values, critical and semi critical paths, calendaring networks. PERT- Assumptions underlying PERT analysis, determining three time estimates, analysis, slack computations, calculation of probability of completion. Introduction to Project Monitoring software						**CO3**		
UNIT-IV	**Contracts**					**Periods: 12**		
Types of Contract, Contract document, Condition of Contract, Tender – Tender Notice Tender documents, Acceptance-Deposits by the Contractor- Arbitration-M.Book-Muster roll- Stores.						**CO4**		
UNIT-V	**Labour Legislations and Construction**					**Periods: 12**		
Labour Legislations-Safety in Construction: Objectives, Steps in Safety Programme, Safety Costs, Safety Codes, Occupational Safety and Hazards, Accidents- Causes of Accident,						**CO5**		
Lecture Periods: 45	**Tutorial Periods: 15**	**Practical Periods:-**				**Total Periods: 60**		
Reference Books:								
1. Construction Management Fundamentals, Tata McGraw-Hill, 2019.								
2. Construction Planning & Management, New Age International (P) Ltd., 2014								
3. Chitkara.K.K., Construction Project Management Planning Scheduling and Controlling, TataMcGraw-Hill, 2014								
4. Martand T. Telsang, Industrial and Business Management, S.Chand & Company Ltd., New Delhi, 2001								
5. Kumar NeerajJha, Construction Project Management Theory & Practice, Pearson Education Ltd., 2014.								

CO-PO Mapping

Course Name: **Construction Management** Course Code: **CEUC127**

Course outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	3	3	3	2	3	3	3	3	2	2
CO2	3	3	3	3	3	3	3	2	3	3	3	3	2	2
CO3	3	3	3	3	3	3	3	2	3	3	3	3	2	2
CO4	3	3	3	3	3	3	3	2	3	3	3	3	2	2
CO5	3	3	3	3	3	3	3	2	3	3	3	3	1	2

Score: 3 – High; 2 – Medium; 1 – Low

Department: Civil Engineering			Programme: **B.Tech.**						
Semester: Seventh			Course Category Code: PCC			Semester Exam Type: TY			
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
CEUC128	**Industrial Waste Disposal and Treatment**		3	0	0	3	40	60	100
Prerequisite:	Environmental Engineering								
Course Outcome	**CO1**	Acquire the knowledge on the uses of Water by Industries							
	CO2	Understand the Pre-Treatment Methods for the waste water.							
	CO3	Understand the Treatment of Industrial Wastewater and Safe Disposal of Treated Effluents							
	CO4	Understand the characteristics of Sludge, Treatment and Re-use							
	CO5	Understand the various Industrial Case Studies to study the waste water characteristics and its flow.							
UNIT-I	**Introduction**							**Periods: 9**	
Uses of Water by Industry – Sources and Types of Wastewater, Quality Criteria, Effluent Standards - Individual and Common Effluent Treatment Plants – Population Equivalent, Effects of Industrial Wastes on Streams, Land, Air and Wastewater Treatment Plants.								**CO1**	
UNIT-II	**Pre-Treatment Methods**							**Periods: 9**	
Pretreatment Methods – Process Modification – Methods and Materials Changes – Reduce, Reuse and Recycle Methods, Housekeeping etc. - To reduce Waste Discharge and Strength of the Waste and established methods for By- Products Recovery within the Plant Operations								**CO2**	
UNIT-III	**Treatment Methods for Industrial Waste**							**Periods: 9**	
Equalization – Neutralization - Oil separation – Floatation – Precipitation –Adsorption - Aerobic and Anaerobic Biological Treatments – High-Rate Reactors - Chemical Oxidation – Ozonation Ion Exchange - Membrane technologies – Re-use Schemes of Secondary Sewage for Industrial Feed Water Applications								**CO3**	
UNIT-IV	**Treatment methods for sludge & residuals**							**Periods: 9**	
Residuals of Industrial Waste Treatment – Characteristics of Sludge - Treatment and Reuse - Zero liquid Discharges (ZLD) production of Value Added Products – Green Energy Routes & Carbon Neutral Techniques								**CO4**	
UNIT-V	**Industrial Application**							**Periods: 9**	
Industry and Power Plants - Manufacturing Process Description - Wastewater Characteristics and Waste Treatment Flow Sheet for - Textiles - Tanneries - Pulp and Paper - Chemical Industries - Sugar and Distilleries – Dairy - Iron and Steel - Fertilizers - Pharmaceuticals - Nuclear Power Plants								**CO5**	
Lecture Periods: 45	**Tutorial Periods: -**		**Practical Periods:-**			**Total Periods: 45**			

Reference Books:

1. Eckenfelder. W.W., Industrial Water Pollution Control, McGraw Hill, 2000.
2. Arceivala.S.J. Wastewater Treatment for Pollution Control, Tata Mc.Graw Hill. 2008.
3. M.N.Rao&A.K.Datta, Wastewater Treatment, Oxford &IBH Publications Pvtd.2013.
4. Nemerow,N.L., Theories and Practices of Industrial Wastes Treatment, Addisson and Wesley, 1963.
5. Gurnham,C.F., Principles of Industrial Waste Treatment, John Wiley, New York,1948.

CO-PO Mapping

Course Name: **Industrial Waste Disposal and Treatment** Course Code: **CEUC129**

Course outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	3	3	3	2	3	3	3	1	2	2
CO2	3	3	3	3	3	3	3	2	3	3	3	1	2	2
CO3	3	3	3	3	3	3	3	2	3	3	3	1	2	2
CO4	3	3	3	3	3	3	3	2	3	3	3	1	2	2
CO5	3	3	3	3	3	3	3	2	3	3	3	1	1	2

Department :Civil Engineering		Programme: **B.Tech.**						
Semester : Seventh		Course Category Code: PCC				Semester Exam Type: LB		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
CEUC129	**Computer-Aided Analysis, Design and Detailing of RC Structural Elements**	0	0	4	2	40	60	100
Prerequisite:	Structural Analysis, Design of Concrete Structures, Design of Steel Structures, STAAD PRO							
Course Outcome	**CO1**	Analyze the Continuous beams with and without settlement						
	CO2	Analyze the Frames with vertical and horizontal loads for finding maximum bending moment and shear force.						
	CO3	Analyze the Trusses to find the axial forces in the members						
	CO4	Analyze the Arches for finding axial thrust, shear force and bending moment due to loads.						
	CO5	Analyze, design and detailing of RCC framed structures as per IS:456						

List of Exercise

1. Introduction to STAAD Pro, use of post processor and report generation. **2.** Analysis of Continuous beams with various loads	**CO1**
3. Analysis of Continuous beams with support settlement **4.** Analysis of 2D frames with vertical loads	**CO2**
5. Analysis of 2D frames with vertical and horizontal loads **6.** Analysis of 3D frames with vertical and lateral loads **7.** Analysis of 2 D trusses	**CO3**
8. Analysis of 3D trusses **9.** Analysis of arches	**CO4**
10. Influence line diagram and moment envelope using structural software **11.** Analysis and design of RCC building frames	**CO5**

Lecture Periods:	**Tutorial Periods: -**	**Practical Periods:60**	**Total Periods: 60**

Reference Books:

1. Krishnamoorthy, C.S. and Rajeev, S., Computer Aided Design and Analytical Tools, Narosa, 2019

CO-PO Mapping

Course Name: **Computer Aided Analysis, Design and Detailing of RC Structural Elements**
Course Code: **CEUC130**

Course outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO1	PSO 2	PSO3
CO1	3	3	3	3	3	3	2	3	3	3	3	1	3	3
CO2	3	3	3	3	3	3	2	3	3	3	3	1	3	3
CO3	3	3	3	3	3	3	2	3	3	3	3	1	3	3
CO4	3	3	3	3	3	3	2	3	3	3	3	1	3	3

CO5	3	3	3	3	3	3	2	3	3	3	3	1	3	3

Department : **Civil Engineering**		Programme : **B.Tech**						
Semester : Seventh		Course Category Code: **PCC**				Semester Exam Type:		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
CEUC130	**Mini Project**	0	0	4	2	100	--	100
Prerequisite:	-							
Course Outcome	**CO1**	Carry out literature surveys, understand state of art techniques.						
	CO2	Identify and apply appropriate tools to solve a problem.						
	CO3	Transform knowledge into an algorithmic/experimental process.						
	CO4	Prepare and present reports on the project work.						
	CO5	Able to deliver a technical seminar based on the mini-project work carried out						

The objective of this course is to enable the students to carry out the mini-project in a group. The topic shall be chosen in consultation with the Faculty coordinators. Each group of students is expected to make a detailed review of the literature, formulate the problem, carry out the mini project and prepare a report on the work done. The mini project can be a small project work or it can be a part of the work planned for the main project. The students should present the results of the work in the review committee meetings. A departmental committee shall evaluate the performance of the students.	CO1-CO5

Lecture Periods : -	**Tutorials Periods: -**	**Practical Periods:**	**Total Periods:**

CO-PO Mapping

Course Name: **Mini Project** Course Code: **CEUC131**

Course outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	3	3	3	1	3	3	3	2	2	3
CO2	3	3	3	3	3	3	3	1	3	3	3	2	2	3
CO3	3	3	3	3	3	3	3	1	3	3	3	2	2	3
CO4	3	3	3	3	3	3	3	1	3	3	3	2	2	3
CO5	3	3	3	3	3	3	3	1	3	3	3	2	2	3

Department : **Civil Engineering**			Programme : **B.Tech**						
Semester : Seventh			Course Category Code: **PCC**				Semester Exam Type:		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
CEUC131	**Comprehensive Viva**		0	0	0	1	100	--	100
Prerequisite:	-								
Course Outcome	**CO1**	Demonstrate a broad understanding of the subject area							
	CO2	Present complex concepts in an easy-to-understand way, answering questions confidently.							
	CO3	Handle unexpected and challenging questions.							
	CO4	Respond thoughtfully to feedback and participate actively in discussions.							
	CO5	Understand the Practical difficulties in applying the various forms of solutions to find the feasible solution							
Comprehensive viva is an oral examination conducted to evaluate the critical thinking, analytical abilities, and how well a student can discuss and apply concepts learned throughout their studies. A committee comprising of five faculty members will conduct the comprehensive viva examination and evaluate the students. Experts from the industry may also be included in this committee. The Head of the Department shall constitute this committee.							CO1-CO5		
Lecture Periods : -	**Tutorials Periods: -**		**Practical Periods:-**				**Total Periods:-**		

CO-PO Mapping

Course Name: **Comprehensive Viva** Course Code: **CEUC132**

Course outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	3	3	3	1	3	3	3	2	2	3
CO2	3	3	3	3	3	3	3	1	3	3	3	2	2	3
CO3	3	3	3	3	3	3	3	1	3	3	3	2	2	3
CO4	3	3	3	3	3	3	3	1	3	3	3	2	2	3
CO5	3	3	3	3	3	3	3	1	3	3	3	2	2	3

Department : **Civil Engineering**		Programme : **B.Tech. (CE)**						
Semester : **Eight**		Course Category Code: **PCC**				Semester Exam Type:		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
CEUC132	**Project Work**	0	0	16	8	60	40	100
Prerequisite:	-							
Course Outcome	**CO1**	Apply Civil Engineering Knowledge in Various specializations to model and solve real world problems						
	CO2	Apply Civil Engineering Knowledge to develop products, processes or technologies for sustainable and socially relevant applications.						
	CO3	Function effectively as an individual and as a leader in a team and execute the designated tasks.						
	CO4	Identify technology or research gaps in the Chosen area of Civil Engineering and propose innovative solutions.						
	CO5	Organize and Communicate technical and Scientific findings effectively in written and oral forms.						

The objective of the design project is to enable the students to work in groups of not more than four members in each group on a project involving analytical, experimental, design or combination of these in Civil Engineering. Each project shall have a guide. The student is required to do literature surveys, formulate the problem and form a methodology of arriving at the solution ofthe problem. The evaluation is based on an internal and external evaluation committee.	CO1-CO5

Lecture Periods : -	**Tutorials Periods: -**	**Practical Periods:16**	**Total Periods:16**

CO-PO Mapping

Course Name: **Project Work** Course Code: **CEUC133**

Course outcomes	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	3	3	3	3	3	3	3	1	3	3	3	2	2	3
CO2	3	3	3	3	3	3	3	1	3	3	3	2	2	3
CO3	3	3	3	3	3	3	3	1	3	3	3	2	2	3
CO4	3	3	3	3	3	3	3	1	3	3	3	2	2	3
CO5	3	3	3	3	3	3	3	1	3	3	3	2	2	3

PROFESSIONAL ELECTIVE COURSES

Department : Civil Engineering		Programme: **B.Tech.**						
Semester : Fifth		Course Category Code: PEC				Semester Exam Type: TY		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
CEUE101	**Disaster Management**	4	0	0	4	40	60	100
Prerequisite:								
Course Outcome	**CO1**	Able to realize the increasing vulnerability of the planet in general and India in particular to disasters						
	CO2	Able to understand Categories of Disasters						
	CO3	Able to realize the responsibilities to society						
	CO4	Able to analyse Capacity Development in Disaster Management						
	CO5	Able to create a basis to work towards preparedness and also helps to develop a culture of safety and prevention						

UNIT-I	**Introduction to Disaster Management**	**Periods: 12**
Definition- nature, characteristics and types of Disasters- Causes and effects, Disaster: A Global View- Disaster Profile of India- Disaster Management cycle.		**CO1**
UNIT-II	**Natural Disaster**	**Periods: 12**
Geological and Mountain Area Disasters -Earthquakes- Volcanic Eruption- Landslides- Snow Avalanches - Wind and Water Related Natural Disaster Floods and Flash Floods- Droughts- Cyclones Tsunamis		**CO2**
UNIT-III	**Manmade disaster**	**Periods: 12**
Understanding Man-Made Disasters- Fires and Forest Fires- Nuclear- Biological and Chemical disaster- Road Accidents		**CO3**
UNIT-IV	**Capacity Development in D.M**	**Periods: 12**
Capacity building-Concept- Structural and nonstructural measures- Capacity assessment; strengthening capacity for reducing risk - Counter disaster resources and their utility in disaster management- Legislative support at the state and national levels-Coping strategies- Industrial safety plan		**CO4**
UNIT-V	**Strategies in Disaster Management**	**Periods: 12**
Strategies for disaster management planning- Steps for formulating a disaster risk reduction plan- Disaster management Act and Policy in India- Organisational structure for disaster management in India- Preparation of state and district disaster management plans		**CO5**

Lecture Periods: 60	**Tutorial Periods:**	**Practical Periods:**	**Total Periods: 60**

Reference Books:

1. Alexander, D. Natural Disasters, ULC press Ltd, London, 1993.
2. Carter, W. N. Disaster Management: A Disaster Management Handbook, Asian Development Bank, Bangkok, 1991.
3. Chakrabarty, U. K. Industrial Disaster Management and Emergency Response, Asian Books Pvt. Ltd., New Delhi 2007

4. Abarquez I. & Murshed Z. Community Based Disaster Risk Management: Field Practitioner's Handbook, ADPC, Bangkok, 2004.
5. Goudie, A. Geomorphological Techniques, Unwin Hyman, London 1990.
6. Goswami, S. C. Remote Sensing Application in North East India, PurbanchalPrakesh, Guwahati, 1997.
7. Manual on Natural Disaster Management in India, NCDM, New Delhi, 2001.
8. Disaster Management in India, Ministry of Home Affairs, Government of India, New Delhi, 2011.

CO-PO Mapping

Course Name: **Disaster Management** Course Code: **CEUE101**

Course outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	3	3	3	2	3	3	3	1	1	1
CO2	3	3	3	3	3	3	3	2	3	3	3	1	1	1
CO3	3	3	3	3	3	3	3	2	3	3	3	1	1	1
CO4	3	3	3	3	3	3	3	2	3	3	3	1	1	1
CO5	3	3	3	3	3	3	3	2	3	3	3	1	1	1

Department : Civil Engineering			Programme : **B.Tech.**						
Semester : Fifth			Course Category Code: PEC				Semester Exam Type: TY		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
CEUE102	**Design of Prestressed Concrete Structures**		3	1	0	4	40	60	100
Prerequisite:									
Course Outcome	**CO1**	To determine the losses of prestress and the cable profiles							
	CO2	To design the prestressed concrete beam.							
	CO3	To check the deflections of prestressed concrete beams and design of composite beams							
	CO4	To design tension and compression members							
	CO5	To design water tanks and pipes							
UNIT-I	**Basic Principle of prestressing**								**Periods:12**
Introduction-Principles of pre-stressing-Materials-Losses-Systems of pre-stressing-Simple cable profiles-Load balancing method.									**CO1**
UNIT-II	**Prestressed Concrete Beams**								**Periods:12**
Pre-tensioned and Post-tensioned beams-Principles of designs-Design for flexure, bond and shear – IS Code provisions-Ultimate Strength of pre-stressed concrete beams in flexure and shear- Design of end anchorage Zones using I S Code method.									**CO2**
UNIT-III	**Deflections and Composite Beams**								**Periods:12**
Deflection of pre-stressed concrete members – Methods of pre-stressing-principles of partial pre-stressing –non-pre-stressed reinforcements-Analysis and Design of composite beams.									**CO3**
UNIT-IV	**Axial and Circular prestressing**								**Periods:12**
Design of Tension and Compression members-Circular pre-stressing-Pipes- Water Tanks-Analysis and design –IS-Code provisions									**CO4**
UNIT-V	**Prestressed continuous Beams**								**Periods:12**
Analysis of continuous beams –Primary moment-secondary moment-cable layout-Linear Transformation – Concordant cable.									**CO5**
Lecture Periods: 45	**Tutorial Periods: 15**		**Practical Periods:**				**Total Periods: 60**		

Reference Books:

1.Krishna Raju. N., Prestressed Concrete, Tata McGraw-Hill, 2013.

2.Sinha.N.C, Roy.S.K, Fundamentals of Prestressed Concrete, S.Chand& Company (P) Ltd., 2013.

3. Rajagopalan.N.,Rajagopalan.N, Prestressed Concrete, Narosa Publishing House, 2013.

4.Dayaratnam. P. Prestressed Concrete Structures, Oxford & I B H, 2013.

5.Pandit. G.S, Gupta. S.P, Prestressed Concrete, CBS Publishers and Distributors, 2013.

6.Lin. T.Y. , Ned H Burns, Design of Pre-stressed Concrete Structures, John Wiley & Sons, 2013.

CO-PO Mapping

Course Name: **Design of Prestressed Concrete Structures** Course Code: **CEUE102**

Course outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO1	PSO 2	PSO3
CO1	3	3	3	3	3	2	2	1	3	3	3	3	3	3
CO2	3	3	3	3	3	2	2	1	3	3	3	3	3	3
CO3	3	3	3	3	3	2	2	1	3	3	3	3	3	3
CO4	3	3	3	3	3	2	2	1	3	3	3	3	3	3
CO5	3	3	3	3	3	2	2	1	3	3	3	3	3	3

Department : Civil Engineering		Programme : **B.Tech.**						
Semester : Fifth		Course Category Code: PEC				Semester Exam Type: TY		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
CEUE103	**Construction Equipment and Resource Planning**	3	1	0	4	40	60	100
Prerequisite:	-							

Course outcome	CO1	Able to know the require equipment specially for earthmovers and excavation methods adopted in construction
	CO2	Able to select the required equipment specially for framed structures works in sub and super structures portion effectively
	CO3	Able to select the suitable equipment specially for bridges, Roads and tunnels to optimize the resources according to the limitation of the construction project
	CO4	Able to frame the organization setup and the development of human resources
	CO5	Able to manage construction projects with effective planning and scheduling on the resource's optimization

UNIT – I	**Excavation**	**Periods: 12**
Excavations for foundations and Basement floors – Methods – temporary earth retaining structures: braced wall, lagging wall, sheet pile wall, soil Nailing – Dewatering methods – water proofing methods – Trenching - Excavators – pumps - Under water concreting.		**CO1**
UNIT – II	**Framed structures**	**Periods:12**
Methods and equipments for: Pile foundation, well foundation, and cofferdam. Shoring and under pinning – RCC Diaphragm walls. Methods and equipments for: Scaffolding, Form work, Hoisting and Rigging (cranes), plastering and flooring. Concrete: RMC plants, pumping, finishing, - shotcreting – Building Demolition Techniques.		**CO2**
UNIT – III	**Bridges, Road and Tunnels**	**Periods:12**
Methods and equipments for precast and cast – in – situ of RCC Box girder bridge construction: Balanced cantilever method, Span by Span Method, Incremental lunching methods. – Cable Stayed Bridges – suspension bridges. Methods and equipment's for construction Flexible and rigid pavements, Tunnels in soft ground- Cut and cover method, TBMs, Tunnel Lining		**CO3**
UNIT – IV	**Resources Formulation**	**Periods: 12**
Project Formulation – Meaning, Need, Analysis- Source of Finance, Organization – Definition, Human Resource Management – Objectives, Functions, Recruitment, Selection, Training – Performance Appraisal Steps – Motivation & Leadership.		**CO4**
UNIT – V	**Resources Planning & Scheduling**	**Periods: 12**
Types of resource- Time, Men, Material, Machinery, Money, Space. Balancing of resource- Resource Smoothing technique- Time constraint. Resource levelling technique- Resource constraint- Case study. Resource optimization: Types of cost – Direct, Indirect and Total Cost. Variation of Cost with time. Schedule Compression Techniques- Crashing, Fast Tracking & Re-estimation- Crash time and crash cost. Optimize project cost for time and resource. CPM Cost model.		**CO5**

Total Contact Hours: 45	**Total Tutorials :15**	**Total Practical Class : 0**	**Total Hours: 60**

Reference Books

1. Varghese, P.C., "Building Construction", Prentice Hall India, 2007
2. Punmia B. C. and Khandelwal K.K., "Project Planning and Control with PERT/CPM", Laxmi publications, New Delhi, 1989..
3. AntilJ.M., Civil Engineering Construction, McGraw Hill Book Co., 1982
4. Chudley, R., Construction Technology, ELBS Publishers, 2007.
5. Peurifoy, R.L. Construction Planning, Methods and Equipment, McGraw Hill, 2011
6. Nagarajan.K, Project Management, New Age International Pvt. Ltd Publishers, New Delhi, 2010.
7. National Building Code, Bureau of Indian Standards, New Delhi, 2017
8. Varma., M., Construction Equipment and its Planning & Application, Metropolitan Book Co., 1979
9. Chitkara.K.K., Construction Project Management Planning Scheduling and Controlling,Tata McGraw-Hill, 2014
10. Smith, R.C, Andres, C.K Principles and Practice of Heavy Construction, Prentice Hall, 1986
11. Chew, M. Y. L., Michael Chew Yit Lin Construction Technology for Tall Buildings, 3rd Ed., World Scientific Publishing Co. Pte. Ltd., 2009

CO-PO Mapping

Course Name: **Construction Equipment and Resource Planning** Course Code: **CEUE103**

Course outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	3	3	3	2	3	3	3	2	2	2
CO2	3	3	3	3	3	3	3	2	3	3	3	2	2	2
CO3	3	3	3	3	3	3	3	2	3	3	3	2	2	2
CO4	3	3	3	3	3	3	3	2	3	3	3	2	2	2
CO5	3	3	3	3	3	3	3	2	3	3	3	2	1	2

Department :Civil Engineering			Programme: **B.Tech.**						
Semester : Fifth			Course Category Code: PEC				Semester Exam Type: TY		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
CEUE104	**Environmental Geotechnology**		3	1	0	4	40	60	100
Prerequisite:	Nil								
Course Outcome	**CO1**	Ability to understand the Soil-Pollutant Interaction, Physico-chemical modeling - failures of foundations due to pollutants.							
	CO2	Able to Specify site investigation techniques for characterization of contaminated sites.							
	CO3	Able to Identify contaminant transport mechanisms in soils.							
	CO4	Able to identify the contaminated ground soil for engineering purposes.							
	CO5	Able to understand the control techniques on the remediation of soil pollutant laden system.							
UNIT-I	**Soil- Pollutant Interaction**							**Periods: 12**	
Introduction to geo environmental engineering – environmental cycle – sources, production and classification of waste – causes of soil pollution – factors governing soil-pollutant interaction- Physico-chemical behavior and modeling -failures of foundations due to pollutants.								**CO1**	
UNIT-II	**Characterization, Stabilization and Disposal**							**Periods: 12**	
Safe disposal of waste – site selection for landfills – characterization of land fill sites – waste characterization – stability of landfills – current practice of waste disposal- passive contaminant system - Hazardous waste control and storage system – mechanism of stabilization - solidification of wastes – micro and macro encapsulation – absorption, adsorption, precipitation- detoxification — organic and inorganic stabilization								**CO2**	
UNIT-III	**Transport of Contaminants**							**Periods: 12**	
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 – bearing capacity of compacted fills – pollution of aquifers by mixing of liquid waste – protecting aquifers.								**CO3**	
UNIT-IV	**Detection and Testing Methods**							**Periods: 12**	
Methodology- review of current soil testing concepts – Proposed approach for characterization and identification of contaminated ground soil for engineering purposes.								**CO4**	
UNIT-V	**Remediation of Contaminated Soils**							**Periods: 12**	
Rational approach to evaluate and remediate contaminated sites – monitored natural attenuation – exsitu and insitu remediation – solidification, bio – remediation, incineration, soil washing, electro kinetics, soil heating, verification, bio venting – Ground water remediation – pump and treat, air sparging, reactive well- application of geo synthetics in solid waste management – rigid or flexible liners.								**CO5**	
Lecture Periods: 45	**Tutorial Periods: 15**		**Practical Periods:-**				**Total Periods: 60**		

Reference Books:

1. Mitchell, J. K and Soga, K Fundamentals of Soil Behaviour, John Wiley and Sons Inc., 2005.
2. Rowe, R. K, Geotechnical and Geo environmental Engineering Handbook, Kluwer Academic Publishers,

2001.
3. Fang, H.Y. Introduction to environmental Geotechnology, CRC press New York, 1997.
4. Reddi, L. N. and Inyang, H. F, Geo environmental Engineering - Principles and Applications, Marcel Dekker Inc, 2000.
5. Wentz, C.A., Hazardous Waste Management, McGraw Hill, Singapore, 1989.
6. Daniel, B.E., Geotechnical practice for waste disposal, Chapman and Hall, London, 1993.
7. Lagrega, M.d., Bukingham, P.L., and Evans, J.C., Hazardous Waste Management, McGraw Hill, Inc. Singapore, 1994.

CO-PO Mapping

Course Name: **Environmental Geotechnology** Course Code: **CEUE104**

Course outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	3	3	3	2	3	3	3	1	2	1
CO2	3	3	3	3	3	3	3	2	3	3	3	1	2	1
CO3	3	3	3	3	3	3	3	2	3	3	3	1	2	1
CO4	3	3	3	3	3	3	3	2	3	3	3	1	2	1
CO5	3	3	3	3	3	3	3	2	3	3	3	1	1	1

Department :Civil Engineering			Programme: **B.Tech.**						
Semester : Fifth			Course Category Code: PEC				Semester Exam Type:TY		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
CEUE105	Formwork for Concrete Structures		3	1	0	4	40	60	100
Prerequisite:	Nil								
Course Outcome	**CO1**	To understand the importance of formwork in construction							
	CO2	To apply different formworks materials in different needs							
	CO3	To design forms for simple construction elements							
	CO4	To select suitable forms for specific needs							
	CO5	To design suitable scaffolding with different materials							

UNIT-I	**Formwork materials**	**Periods: 12**
Introduction, requirements, selection and classification of formworks. Formwork materials – Timber, Plywood, Plastic, steel and other materials. Form coatings and linings. Design Concepts-Loads on formwork- estimation of permissible stresses. Maximum Bending Moment, Shear Force, and Deflection		**CO1**
UNIT-II	**Forms for footings, walls and columns**	**Periods: 12**
Conventional Formwork for Foundation, Conventional Wall Formwork, Design illustrations. Conventional Column Formwork, Modular Column Formwork System, Disposable Column Formwork, All Metal Column Formwork, Achieving Formwork Economy in Column Construction, Design illustration for Column Form		**CO2**
UNIT-III	**Slab and Beam Formwork**	**Periods: 12**
Traditional Slab and Beam Formwork, Various Slab and Beam Formwork Solutions Offered, Achieving Economy in Slab Construction, Design of Slab and Beam Formwork, Illustration of Slab and Beam Formwork Design		**CO3**
UNIT-IV	**Formwork for special structures**	**Periods: 12**
Formwork for Shells, Domes, Overhead Water Tanks, Tunnel, Bridge formwork and flying formwork, Advantages and Limitations of Flying Forms, Slip forms Form failures-causes, Avoiding Formwork Failure		**CO4**
UNIT-V	**Formwork Supports and Scaffold**	**Periods: 12**
Shores/Props and Dropheads, Multi-Legged Shoring Towers, Design of Vertical Supports for Formwork, Classification of Scaffolds, Timber Scaffolds and Metal Scaffolds		**CO5**

Lecture Periods: 45	**Tutorial Periods:15**	**Practical Periods:-**	**Total Periods: 60**

Reference Books:

1. K. N.Jha, "Formwork for Concrete Structures" Mc Graw Hill Education Pvt Ltd, New Delhi, 2012
2. Modern Practices in Formwork for Civil Engineering Construction Works" University Science Press. 2014
3. Robert L Peurifoy and G D Oberlender, "Formwork for Concrete Structures" Mc Graw Hill, New York, Fourth Edition 2014
4. PERI Handbook on Formwork Scaffolding Engineering, PERI International 2012

CO-PO Mapping

Course Name: **Formwork for Concrete Structures** Course Code: **CEUE105**

Course outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	3	3	3	2	3	3	3	1	3	2
CO2	3	3	3	3	3	3	3	2	3	3	3	1	3	2
CO3	3	3	3	3	3	3	3	2	3	3	3	1	3	2
CO4	3	3	3	3	3	3	3	2	3	3	3	1	3	2
CO5	3	3	3	3	3	3	3	2	3	3	3	1	3	2

Department : Civil Engineering		Programme : **B.Tech.**						
Semester : Sixth		Course Category Code: PEC				Semester Exam Type: TY		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
CEUE106	**Safety Practices in Construction**	4	0	0	4	40	60	100
Prerequisite:	-							

Course Outcome		
	CO1	Able to understand basic concepts of construction safety
	CO2	Able to appreciate the elements of an Effective Safety Programmes.
	CO3	Able to virtualize the line of safety management.
	CO4	Able to understand the intimacy behind the auditing and safety in construction methods.
	CO5	Able to orient the safety in construction equipments and fire safety.

UNIT – I	**Accidents and related laws**	**Periods: 12**
Construction accidents - Construction Safety Management: Importance - causes of accident, Construction industry related laws– occupational and safety hazard assessment.		**CO1**
UNIT – II	**Safety Procedures**	**Periods: 12**
Elements of an Effective Safety Programmes - Job-site assessment - Safety Meetings - Safety Incentives. Contractual Obligations - Substance Abuse - safety Record Keeping -Safe Workers		**CO2**
UNIT – III	**Safety Professionals and Management**	**Periods: 12**
Safety and First Line Supervisors - Safety and Middle Managers - Top Management Practices, Company Activities and Safety - Project Coordination and Safety Procedures - Workers Compensation -Accident prevention-cost of accidents-accident reporting investigation		**CO3**
UNIT – IV	**Safety Audit and Methods**	**Periods: 12**
Total loss control and damage control- safety audit - safety planning and site preparation-safety system of storing construction materials-Excavation - blasting- timbering-scaffolding- Safety in demolition work		**CO4**
UNIT – V	**Safety in Equipments and fire hazards**	**Periods: 12**
safe use of ladders -Safety in hand tools- Safety in Hoisting apparatus and conveyors-Safety in the use of mobile cranes-Manual handling- - Fire hazards and preventing methods.		**CO5**

Lecture Periods: 60	**Tutorials Periods: -**	**Practical Periods: -**	**Total Periods: 60**

Reference Books:

1. Jimmy W. Hinze, Construction Safety, Prentice Hall Inc., 1997
2. Richard J. Coble, Jimmie Hinze and Theo C. Haupt, Construction Safety and Health Management, Prentice Hall Inc., 2001.
3. Hand Book on Construction Safety Practices, SP: 70, BIS, 2001.
4. Tamilnadu Factory Act, Department of Inspectorate of factories, Tamil Nadu. Health

CO-PO Mapping

Course Name: **Safety Practices in Construction** Course Code: **CEUE106**

Course outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	3	3	3	2	3	3	3	1	3	2
CO2	3	3	3	3	3	3	3	2	3	3	3	1	3	2
CO3	3	3	3	3	3	3	3	2	3	3	3	1	3	2
CO4	3	3	3	3	3	3	3	2	3	3	3	1	3	2
CO5	3	3	3	3	3	3	3	2	3	3	3	1	3	2

Department : Civil Engineering		Programme: **B.Tech.**						
Semester : Sixth		Course Category Code: PEC				Semester Exam Type: TY		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
CEUE107	**Advanced Structural Analysis**	3	1	0	4	40	60	100
Prerequisite:	-							
Course Outcome	**CO1**	Able to apply flexibility and stiffness matrices for each element.						
	CO2	Able to find flexibility and stiffness method for degree of redundancy 3 for continuous beams.						
	CO3	Able to find settlements for rigid joint frames using flexibility and stiffness method.						
	CO4	Able to find flexibility and stiffness method for pin jointed frames with degree of redundancy 3.						
	CO5	Able to find solution techniques.						

UNIT – I	**Strain Energy Methods**	**Periods: 12**
Degree of redundancy- Flexibility and stiffness characteristics of structures- Flexibility and stiffness matrices, and their relationship -Element and global stiffness matrices- Transformation matrices		**CO1**
UNIT – II	**Analysis of continuous beams**	**Periods: 12**
Analysis of continuous beams (with redundancy restricted to three) by flexibility and stiffness method- support settlement- comparison of methods.		**CO2**
UNIT – III	**UNIT –III Analysis of rigid jointed frames**	**Periods: 12**
Analysis of rigid jointed plane frames (with redundancy restricted to three) by flexibility and stiffness method- support settlement- choice of methods		**CO3**
UNIT – IV	**Analysis of pin jointed frames**	**Periods: 12**
Analysis of pin jointed plane frames (with redundancy restricted to three) by flexibility and stiffness method- lack of fit and temperature stress- choice of methods		**CO4**
UNIT – V	**Solution Techniques**	**Periods: 12**
Assembly of structure stiffness matrix – Bandedness – Bandwidth calculation – Solvers – Band width solvers – Triangulation		**CO5**

Lecture Periods: 45	Tutorial Periods: 15	Practical Periods: -	Total Periods: 60

Reference Books:

1. Willium Weaver and James M Gere Matrix Analysis of Framed Structure, Van Nostrand Reinhold Company; 2nd edition.
2. Pandit, G.S. and Gupta S.P., "Structural Analysis- A matrix approach", Tata McGraw Hill Publishing, New Delhi 2014.
3. Natarajan, C and Revathi, P, Matrix methods of structural analysis-Theory and problems, PHI learning Pvt Ltd., New Delhi 2014.
4. Devdas Menon, Advanced Structural Analysis, Narosa Publishing House, 2012

CO-PO Mapping

Course Name: **Advanced Structural Analysis** Course Code: **CEUE107**

Course outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	3	2	2	1	3	3	3	3	2	3
CO2	3	3	3	3	3	2	2	1	3	3	3	3	2	3
CO3	3	3	3	3	3	2	2	1	3	3	3	3	2	3
CO4	3	3	3	3	3	2	2	1	3	3	3	3	2	3
CO5	3	3	3	3	3	2	2	1	3	3	3	3	2	3

Department : Civil Engineering		Programme : **B.Tech.**						
Semester : Sixth		Course Category Code: PEC				Semester Exam Type: TY		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
CEUE108	**Geotechnical Processes and Application**	3	1	0	4	40	60	100
Prerequisite:								
Course Outcome	**CO1**	Able to understand the field compaction and equipment's.						
	CO2	Able to understand the design of dewatering system and sand drains.						
	CO3	Able to understand the types of grouting and grouting equipment's.						
	CO4	Able to understand the different soil reinforcement and chemical Stabilization methods for soil improvement.						
	CO5	Able to understand the design and practical applications of Geo synthetic materials.						

UNIT – I	**Introduction**	**Periods : 12**
Introduction: Need – methods – suitability – Mechanical modification: principle - Surface compaction: Field compaction and equipments, compaction specification and controls. Vibration methods: dynamic consolidation, vibratory rollers, Vibro floatation.		**CO1**
UNIT – II	**Drainage Methods**	**Periods : 12**
Drainage methods: Well point systems, deep well drainage, vacuum dewatering system, design of dewatering system – field permeability tests, dewatering by electro osmosis. Preloading, sand drains, wick drains- Thermal methods case studies.		**CO2**
UNIT – III	**Grouting**	**Periods : 12**
Grouting: Classification – Methods – Types – grouts – equipments, grouting design and layout, grout monitoring – applications – Case studies.		**CO3**
UNIT – IV	**Stabilization**	**Periods : 12**
Stabilization: cement stabilization, Lime stabilisation – chemical stabilistion - methods, principles, applications and field control. Stabilization using reinforcement – rock anchor-soil tie backs.		**CO4**
UNIT – V	**Geo synthesis**	**Periods : 12**
Geo synthetics: Geotextiles, Geogrids, Geomembranes, Geonets, Geomats, Geomeshes, principles Design and applications – Case studies.		**CO5**

Lecture Periods : 45	**Tutorials Periods: 15**	**Practical Periods : -**	**Total Periods : 60**

Reference Books

1. Purushothama raj. P. Ground improvement techniques, Laxmi Publications (P) Ltd, India, 2007
2. Hausmann. M.R. Engineering principles of Ground Modification, McGraw-Hill, 2009
3. Koerner, R.M., Construction & Geotechnical methods in foundation engineering, MGH, New York,1985
4. Jones.C.J.F.P., Earth reinforcement and soil structures, Butter worth &co., London,1985
5. Sivakumar babu. G.I., Introduction to Soil Reinforcement & Geosynthetics, Universities Press Ltd., 2013

CO-PO Mapping

Course Name: **Geotechnical Processes and Application** Course Code: **CEUE108**

Course outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	3	3	3	2	3	3	3	1	2	2
CO2	3	3	3	3	3	3	3	2	3	3	3	1	2	2
CO3	3	3	3	3	3	3	3	2	3	3	3	1	2	2
CO4	3	3	3	3	3	3	3	2	3	3	3	1	2	2
CO5	3	3	3	3	3	3	3	2	3	3	3	1	2	2

Department :Civil Engineering			Programme: **B.Tech.**					
Semester : Sixth			Course Category Code: PEC			Semester Exam Type:TY		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks	
			L	T	P	C	CA	SE	TM
CEUE109	**Irrigation Engineering**		3	1		4	40	60	100
Prerequisite:	Nil							
Course Outcome	**CO1**	To familiarize the students with various irrigation practices adopted						
	CO2	To identify the irrigation requirements of various crops and to design irrigation channels						
	CO3	Student should able to identify the suitable method of irrigation and water requirement for a given soil and crop.						
	CO4	Students should also be able to design and manage irrigation systems.						
	CO5	Students will familiarize with the land use management system						
UNIT-I	**Types of Irrigation Systems**						**Periods: 12**	
Introduction: Need, advantages and disadvantages of Irrigation - Environmental effects - Types of Irrigation systems -Gravity irrigation, canals, Tanks, Wells and Irrigation galleries - Water lifts. Soil -water - plant relationship: Soil and its function - Physical properties of soil and their importance in relation to irrigation - Classes and availability of soil water - Movement of water in soils - Measurement of soil moisture - Crop growth and moisture relationship - Salt problems in soil and effect of salts on plant growth.								**CO1**
UNIT-II	**Irrigation Water Requirement**						**Periods: 12**	
Evaporation, Evapo transpiration, Consumptive use and its estimation - Crop factor - Lysimeters - Effective rain fall and irrigation requirements - Water requirements of various crops - Duty of water - Quality of irrigation water.								**CO2**
UNIT-III	**Methods of Irrigation**						**Periods: 12**	
Surface, subsurface and overhead methods - Check basin, border & furrow, Drip and sprinkler irrigation - Irrigation efficiency, Depth, Rate and frequency of irrigation - Irrigation schedule.								**CO3**
UNIT-IV	**Design of Irrigation Channels**						**Periods: 12**	
Design of unlined and lined channels for irrigation - Location and design of canal regulation structures - Cross drainage structures - Measuring devices.								**CO4**
UNIT-V	**Land Development and Management**						**Periods: 12**	
Land Development: Reclamation and management of saline & alkaline soils, water logging, Causes and remedial measures - Design, construction and maintenance of drainage systems. Irrigation Management: Management of irrigation system - water charge assessment and water use management.								**CO5**
Lecture Periods: 45	**Tutorial Periods:15**		**Practical Periods:-**			**Total Periods: 60**		

Reference Books:

1. Basak.K.N, Irrigation Engineering, Tata Mc-Graw-Hill, 2013.
2. Sharma.R.K., and Sharma. T.K., Irrigation Engineering ,S.Chand& Company Ltd, 2014.
3. PunmiaB.C, Ashok Kumar Jain, Pande Bb Lal, Irrigation & Water Power Engineering, Lakshmi Publications, 2013
4. Arora.,K.R., Irrigation Water Power & Water Resources Engineering, Standard Publishers, 2013.
5. Das, M.M, Saikia, M.S Irrigation and water power Engineering, PHI, Learning, (P) Ltd, New Delhi, 2009

CO-PO Mapping

Course Name: **Irrigation Engineering** Course Code: **CEUE109**

Course outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	3	3	2	1	3	3	3	2	1	1
CO2	3	3	3	3	3	3	2	1	3	3	3	2	1	1
CO3	3	3	3	3	3	3	3	1	3	3	3	2	2	2
CO4	3	3	3	3	3	3	3	1	3	3	3	2	2	2
CO5	3	3	3	3	3	3	3	1	3	2	3	2	2	2

Score: 3 – High; 2 – Medium; 1 – Low

Department : Civil Engineering		Programme : **B.Tech.**						
Semester : Sixth		Course Category Code: PEC				Semester Exam Type: TY		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
CEUE110	**Advanced Reinforced Concrete Structures**	3	1	0	4	40	60	100
Prerequisite:								
Course Outcome	**CO1**	Able to design retaining walls and beam-column joints						
	CO2	Able to design slabs and grid floors						
	CO3	Able to design deep beams and crack width estimation						
	CO4	Able to design overhead tanks						
	CO5	Able to design formwork for wall, column, beam and slab						

UNIT – I	**Design of Wall and Beam-Column Joint**	**Periods : 12**
Design of Cantilever and Counterfort Retaining walls, Design of Beam-Column Joints-detailing of joints.		**CO1**
UNIT – II	**Design of Slabs and Floors**	**Periods : 12**
Design of Slabs by Yield Line theory and Hillerborg's Strip method, Design of Flat Slabs, Design of Grid floors by Approximate Analysis		**CO2**
UNIT – III	**Design of Beams and Serviceability Requirements**	**Periods : 12**
Design of Deep Beams, Design of beams curved in Plan, Deflection of RC beams, Estimation of Crack width in RC Beams, Redistribution moments in RC beams		
UNIT – IV	**Design of Storage Structures**	**Periods : 12**
Design of Bunkers and Silos, Design of Overhead Circular and Rectangular Water Tanks (without staging)		
UNIT – V	**Design of Formwork**	**Periods : 12**
Introduction to Formwork, Design of Formwork for wall, column, beam and slab elements, Introduction to Composite Construction, Design of Steel-Concrete Composite beams, Design of beams with cast in situ slab.		

Lecture Periods : 45	**Tutorial Periods : 15**	**Practical Periods:-**	**Total Periods : 60**

Reference Books

1. Varghese, P.C., "Advanced Reinforced Concrete Design", Prentice-hall of India (p) Ltd., 2012.
2. Jha. K.N, "Formwork for Concrete Structures" McGraw Hill Education Pvt Ltd, New Delhi 2012
3. Shah.V.L and KarveS.R, Limit State Theory & Design of Reinforced Concrete-IS 456 2000, Standard Publishers, 2013.
4. Sinha, S.N., Reinforced Concrete Design, Tata McGraw Hill, 2014.
5. Johnson, R.P, Composite Structures of steel and concrete, Black Well Publishing, 2011.
6. UnnikrishnaPillai.S, DevdasMenon, Reinforced Concrete Design, Tata McGraw-hill, 2013

CO-PO Mapping

Course Name: **Advanced Reinforced Concrete Structures** Course Code: **CEUE110**

Course outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	3	2	2	1	3	3	3	1	3	3
CO2	3	3	3	3	3	2	2	1	3	3	3	1	3	3
CO3	3	3	3	3	3	2	2	1	3	3	3	1	3	3
CO4	3	3	3	3	3	2	2	1	3	3	3	1	3	3
CO5	3	3	3	3	3	2	2	1	3	3	3	1	3	3

Department : Civil Engineering		Programme : **B.Tech.**						
Semester : Seventh		Course Category Code: PEC				Semester Exam Type: TY		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
CEUE111	**Bridge Engineering**	3	1	0	4	40	60	100
Prerequisite:								
Course Outcome	**CO1**	Able to select the type of bridge, design and its construction						
	CO2	Able to understanding of basic concepts in proportioning and design of bridges in terms of aesthetics, geographical location and functionality.						
	CO3	Able to understand the load flow mechanism and review of design codes. loads on bridges						
	CO4	Able to understand design and construction of RC and steel girders.						
	CO5	Able to understand the concepts of maintenance and rehabilitation of bridges						

UNIT –I	**Introduction**	**Periods : 12**
History and Development of Bridges, Classification of Bridges - Investigations for culverts, minor bridge and for major bridges– Topography, Catchment, Hydrology, Geotechnical aspects, Construction Resources – Design Flood Discharge-Methods- Linear waterway.		**CO1**
UNIT – II	**Bridge Foundation**	**Periods : 12**
Choice of Foundation for piers and abutments –Types – Pile foundation- types - spacing of piles- pile cap - Load on Foundation - Well foundation – types – Scour Depth – Stability of well foundation - well sinking - methods – Tilt correction.		**CO2**
UNIT –III	**Loads on Bridge**	**Periods : 12**
Loading standards for road and railway bridges- design of RC solid slab bridges for IRC loading- design of kerb- design of Tee beam bridges.		**CO3**
UNIT –IV	**Construction of Bridges**	**Periods : 12**
Setting out of piers and abutments for: minor bridges and culverts, Single span and multi span Bridges- Superstructure- supports and centering for RC bridges – erection process of RC girders and steel girders for bridges.		**CO4**
UNIT –V	**Maintenance of Bridges**	**Periods : 12**
Maintenance- Inspection of bridges, Maintenance of substructure and substructures- Load testing on bridges-Temporary and movable bridges- bridge failure- rehabilitation of RC bridges- Case studies. .		**CO5**

Lecture Periods : 45	**Tutorials Periods:15**	**Practical Periods : -**	**Total Periods : 60**

Reference Books

1. Ponnuswamy S., “Bridge Engineering” Tata McGraw Hill Publishing Co., 2013.
2. Johnson Victor. D., “Essentials of Bridge Engineering”, Oxford IBH Publishers, 2013.
3. Rangwala.S.C, Rangwala.P.S, Rnagwala.K.S., Bridge Engineering, Charotar Books Publishers, 2013.
4. David Blockley, Bridges, Oxford University Press, 2010.

5. Singh, V.P, Wells and Caissons, Nemchand& Brothers,1981.

CO-PO Mapping

Course Name: **Bridge Engineering** Course Code: **CEUE111**

Course outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	3	2	2	1	3	3	3	1	2	2
CO2	3	3	3	3	3	2	2	1	3	3	3	1	2	2
CO3	3	3	3	3	3	2	2	1	3	3	3	1	2	2
CO4	3	3	3	3	3	2	2	1	3	3	3	1	2	2
CO5	3	3	3	3	3	2	2	1	3	3	3	1	2	2

Department : Civil Engineering		Programme : **B.Tech.**						
Semester : Seventh		Course Category Code: PEC				Semester Exam Type: TY		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
CEUE112	**Earthquake Resistant Structures**	3	1	0	4	40	60	100
Prerequisite:	-							

Course Outcome		
	CO1	Able to appreciate various elements of Engineering Seismology
	CO2	Able to draw the concepts of theory of vibration
	CO3	Able to visualize the theory behind earthquake resistance of various structures and mechanisms
	CO4	Able to expand knowledge on Codal provisions of earthquake resistance.
	CO5	Able to solve any problem in earthquake resistance.

UNIT - I	**Elements of Engineering Seismology**	**Periods : 12**
Elements of engineering seismology - characteristics of earthquake- earthquake size- plate tectonics – types of seismic waves – terms associated with earthquakes (Magnitude/Intensity of an earthquake-scales-Energy released - Earthquake measuring instruments-Seismoscope – seismographs , accelerograph) - effect of earthquake - earthquake history- seismicity zone of India.		**CO1**
UNIT - II	**Theory of Vibrations**	**Periods : 12**
Theory of vibrations –-formulation of equation of motion (Elements of a vibratory system- Degrees of Freedom-Continuous system-Lumped mass idealization-Oscillatory motion-Simple Harmonic Motion) - single degree of freedom system- free and forced vibrations (Response to harmonic excitation - Impulse and response to unit impulse - Duhamel integral) - damped and undamped vibrations - Basic introduction to multiple degree of freedom systems - Decoupling of equations of motion - Concept of mode superposition (No derivations).		**CO2**
UNIT – III	**Structural Systems**	**Periods : 12**
Principles of earthquake resistant deign of RC members - frame buildings - Masonry Buildings - Structural Walls and Non-Structural Elements. Performance of structures under past earthquakes-lessons learnt from past earthquakes–soil liquefaction - Principles of earthquake resistant design - Structural system requirements of buildings – Earthquake Resistant Masonry Buildings		**CO3**
UNIT -IV	**Introduction to IS Codes**	**Periods : 12**
Behavior of reinforced concrete and steel elements under cyclic loading – ductility and energy dissipation- Introduction to Indian Standard Codes -IS:4326 – 1993 and IS13920-1993.-detailing for seismic resistance of beam-column joints, beams, columns and footings - Lateral load resisting systems		**CO4**
UNIT - V	**Computation of Design lateral loads/ Introduction to Retrofitting**	**Periods : 12**
Design earthquake loads – equivalent static force procedure as per IS 1893 – 2002 – Load combinations –GOI guidelines on Seismic Retrofitting of Deficient Buildings and Structures.		**CO5**

Lecture Periods : 45	**Tutorials Periods: 15**	**Practical Periods : -**	**Total Periods : 60**

Reference Books

1. Pankaj Agrarwal & Manish Shrikhande “Earthquake resistant Design of Structures” Prentice Hall of India Pvt Ltd. New Delhi, 2013
2. Duggal.S.K. Earthquake Resistant Design of Structures, Oxford University Press, 2014.
3. Leigh.W, Mario Paz. “Structural Dynamics – Theory & Computations”, Springer Verlag, 2010.
4. A K.Chopra, “Dynamics of Structures Theory and Applications to Earthquake Engineering” Prentice Hall of India (P) Ltd., 2008.
5. Pauley T and Priestley M.J.N, Seismic Design of Reinforced Concrete and Masonry Buildings, John Wiley & Sons, New York, 2012.
6. Stratta, J.L “Manual of seismic Design”, Pearson Education Ltd., 2004.
7. National Disaster Management Guidelines on “Seismic Retrofitting of Deficient Buildings and Structures” June 2014, National Disaster Management Authority ,Government Of India

CO-PO Mapping

Course Name: **Earthquake Resistant Structures** Course Code: **CEUE112**

Course outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO1	PSO 2	PSO3
CO1	3	3	3	3	3	2	2	1	3	3	3	1	2	3
CO2	3	3	3	3	3	2	2	1	3	3	3	1	2	3
CO3	3	3	3	3	3	2	2	1	3	3	3	1	2	3
CO4	3	3	3	3	3	2	2	1	3	3	3	1	2	3
CO5	3	3	3	3	3	2	2	1	3	3	3	1	2	3

Department :Civil Engineering			Programme: **B.Tech.**						
Semester : Seventh			Course Category Code: PEC				Semester Exam Type:TY		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
CEUE113	**Railways, Airport and Harbour Engineering**		3	1	0	4	40	60	100
Prerequisite:	Nil								
Course Outcome	**CO1**	Able to understand the various components of railways and their functional requirements.							
	CO2	Able to understand the design strategies followed for railway system in Indian Scenario.							
	CO3	Able to understand the concepts of Airport planning and basic in design							
	CO4	Able to understand the design strategies for the runway, taxi way, marking lighting LCN and PCN							
	CO5	Able to understand the basic concepts of planning Harbour and harbour facilities							
UNIT-I	**Railways Planning**							**Periods: 12**	
Permanent way – gauges, components of permanent way, rails; functions, requirements, types, failures, creep of rails; Sleepers - types, requirements; Ballast – functions requirements, track fittings and fastenings. – MRTS									**CO1**
UNIT-II	**Design Concepts**							**Periods: 12**	
Geometric design of the track – gradients, grade compensation, speed, super-elevation, cant deficiency, negative cant transition curve. Points and crossings – turn outs, switches, crossings, types of crossings, Design of turnouts; stations - site selection, requirements of a railway station, classification of stations; yards – types of yards									**CO2**
UNIT-III	**Airport Planning**							**Periods: 12**	
Airport planning – Aircraft characteristics –airport planning, obstructions, types of airport, Wind rose diagram, Runway orientation									**CO3**
UNIT-IV	**Runways**							**Periods: 12**	
Basic runway length and corrections. Design of exit taxiway, Runway marking and lighting, LCN and PCN, airport drainage, Problems on LCN & PCN									**CO4**
UNIT-V	**Port Planning**							**Periods: 12**	
Requirement of a Harbour - General Planning - Site investigation. Description of selected Indian ports. Technical planning of Harbour – Break water, Berthing structures. Shipping terminal facilities – Essentials of passenger terminal, dry bulk cargo terminal, Liquid bulk cargo terminals and container terminals. Navigational aids – Light house.									**CO5**
Lecture Periods: 45	**Tutorial Periods:15**		**Practical Periods:-**				**Total Periods: 60**		
Reference Books:									
1. Saxena, C.S.and. S. Arora. S.A., course in Railway Engineering, Dhanpat Rai & Sons New ,Delhi. 2007.									
2. Airport Planning and Design by S.K. Khanna, M.G. Arora, Nem Chand Bros., Roorkee.									

3. Air Transportation Planning and Design by Virender Kumar & Satish Chandra, Galgotia
4. IS: 4651 - Code of practice for Planning and Design of Port and harbour (Part – I) Site Investigation

CO-PO Mapping

Course Name: **Railways, Airport and Harbour Engineering** Course Code: **CEUE113**

Course outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	3	3	3	1	3	3	3	2	2	2
CO2	3	3	3	3	3	3	3	1	3	3	3	2	2	2
CO3	3	3	3	3	3	3	3	1	3	3	3	2	2	2
CO4	3	3	3	3	3	3	3	1	3	3	3	2	2	2
CO5	3	3	3	3	3	3	3	1	3	3	3	2	2	2

Department :Civil Engineering			Programme: **B.Tech.**						
Semester :Seventh			Course Category Code: PEC				Semester Exam Type:TY		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
CEUE114	**Design and Construction of Prefabricated Structures**		3	1	0	4	40	60	100
Prerequisite:	Nil								
Course Outcome	**CO1**	Able to understand materials used in Precast Structures							
	CO2	Able to implement Construction Techniques							
	CO3	Able to design Precast concrete floors and beams							
	CO4	Able to design Precast concrete columns and connections							
	CO5	Able to execute the construction sequence in a project with precast elements.							
UNIT-I	**Materials in Precast Structures**							**Periods: 12**	
Materials, admixtures, pigments - Modular co-ordination, standardization and tolerances- systemofpre-fabrication.Pre-castconcretemanufacturingtechniques,Moulds–constructiondesign, maintenance and repair.								**CO1**	
UNIT-II	**Precast Construction Techniques**							**Periods: 12**	
Pre-casting techniques-Planning, analysis and design considerations-Handling techniques- Transportation Storage and erection of structures. Curing techniques including accelerated curing such as steam curing, hot air blowing, etc.								**CO2**	
UNIT-III	**Precast concrete floors and beams**							**Periods: 12**	
Simplified frame analysis, Precast concrete flooring options, flooring arrangements, structural design of individual units, design of composite floors, Composite and non-composite Reinforced beams.								**CO3**	
UNIT-IV								**Periods: 12**	
Precast concrete columns and their design. Basic mechanism of joints and connections, compression joints, shear joints, tension joints. Connections-pin jointed and moment resisting Connections.								**CO4**	
UNIT-V	**Application of Prefabricated structures**							**Periods: 12**	
Pre-cast and pre-fabricating technology for low cost and mass housing schemes. Small pre- cast products like door frames, shutters, Ferro-cement in housing - Water tank service core unit, 3D Printing.								**CO5**	
Lecture Periods: 45	**Tutorial Periods:15**		**Practical Periods:-**				**Total Periods: 60**		

Reference Books:

1. Levitt. M., Precast concrete-Materials, Manufacture Properties and Usage, Applied Science Publs.2007
2. Hubert Bachman, Alfred Steinle, Precast Concrete Structures, Published by Ernst &Sohn GmbH &Co. KG,2011
3. Konex.T., Handbook of Pre-castConstruction,Vol..1.2&3
4. KimSElliott,PrecastConcreteStructures,ButterworthHeinemannPublishers,2002
5. Lewicki. B., Building with Large Pre-fabrications, Elsevier Publishers

CO-PO Mapping

Course Name: **Design and Construction of Prefabricated Structures** Course Code: **CEUE114**

Course outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	3	3	3	1	3	3	3	3	1	2
CO2	3	3	3	3	3	3	3	1	3	3	3	3	1	2
CO3	3	3	3	3	3	3	3	1	3	3	3	3	1	2
CO4	3	3	3	3	3	3	3	1	3	3	3	3	1	2
CO5	3	3	3	3	3	3	3	1	3	3	3	3	1	2

Score: 3 – High; 2 – Medium; 1 – Low

Department : Civil Engineering		Programme : **B.Tech.**						
Semester : Seventh		Course Category Code: PEC				Semester Exam Type: TY		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
CEUE115	**Advanced Steel Design**	3	1	0	4	40	60	100
Prerequisite:								
Course Outcome	**CO1**	Able to understand the behavior of beam column joint and to know the design procedure						
	CO2	Able to calculate the wind loads and design of industrial steel structures such as trusses, gantry girders, and columns.						
	CO3	Able to make load calculation and combinations of load and its effects on structures like Chimney and Towers						
	CO4	Able to understand the behavior of bridges under various loads and can design the bridges to withstand the loads						
	CO5	Students are exposed to various steel section, techniques, and the latest software for analysis and design of steel structures						

UNIT-I	**Design of Beam-Columns**	**Periods: 12**
Behavior – torsional buckling in beam-columns- interaction under biaxial loading- design of beam-columns – design of eccentrically loaded base plates.		**CO1**
UNIT-II	**Industrial Structures:**	**Periods: 12**
Loads – wind load calculations - design of Trusses, Design of gantry girders, and gantry girder columns.		**CO2**
UNIT –III	**Chimneys &Towers**	**Periods: 12**
Chimneys: loading and load combinations – design and stability considerations – design of base and foundations for chimneys. Towers: Analysis and design of lattice towers- transmission line towers- configurations- types-loads and load combinations- temperature effect-design principles		**CO3**
UNIT – IV	**Bridges**	**Periods: 12**
Design of Plate girder bridges – influence line diagram - IRC guidelines- effect of wind. Design of truss girder bridges- types of bearings and design of bearings.		**CO4**
UNIT – V	**Cold Formed Sections**	**Periods: 12**
Design in light gauge steel sections. Pre-Engineered Buildings: Advantages – design principles. Introduction to various software for design of steel structures.		**CO5**

Lecture Periods: 45	Tutorial:15	Practical Periods -	Total Periods :60

Reference Books

1. Shiyekar, M.R., Limit State Design in Structural Steel, Second Edition, PHI Learning Private Ltd., Delhi, 2013.
2. Shah, V.L., and Veena Gore, Limit State Design of Steel Structures, Structures Publications, Pune, 2012.
3. Subramanian, P., Design of steel structures, Oxford Publishers, New Delhi, 2007
4. Bhavikatti, S.S., Design of Steel Structures, IK International Publishing House Pvt Ltd, New Delhi, 2014.

5. Sai Ram K.S., Design of Steel Structures, Pearson Education Ltd., 2013.
6. VirendraGehlot, Ram Chandra, Design of steel structures, Vol.I& II, Standard Publishers, 2012

CO-PO Mapping

Course Name: **Advanced Steel Design** Course Code: **CEUE115**

Course outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	3	3	3	1	3	3	3	1	2	2
CO2	3	3	3	3	3	3	3	1	3	3	3	1	2	2
CO3	3	3	3	3	3	3	3	1	3	3	3	1	2	2
CO4	3	3	3	3	3	3	3	1	3	3	3	1	2	2
CO5	3	3	3	3	3	3	3	1	3	3	3	1	2	2

Score: 3 – High; 2 – Medium; 1 – Low

HONOUR COURSES

Department :Civil Engineering			Programme: **B.Tech.**						
Semester : Fourth			Course Category Code: HNC				Semester Exam Type: TY		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
CEUH101	**Advanced Surveying**		3	1		4	40	60	100
Prerequisite:	Surveying & Geomatics								
Course Outcome	**CO1**	Solve site specific problems of extensive surveying such as triangulation							
	CO2	Deduce errors in linear and angular measurements by means of error correction							
	CO3	Impart knowledge on Aerial surveying							
	CO4	Study the basics of Remote sensing and its application							
	CO5	To give an introductory knowledge of the Geographical Information System in various field of application							
UNIT-I	**Control Surveying**							**Periods: 12**	
Triangulation figure – frame work of triangulation system- classifications- signals and towers- reconnaissance – base line measurement – rigid and flexible bars- tape corrections – radar ranging – satellite stations – reduction to centre.								**CO1**	
UNIT-II	**Surveying Adjustments**							**Periods: 12**	
Definitions – Law of weights- Laws of accidental errors- Principles of least square – Distribution of errors to the field measurements- Normal equation – Methods of correlates – Triangulation Adjustments – Spherical excess								**CO2**	
UNIT-III	**Fundamental of Total Station Surveying**							**Periods: 12**	
Methods of measuring distance – Basic Principles of Total station –Historical development- Classification – Application and comparison with conventional surveying. Infra-red and laser Total station Instruments Microwave systems – measuring principles- Sources of errors- Care and maintenance of Total station instrument								**CO3**	
UNIT-IV	**GPS Surveying**							**Periods: 12**	
Introduction to GPS – GPS Systems and their features – Segments of GPS – Their importance and role- Absolute positioning and Differential GPS – Factors governing accuracy I GPS positioning – Different types of errors in GPS surveying								**CO4**	
UNIT-V	**Basics of Geographical Information system**							**Periods: 12**	
Sub system of GIS – Data for GIS – Representation features – Vector data structure – Raster data Structure – Conversion of Raster vs Vector data structure – capabilities/ functionalities of GIS – Neighbourhood functions – map overlay analysis – data quality – source of errors in GIS – application of GIS – Remotes sensing and GIS								**CO5**	
Lecture Periods: 45	**Tutorial Periods: 15**		**Practical Periods:-**				**Total Periods: 60**		

Reference Books:

1. 1. S.K. Duggal ., " Surveying", Vol II McGraw Hill Education fourth edition
2. Punmia. B.C., et. al.." Surveying", Vol II, Laxmi Publications 2002.
3. Kanetkar,T.P., Surveying and Levelling, Vols II, United book corporation, Pune
4. Shahani,P.B, Text book of Surveying Vol I& Vol II, Oxford & IBH Publications 1998.

5. Lillesand,T.M., and Kiefer RW., Remote sensing and Image interpretation, John Wiey sand Sons, Inc New York 1997.
6. N.Madhu ,R.Sathikumar, Satheesh Gopi Publisher. Pearson Education India , Total station, Remote sensing and GIS

CO-PO Mapping

Course Name: **Advanced Surveying** Course Code: **CEUH101**

Course outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	2	2	3	3	3	3	3	2	2	2
CO2	3	3	3	3	2	2	3	3	3	3	3	2	2	2
CO3	3	3	3	3	2	2	3	3	3	3	3	2	2	2
CO4	3	3	3	3	2	2	3	3	3	3	3	2	2	2
CO5	3	3	3	3	2	2	3	3	3	3	3	2	2	2

Department :Civil Engineering			Programme: **B.Tech.**						
Semester : Fifth			Course Category Code: HNC				Semester Exam Type: TY		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
CEUH102	**Environmental Impact Assessment**		3	1		4	40	60	100
Prerequisite:	Environmental Engineering								
Course Outcome	**CO1**	To acquire knowledge on the impacts of various developmental project on Environment							
	CO2	To study about various the EIA methodologies and process							
	CO3	To decide the appropriate technologies to quantify the impacts on physical-chemical environment							
	CO4	To decide the appropriate technologies to quantify the impacts on Biological and Socio-Economic Environment							
	CO5	To prepare EIS, EMP and Environmental audit							
UNIT-I	**Introduction of EIA**							**Periods: 12**	
Historical perspective of environmental protection laws and acts in India - Definition of EI, EIA, EIS - Industrial policy statement of the Government of India. Legal and Regulatory aspects in India - Types and Limitations of EIA - Minimum National Standards – Bureau of Indian Standards - WHO standards.									**CO1**
UNIT-II	**Methodologies**							**Periods: 12**	
EIA methodologies – EIA processes- Appropriate Methodologies, Quantification, - Cost benefit analysis - Risk assessment, Test Model format - Preliminary survey and assessment									**CO2**
UNIT-III	**Impact on Physical – Chemical Environment**							**Periods: 12**	
Background - Typical considerations and factors, air quality impact of industry, transport systems, mitigation methods. Water quality impact: Water quality criteria and standards, Field Surveys -water quality- impacts by developmental projects –Land and soil quality impacts- Soil fertility and remediation. Noise impact: Noise and sound, the effects of noise on people, noise scales and rating methods, estimating transportation noise impact.									**CO3**
UNIT-IV	**Impact on Biological and Socio-Economic Environment**							**Periods: 12**	
Energy impact considerations, data sources, energy conservation data, EIA of hydro, thermal and nuclear power plants, and new and renewable energy sources. Vegetation and Wild life impact: Biological concepts and terms, mitigating measures, alternatives - Types, steps in performing socio economic impact assessment, analysis of public services and facilities, impacts, social impacts									**CO4**
UNIT-V	**Summarization of Environmental Impacts**							**Periods: 12**	
Environmental Management plan, Public involvement - impacts of economic profile of the community, Exchange of information - comparison of alternatives-Training-Preparation of written documentations-Environmental Auditing – Environmental safety & health - Environmental Monitoring – EIA software's and application to case studies									**CO5**
Lecture Periods: 45	**Tutorial Periods:15**	**Practical Periods:-**	**Total Periods:60**						
Reference Books:									
1. Trivedi.P.R, Environmental Impact Assessment, APH Publishing, 2011.									

2. Canter,L.W., Environmental Impact Assessment, McGraw Hill, 1996.
3. Petts, J., Handbook of Environmental Impact Assessment Vol.I and II, Blackwell Science, London, 1999.
4. Environmental assessment of development projects, United Nations Asia and Pacific Development Centre, Kuala Lampur, 1983.
5. John, G. Rau and David C. Wooten (Ed), Environmental Impact Analysis Hand Book, McGraw Hill Book Co., 1980.

CO-PO Mapping

Course Name: **Environmental Impact Assessment** Course Code: **CEUH102**

Course outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	3	3	3	1	3	3	3	2	2	2
CO2	3	3	3	3	3	3	3	1	3	3	3	2	2	2
CO3	3	3	3	3	3	3	3	1	3	3	3	2	2	2
CO4	3	3	3	3	3	3	3	1	3	3	3	2	2	2
CO5	3	3	3	3	3	3	3	1	3	3	3	2	2	2

Department :Civil Engineering			Programme: **B.Tech.**						
Semester : Sixth			Course Category Code: HNC			Semester Exam Type: TY			
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
CEUH103	**Coastal and Offshore Structures**		3	1		4	40	60	100
Prerequisite:									
Course Outcome	**CO1**	Able to understand costal process							
	CO2	Able to plan the various elements associated with Harbour							
	CO3	Able to understand the design principles of Harbour structures							
	CO4	Able to understand the Docks and Shor protection Methods							
	CO5	Able to understand the basic elements and foundation of offshore structures							
UNIT-I	**Coastal Process**						**Periods: 12**		
Factors influencing coastal topography - Waves: Definitions – Classification - Wave generation – Shoaling – Refraction – Reflection – Diffraction – Breaking of waves – Near shore currents – Tides Force due to non-breaking, breaking and broken waves on vertical,barriers and on piles – Problems									**CO1**
UNIT-II	**Harbour Planning (Technical)**						**Periods: 12**		
Classification of Harbours - Factors affecting the growth of Port. Requirement of a Harbour - General Planning – Technical planning of Harbour components - Harbour entrance - Navigational Channel – Depth of harbour – Turning basin – Essentials of dry bulk cargo terminal, Liquid bulk cargo terminals and container terminals.									**CO2**
UNIT-III	**Harbour Structures**						**Periods: 12**		
Break waters: Types – Selection – Forces and – Design principles of RMBW and Vertical break waters. – Berthing structures: Types – Loads – Selection and design principles of berthing structures. Selection and Design principles of Dock fenders and Mooring accessories.									**CO3**
UNIT-IV	**Docks & Coastal Protection**						**Periods: 12**		
Dry Docks: Graving docks, Synchrono lifts, slipways – Dredging Methods - Dredgers Erosion process – Costal Protection Methods – Function – Types : Sea walls – Bulkhead – Revetment – Groins – Artificial beach nourishment.									**CO4**
UNIT-V	**Offshore Structures**						**Periods: 12**		
Types of offshore structures: selection & function. Physical, environmental and geotechnical aspects of offshore construction. Foundations for offshore structures. Introduction to installation of offshore Structures. Submarine pipelines									**CO5**
Lecture Periods: 45	**Tutorial Periods: 15**		**Practical Periods:-**				**Total Periods: 60**		
Reference Books:									
1. Shore Protection Manual (Vol – I, II, III) U.S. Army Crops of Engg. USA									
2. Narasimhan& S. kathiroli, Harbour and Coastal Engineering (Indian Scenario) Vol - I & Vol – II, NIOT- Chennai									

3. Alonzo Def. Quinn., Design and construction of Port and Marine structures McGraw Hill Book co.
4. Chakrabarti.,S.K., Hand Book of Offshore Engineering (Vols. 1 & 2)‖ Elsevier Publications
5. Gerwick, C., Construction of Marine and Offshore structures, CRC Press.

CO-PO Mapping

Course Name: **Coastal and Offshore Structures** Course Code: **CEUH103**

Course outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	3	3	3	2	3	3	3	1	2	2
CO2	3	3	3	3	3	3	3	2	3	3	3	1	2	2
CO3	3	3	3	3	3	3	3	2	3	3	3	1	2	2
CO4	3	3	3	3	3	3	3	2	3	3	3	1	2	2
CO5	3	3	3	3	3	3	3	2	3	3	3	1	2	2

Department :Civil Engineering			Programme: **B.Tech.**						
Semester : Seventh			Course Category Code: HNC				Semester Exam Type: TY		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
CEUH104	**Highways and Airport Pavement Design**		3	1		4	40	60	100
Prerequisite:									
Course Outcome	**CO1**	To enable the students to understand the design factors associated with highway and airport							
	CO2	To enable the students to understand the materials used and criteria to select Materials							
	CO3	To enable the students to understand the design approaches related to flexible Pavement							
	CO4	To enable the students to understand the design principles associated with rigid Pavement							
	CO5	To enable the students to understand the techniques of pavement evaluation							
UNIT-I	**Introduction**							**Periods: 12**	
Introduction: Pavement types, components, highway and airport pavements, complexities in pavement design. Design Factors: Sub grade - Significance, soil classification, assessment of strength characteristics, Traffic Loads, Climatic factors - variation in moisture content and applications, wheel load stresses, wheel load configurations in highway and airport pavements, ESWL, repetition of loads and EWL factors, transient loads.									**CO1**
UNIT-II	**Pavement materials**							**Periods: 12**	
Pavement materials Characterization – introduction. Soil- characterization, tests. Aggregates- tests, batch mixing. Bituminous – types of bitumen, tests. Bituminous mixes– design. Cement – tests, design of PQC. Soil stabilization – introduction, methods of stabilization.									**CO2**
UNIT-III	**Flexible pavement Design**							**Periods: 12**	
Flexible pavement Design Methods: General design approaches; Design methods for highway and airport pavements - Group Index, FAA, CBR, Wyoming, Stabilometer, Triaxial test Mc Leod and by Burmister's two layer theory..									**CO3**
UNIT-IV	**Rigid Pavements Design**							**Periods: 12**	
Rigid Pavements and Design: Stresses due to wheel load and temperature, Westergard's analysis, ESWL in rigid pavements, spacing of joints in CC Pavements, thickness design method, IRC design method for highway Pavement, Design of expansion and longitudinal joint details.									**CO4**
UNIT-V	**Pavement Evaluation and Testing**							**Periods: 12**	
Pavement Evaluation and Testing: Pavement failures; Structural evaluation and strengthening of flexible pavements - CBR and plate load tests, Benkelman beam rebound deflection method, strengthening of rigid pavements, Pavement surface condition evaluation, testing techniques for flexible and rigid									**CO5**

pavements.			
Lecture Periods: 45	**Tutorial Periods: 15**	**Practical Periods:-**	**Total Periods: 60**

Reference Books:

1. Sharma, S.K., Principles,Practices and Design of Highway Engg. S.Chand & Co., New Delhi. 2002.
2. Justo, C.E.G, S. K. Khanna, Highway Engineering, S. Chand Publishers, New Delhi, 2006.
3. Khanna S.K& Arora, M.G.Airport Planning and Design, Nemchand and Bros., 2007
4. Partha Chakroborthy and Animesh Das, "Principles of Transportation engineering, Prentice Hall of India Pvt. Ltd., New Delhi – 110001, 2003
5. Robert Horonjeff, Planning & Design of Airports, McGraw Hill Book Co., NewYork, 2007
6. Michel Sargious, "Pavements and surfacing for Highways and Airports", Allied Science publishers Ltd. London, 2006.
7. Yang Huang, "Pavement analysis and design", Allied Publishers Ltd. London, 2006.
8. Yoder, Principles of Pavement Design, John Wiley & Sons, 2003.

CO-PO Mapping

Course Name: **Highways and Airport Pavement Design** Course Code: **CEUH104**

Course outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	3	3	3	1	3	3	3	2	2	3
CO2	3	3	3	3	3	3	3	1	3	3	3	2	2	3
CO3	3	3	3	3	3	3	3	1	3	3	3	2	2	3
CO4	3	3	3	3	3	3	3	1	3	3	3	2	2	3
CO5	3	3	3	3	3	3	3	1	3	3	3	2	2	3

Department : **Civil Engineering**		Programme : **B.Tech. (CE)**						
Semester : Eighth		Course Category Code: HNC				Semester Exam Type: -		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
CEUH105	**Seminar**	3	0	0	2	100	-	100
Prerequisite:	-							
Course Outcome	**CO1**	Establish motivation for the topic of interest in Civil Engineering and develop a thought process for the technical presentation.						
	CO2	Organize a detailed literature survey for the chosen topic in Civil Engineering and prepare a document with respect to technical publications.						
	CO3	Ability to understand advanced technology and research in Civil Engineering.						
	CO4	Ability to identify, formulate, and solve complex engineering problems by applying principles of Civil Engineering, Science and Mathematics						
	CO5	Identify the interdisciplinary and industrial application related topics and prepare the technical presentation.						

Each one of the students will be assigned a Seminar Topic in the current and frontier areas. The student must conduct a detailed study/survey on the assigned topic and prepare a report. The student will make an oral presentation followed by a brief question and answer session. The Seminar (presentation and report) will be evaluated by an internal assessment committee for a total of 100 marks.	**CO1-CO5**

Lecture Periods : -	**Tutorials Periods:**	**Practical Periods : 45**	**Total Periods : 45**

CO-PO Mapping

Course Name: **Seminar** Course Code: **CEUH105**

Course outcomes	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	3	3	3	3	3	3	3	1	3	3	3	2	2	3
CO2	3	3	3	3	3	3	3	1	3	3	3	2	2	3
CO3	3	3	3	3	3	3	3	1	3	3	3	2	2	3

CO4	3	3	3	3	3	3	3	1	3	3	3	2	2	3
CO5	3	3	3	3	3	3	3	1	3	3	3	2	2	3

Annexure-II

Syllabi of the *Ancillary Stream Elective Courses* offered by the Civil Engineering Department

ANCILLARY STREAM TITLE: GREEN CONCEPTS & ENVIRONMENT
(Offered to Other Department students)

Department : Civil Engineering			Programme: **B.Tech.**						
Semester : IV			Course Category Code: ANC				Semester Exam Type: TY		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
CEUN101	**Eco-friendly Building Materials and Construction**		3	0	0	3	40	60	100
Prerequisite:									
Course Outcome	**CO1**	Able to understand the Importance of Eco-Friendly Planning							
	CO2	Able to become aware on various Eco friendly Building Materials							
	CO3	Able to plan, control and monitor construction projects with Cost Effective Construction Techniques							
	CO4	Able to acquired knowledge on how to Provide comforts in buildings in Eco friendly Manner							
	CO5	Able to acquired knowledge on cost effective's sanitation, road construction and comparison.							

UNIT – I	**Eco-friendly Planning:**	**Periods: 9**
Energy Efficient Shelters, Housing Options Today, Site Planning and Use of On-Site Resources, Smaller Houses that Utilize Space and Materials More Efficiently, Working With Nature, Better Window Planning, Balancing Energy and Aesthetic Needs.		**CO1**
UNIT – II	**Eco-friendly Materials**	**Periods: 9**
Construction materials –locally available building materials- Soil, Fly ash, Ferrocement, Lime, Fibres, Stone Dust, Red mud, Gypsum, Alternate Wood, Polymer-ADOBE, Cob Rammed Earth, Light Clay, Straw-Bale, Bamboo, Agro-Industrial Waste, Innovative Materials Developed by CBRI, SERC, Structural Properties of Alternate Building Materials, composite materials, artificial aggregates substitutes for natural conservation		**CO2**
UNIT – III	**Cost Effective Construction Techniques**	**Periods: 9**

Construction Techniques-Innovative Techniques developed by CBRI, SERC for foundation, superstructure, roofing, - Rat trap bond construction, Energy Efficient roofing, Ferro-cement technique, Mud Technology - pre-fabricated construction techniques, advantage of pre-fabrication areas where pre-fabrication can be introduced, modular contained earth, earth bag construction. Low cost housing construction techniques.		**CO3**
UNIT – IV	**Cost Effective Construction Equipment's**	**Periods: 9**
Equipment-Brick moulding machine, Stablilised soil block making machine and plants for the manufacturing of concrete blocks, M.C.R. tile making machine, Ferro-cement wall panel & Roofing channel making machine, R.C.C. Chaukhat making machine.		**CO4**
UNIT – V	**Cost effective sanitation, Road Construction, analysis and comparison**	**Periods: 9**
Waste water disposal system - Cost effective sanitation for rural and urban areas – Ferro-cement Drains, Cost effective road materials, stabilization, construction techniques tests, equipment used for construction, drainage, maintenance, - analysis and comparison - All experimental materials - All experimental techniques.		**CO5**

Lecture Periods: 45	**Tutorials Periods:**	**Practical Periods: -**	**Total Periods: 45**

Reference Books:

1. K.S.Jagadish, B. U. Venkataramareddy and K. S. Nanjundarao. Alternative Building Materials and Technologies. New Age International, 2007.
2. Osman Attmann Green Architecture Advanced Technologies and Materials. McGraw Hill, 2010.
3. Low Energy Cooling For Sustainable Buildings. John Wiley and Sons Ltd, 2009.
4. Mili M. Ajumdar (Ed) Energy Efficient Building in India. Teri and Mnes, 2001/2002
5. Eugene Eccli-"Low Cost, Energy efficient shelter for owner & builder". Rodale Press, 2010

CO-PO Mapping

Course Name: **Eco-friendly Building Materials and Construction** Course Code: **CEUN101**

Course outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	3	3	3	1	3	3	3	2	2	2
CO2	3	3	3	3	3	3	3	1	3	3	3	2	2	2
CO3	3	3	3	3	3	3	3	1	3	3	3	2	2	2
CO4	3	3	3	3	3	3	3	1	3	3	3	2	2	2
CO5	3	3	3	3	3	3	3	1	3	3	3	2	2	2

Department : Civil Engineering		Programme: **B.Tech.**						
Semester : V		Course Category Code: ANC				Semester Exam Type: TY		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
CEUN102	**Disaster Management**	3	0	0	3	40	60	100
Prerequisite:								
Course Outcome	**CO1**	Able to realize the increasing vulnerability of the planet in general and India in particular to disasters						
	CO2	Able to understand Categories of Disasters						
	CO3	Able to realize the responsibilities to society						
	CO4	Able to analyse Capacity Development in Disaster Management						
	CO5	Able to create a basis to work towards preparedness and also helps to develop a culture of safety and prevention						
UNIT-I	**Introduction to Disaster Management**						**Periods: 9**	
Definition- nature, characteristics and types of Disasters- Causes and effects, Disaster: A Global View- Disaster Profile of India- Disaster Management cycle.							**CO1**	
UNIT-II	**Natural Disaster**						**Periods: 9**	
Geological and Mountain Area Disasters -Earthquakes- Volcanic Eruption- Landslides- Snow Avalanches - Wind and Water Related Natural Disaster Floods and Flash Floods- Droughts- Cyclones Tsunamis							**CO2**	
UNIT-III	**Manmade disaster**						**Periods: 9**	
Understanding Man-Made Disasters- Fires and Forest Fires- Nuclear- Biological and Chemical disaster- Road Accidents							**CO3**	
UNIT-IV	**Capacity Development in D.M**						**Periods: 9**	
Capacity building-Concept- Structural and nonstructural measures- Capacity assessment; strengthening capacity for reducing risk - Counter disaster resources and their utility in disaster management- Legislative support at the state and national levels-Coping strategies- Industrial safety plan							**CO4**	
UNIT-V	**Strategies in Disaster Management**						**Periods: 9**	

Strategies for disaster management planning- Steps for formulating a disaster risk reduction plan- Disaster management Act and Policy in India- Organisational structure for disaster management in India- Preparation of state and district disaster management plans	**CO5**

Lecture Periods: 45	**Tutorial Periods:**	**Practical Periods:**	**Total Periods: 45**

Reference Books:

1. Alexander, D. Natural Disasters, ULC press Ltd, London, 1993.
2. Carter, W. N. Disaster Management: A Disaster Management Handbook, Asian Development Bank, Bangkok, 1991.
3. Chakrabarty, U. K. Industrial Disaster Management and Emergency Response, Asian Books Pvt. Ltd., New Delhi 2007
4. Abarquez I. & Murshed Z. Community Based Disaster Risk Management: Field Practitioner's Handbook, ADPC, Bangkok, 2004.
5. Goudie, A. Geomorphological Techniques, Unwin Hyman, London 1990.
6. Goswami, S. C. Remote Sensing Application in North East India, PurbanchalPrakesh, Guwahati, 1997.
7. Manual on Natural Disaster Management in India, NCDM, New Delhi, 2001.
8. Disaster Management in India, Ministry of Home Affairs, Government of India, New Delhi, 2011.

CO-PO Mapping

Course Name: **Disaster Management** Course Code: **CEUN102**

Course outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	3	3	3	1	3	3	3	2	2	3
CO2	3	3	3	3	3	3	3	1	3	3	3	2	2	3
CO3	3	3	3	3	3	3	3	1	3	3	3	2	2	3
CO4	3	3	3	3	3	3	3	1	3	3	3	2	2	2
CO5	3	3	3	3	3	3	3	1	3	3	3	2	2	2

Department : Civil Engineering			Programme : **B.Tech.**						
Semester : VI			Course Category Code: ANC				Semester Exam Type: TY		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
CEUN103	**Air, Water and Noise Pollution**		3	0	0	3	40	60	100
Prerequisite:									
Course Outcome	CO1	To understand basic knowledge on the air pollution & interaction of air pollutants on the meteorological parameters							
	CO2	To study about the control measures of air pollutants and controlling equipment's							
	CO3	To have a basic knowledge on the water pollution on the environment							
	CO4	To study about the control measures of water pollution							
	CO5	To study about the noise pollution and control measures							

UNIT – I	**Introduction of Meteorology and Air pollution**	**Periods:9**
Definition of clean air –air pollutants - Sources and classification - Effects of air pollution on man, animal, vegetation and properties -Ambient Air Quality Standards, Air pollution control legislation. Meteorology and Air pollution – Atmospheric stability – Inversions – Mixing height – Plume behavior – Plume rise estimation – Effluent stream dispersion theories.		**CO1**
UNIT – II	**Control of particulate and gaseous pollutants**	**Periods:9**
Control of Air pollutants: particulates – Filters – Gravitational settling chambers – Centrifugal-multiple type cyclones – Collection efficiency - Electrostatic precipitators – Wet Collectors-Centrifugal spray scrubbers - Venturi scrubbers. Gaseous pollution control – Absorption - Principles – Description of equipment, Adsorption – Principal adsorbents – Equipment descriptions – Condensation – Contact condensers, Incineration –Equipment description-plasma techniques & application		**CO2**
UNIT – III	**Introduction of Water pollution**	**Periods:9**

Hydrosphere, Hydrological cycle and Natural water. Pollutants of water, their origin and effects: Oxygen demanding wastes, pathogens, nutrients, Salts, thermal application, heavy metals, pesticides, volatile organic compounds. River, Lake, Ground water pollution.		**CO3**
UNIT – IV	**Control of Water pollution**	**Periods:9**
Water pollution control regulations, Water pollution control criteria, Organic content of natural waters, Water pollution discharge mixing zones, Water pollution in lakes and reservoirs, water augmentation – rain water harvesting methods, Clean development mechanism		**CO4**
UNIT – V	**Control of Noise pollution**	**Periods:9**
Sound and noise - Source of noise pollution - Environmental and industrial noise -Effects of noise pollution - Fundamentals of sound - generation, propagation, etc., Sound measurement, sound level meters – Measures for prevention and control of noise -Environmental and industrial noise control legislation.		**CO5**

Lecture Periods: 45	**Tutorial Periods:**	**Practical Periods:**	**Total Periods:45**

Reference Books:

1. Rao. M.N. et al., Air Pollution, Tata Mc.Graw Hill, 2013.
2. Rao. C.S., Environmental Pollution Control Engineering, New Age International Publishers, 2014.
3. Trivedi.P.R.,Noise Pollution. Akashdeep Publishing House, 1992.
4. Noel de Nevers, Air Pollution Control Engineering, Mc.Graw Hill, New York. 2012.
5. Stern, A.C., Air Pollution, Vol. I, II and III, Academic Press, 2012.
6. Cunniff, P.F., Environmental Noise Pollution, John Wiley and Sons, 2010.

CO-PO Mapping

Course Name **Air, Water and Noise Pollution** Course Code: **CEUN103**

Course outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	3	3	3	1	3	3	3	2	2	3
CO2	3	3	3	3	3	3	3	1	3	3	3	2	2	3
CO3	3	3	3	3	3	3	3	1	3	3	3	2	2	3
CO4	3	3	3	3	3	3	3	1	3	3	3	2	2	3
CO5	3	3	3	3	3	3	3	1	3	3	3	2	2	3

Department : Civil Engineering			Programme: **B.Tech.**						
Semester : VII			Course Category Code: ANC				Semester Exam Type: TY		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
CEUN104	**Environmental Health and Safety**		3	0	0	3	40	60	100
Prerequisite:	Nil								
Course Outcome	**CO1**	Need for EHS in industries and related Indian regulations							
	CO2	Various types of Health hazards, effect, assessment and control methods							
	CO3	Various safety systems in working environments							
	CO4	Various safety systems in working environments							
	CO5	EHS Management System and its elements							

UNIT – I	**Codes and Regulations**	**Periods: 9**
Need for developing Environment, Health and Safety systems in work places- International initiatives, National Policy and Legislations on EHS in India - Regulations and Codes of Practice - Role of trade union safety representatives - Ergonomics..		**CO1**
UNIT – II	**Occupational Health and Hygiene**	**Periods: 9**
Definition of occupational health and hygiene - Categories of health hazards – Exposure pathways and human responses–Exposure Assessment-occupational exposure limits - Hierarchy of control measures - Role of personal protective equipment and the selection criteria		**CO2**
UNIT – III	**Workplace Safety and Safety Systems**	**Periods: 9**
Features of Satisfactory and Safe design of work premises – good housekeeping - lighting and color, Ventilation and Heat Control, Noise, Chemical and Radiation Safety – Electrical Safety – Fire Safety – Safety at Construction sites, ETP – Machine guarding – Process Safety, Working at different levels		**CO3**
UNIT – IV	**Hazards and Risk Management**	**Periods: 9**
Safety appraisal – Job Safety Analysis-Control techniques – plant safety inspection – Accident investigation - Analysis and Reporting – Hazard and Risk Management Techniques –Onsite and Offsite emergency Plans. Employee Participation- Education and Training- Case Studies		**CO4**
UNIT – V	**Environmental Health and Safety Management**	**Periods: 9**

Concept of Environmental Health and Safety Management – Elements of Environmental Health and Safety Management Policy and implementation and review – ISO 45001-Strucure and Clauses-Case Studies	**CO5**

Lecture Periods: 45	**Tutorials Periods:**	**Practical Periods: -**	**Total Periods: 45**

Reference Books:

1. Industrial Health and Safety Acts and Amendments, by Ministry of Labour and Employment, Government of India 2. Fundamentals of Industrial Safety and Health by Dr.K.U.Mistry, Siddharth Prakashan, 2012
3. The Facility Manager's Guide to Environmental Health and Safety by Brian Gallant, Government Inst Publ., 2007.
4. Effective Environmental, Health, and Safety Management Using the Team Approach by Bill Taylor, Culinary and Hospitality Industry Publications Services, 2005.
5. Environmental and Health and Safety Management by Nicholas P.Cheremisinoff and Madelyn L. Graffia, William Andrew Inc. NY, 1995

CO-PO Mapping

Course Name**: Environmental Health and Safety** Course Code: **CEUN104**

Course outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	3	3	3	1	3	3	3	2	3	3
CO2	3	3	3	3	3	3	3	1	3	3	3	2	3	3
CO3	3	3	3	3	3	3	3	1	3	3	3	2	3	3
CO4	3	3	3	3	3	3	3	1	3	3	3	2	3	3
CO5	3	3	3	3	3	3	3	1	3	3	3	2	3	3

ANCILLARY STREAM TITLE: EMERGING TECHNOLOGIES
(Interdisciplinary- Offered to Civil Engg Students)

Department : Mechanical Engineering			Programme: **B.Tech.**						
Semester : IV			Course Category Code: ANC				Semester Exam Type: TY		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
CEUI101	**Robotics and Automation**		3	-	0	3	40	60	100
Prerequisite:									
Course Outcome	CO1	Explain the fundamental principles of robotics in the context of engineering and construction							
	CO2	Interpret the role and impact of automation in enhancing construction processes.							
	CO3	Compare the effectiveness of various sensor technologies in construction robotics for different scenarios							
	CO4	Asses the risk and safety challenges associated with the construction robotics focusing on human robot interaction							
	CO5	Implement the knowledge of advanced materials and innovative technologies for modern construction challenges							

UNIT – I	**Introduction to Robotics and Automation**	**Periods: 9**
Overview of Robotics and Automation, Importance and applications in the construction industry, Challenges and opportunities Definition & Need of Robot, Laws of robots, Physical Overview of robots- Robot Anatomy - Coordinate Systems, Work Envelope Types and Classification- Specifications. Application in construction		**CO1**
UNIT – II	**Robotic Automation and Gripper Technologies**	**Periods: 9**
Pneumatic Drives-Hydraulic Drives-Mechanical Drives-Electrical Drives-D.C. Servo Motors, Stepper Motors, End Effectors-Grippers-Mechanical Grippers, Pneumatic and Hydraulic-Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection, force calculation and Design Considerations.		**CO2**
UNIT – III	**Sensor and Sensor Technologies**	**Periods: 9**

Sensor technologies in construction robotics - Robotics Sensors - Types, Classification - Position Sensors & Range Sensors and Requirements of a sensor, Applications of the sensors. Robotics for inspection and maintenance - Integration of Al and machine learning in construction robotics.			**CO3**
UNIT – IV	**Challenges and Safety in Robotics**		**Periods: 9**
Automated construction machinery and equipment construction planning and management - Safety considerations and risk management- Applications in earthmoving, concreting, and bricklaying, Ethical and environmental implications of robotics in construction			**CO4**
UNIT – V	**Future Trends and Innovations**		**Periods: 9**
Emerging technologies in construction robotics - Advanced materials and 3DD printing in construction - Unmanned Aerial Vehicles (UAVs) and drones in construction Case studies of innovative robotic construction projects, Research advancements and ongoing projects			**CO5**
Lecturer Periods: 45	**Tutorials Periods:**	**Practical Periods:**	**Total Periods: 45**

Reference Books:

1. "Robotics in Civil Engineering" by P. G. Bernold, 2018
2. "Automation in Construction: An Introduction" by Thomas Bock and Thomas Linner, 2009
3. "Robotic Applications in Civil Engineering" by H. Al-Bayati, 2018
4. "Construction Robotics" by Thomas Linner and Thomas Bock, 2020
5. "Intelligent Robotics and Applications in Construction" by Ming Lu, 2020
6. Advances in construction robotics by Xie, 2019.

CO-PO Mapping

Course Name: **Robotics and Automation** Course Code: **CEUI101**

Course outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	3	3	3	1	3	3	3	2	2	3
CO2	3	3	3	3	3	3	3	1	3	3	3	2	2	3
CO3	3	3	3	3	3	3	3	1	3	3	3	2	2	3
CO4	3	3	3	3	3	3	3	1	3	3	3	2	2	3
CO5	3	3	3	3	3	3	3	1	3	3	3	2	2	3

Department : EIE			Programme : **B.Tech.**						
Semester : V			Course Category Code: ANC				Semester Exam Type: TY		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
EIUC151	**Instrumentation and Sensor Technologies for Civil Engineering Applications**		3	0	0	3	40	60	100
Prerequisite:									
Course Outcome	CO1	Identify the basic forces for indicating instruments							
	CO2	Apply the instrument techniques for structural related problem in civil engineering							
	CO3	Apply seismic instruments for measuring the vibration motion in structures							
	CO4	Quantity the environmental related problems by using the various measuring instruments							
	CO5	Explain the principle and usage of flow meters in flow measurements							

UNIT –I	**Basic forces for indicating instruments**	Periods : 9

Introduction - Permanent moving coil instrument- Shunts and Multipliers - Moving iron instruments, Errors in measurements - Construction and operating principles of attraction and repulsion types - Wheat stone bridge Kelvin's double bridge - Maxwell's bridge, Hay's bridge, Wein bridge.

UNIT –II	**Structural Instrumentation**	Periods : 9

Classification of transducers - Capacitive, inductive, photo electric transducer - LVDT ,velocity transducer - Load cell, Hydraulic load cell - Pneumatic load cell, Torque meter - Load cells using strain gauges - Elastic force transducers, Elcometer - Cathode ray tube, Principle of operation - X-Y recorder, Strip chart recorder, Galvanometric type strip chart recorder.

UNIT –III	**Motion Measurements**	Periods : 9

Relative motion measuring devices - Vibration measurements - Principle of seismic instruments - Displacement measurements, Acceleration measurement - Velocity measurement Time and frequency measurement - Angular motion measurement, Eddy current drag cup tachometer - Optical methods Pneumatic gauges - Surface roughness measurements - Stylus method ,Photo electric type tachometer.		
UNIT –IV	**Environmental pollution**	Periods : 9
Orsat apparatus,Gas chromatograph - Measurement of automobile emission, stack emission - Viscosity measurement ,Capillary tube viscometer - Liquid level measurement, Rotameter type viscometer - Efflux viscometer, Slight glass method - Capacitance type liquid gauge - Ultrasonic liquid level gauge.		
UNIT –V	**Flow measurements**	Periods : 9
Primary methods - Ultrasonic flow meter, Electromagnetic flow meter - Turbine flow meter - Lobed impeller meter, Rotary vane flow meter.		

Lecturer Periods: 45	**Tutorials Periods:**	**Practical Periods:**	**Total Periods: 45**

Reference Books

1. Keith Cheatle, “Fundamentals of Test Measurement Instrumentation”, ISA publishers, 2004.
2. Michael D. Whitt, “Successful Instrumentation and Control systems design with CD”, ISA publishers, 2004.
3. Jim Strothman, “ISA Handbook of Measurement Equations and Tables”, 2nd Edition, ISA publishers, 2006.
4. Gregory K. McMillan and Robert A. Cameron, “Advanced pH Measurement and Control”, 3rd Edition, ISA publishers, 2005.

CO-PO Mapping

Course Name: **Instrumentation and Sensor Technologies** Course Code: **CEUI102**

Course outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	3	3	3	1	3	3	3	2	3	3
CO2	3	3	3	3	3	3	3	1	3	3	3	2	3	3
CO3	3	3	3	3	3	3	3	1	3	3	3	2	3	3
CO4	3	3	3	3	3	3	3	1	3	3	3	2	3	3
CO5	3	3	3	3	3	3	3	1	3	3	3	2	3	3

Department : Physics			Programme : **B.Tech.**						
Semester : VI			Course Category Code: ANC				Semester Exam Type: TY		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
CEUI103	**Non-Destructive Testing**		3	0	0	3	40	60	100
Prerequisite:									
Course Outcome	CO1	Identify the problem in structures by visual inspection without any special instruments							
	CO2	Examine the quality of structures/materials by ultrasonic test and its principles with help of data from equipment's and methods							
	CO3	Understand the quality of structures/materials by radiography with principals of X ray and its principles with help of digital radiography, image collection							
	CO4	Understand the quality of structures/materials by thermography approach with help sources and detectors and more technique							
	CO5	Understand and apply the latest techniques/methods adopted in NDT							

UNIT – I	**Surface Examination Method**	**Periods: 9**
Visual Inspection- Liquid Penetrant- Magnetic Particle - Eddy Current - Physical Principles, Methodology, Limitations, Applications.		**CO1**
UNIT – II	**Volumetric Examination Method-Part1**	**Periods: 9**
Ultrasonic Testing-Ultrasonic NDT principles, Different types of wave modes, Physics of wave generation, reception, interactions and propagation. Calibration, data collection, quantification, and interpretation, New methods using guided waves, Resonance and other Low Frequency Methods.		**CO2**
UNIT – III	**Volumetric Examination Method-Part2**	**Periods: 9**
Radiography Testing- Principles of X-ray NDT, Equipment, Calibration, Image Collection,		

Quantification, and Interpretation. High power sources and high-quality films. Digital Radiography, Introduction to Tomography and Laminographic.		**CO3**
UNIT – IV	**Condition Monitoring Method**	**Periods: 9**
Thermography –: Principles of thermography and approaches in NDT, Sources and detectors, capabilities and limitations, measurement of diffusivity and wall thickness. **Infrared Testing - Vibration Analysis.**		**CO4**
UNIT – V	**Special NDT methods**	**Periods: 9**
Introduction to special NDT methods -magnetic resonance imaging, vibration monitoring, laser ultrasonic, holography, computed tomography.		**CO5**

Lecture Periods: 45	**Tutorials Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Reference Books:

1. Nondestructive Evaluation - Theory, Techniques, and Applications, by P.J. Shull, Marcell Decker Inc., NY 2002.
2. Non-destructive Evaluation - A tool in Design, Manufacturing and Service by D.E. Bray and R. K. Stanley, Revised Edition CRC Press, 1996.
3. Breysse.D, Non-Destructive Assessment of Concrete Structures: Reliability and Limits of Single and Combined Techniques, Springer Publishers, 2012.
4. NDT Handbooks Vol 1-17, ASNT Press, OH, USA

CO-PO Mapping

Course Name: **Non-Destructive Testing** Course Code: **CEUI103**

Course outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	2			3	3	3	3		3	1
CO2	3	3	3	3	2			3	3	3	3		3	1
CO3	3	3	3	3	2			3	3	3	3		3	1
CO4	3	3	3	3	2			3	3	3	3		3	1
CO5	3	3	3	3	2			3	3	3	3		3	1

Department : Civil Engineering		Programme: **B.Tech.**						
Semester : VII		Course Category Code: ANC				Semester Exam Type: TY		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
CEUI104	**3D Printing and Advanced Material Science**	3	0	0	3	40	60	100
Prerequisite:								
Course Outcome	CO1	Identify the benefits and limitations of various additive manufacturing processes						
	CO2	Learn about CAD software tools to create and manipulate geometric models suitable for 3D printing.						
	CO3	Select the most appropriate one based on material application and process parameters						
	CO4	Estimate the cost and amount of raw materials required for various applications						
	CO5	Investigate advanced applications of 3D printing in various industries						

UNIT – I	**Introduction to Additive Manufacturing**	**Periods: 9**
Additive Manufacturing Process Chain - printing - Benefits and limitations of 3D Hybrid AM - 4D Printing - Bio Printing. Applications: Nano Printing, Architectural, and construction industries		**CO1**
UNIT – II	**CAD for 3D Printing Processes**	**Periods: 9**
Introduction to Conceptual Design - CAD - Geometric modeling - Modeling of Parts in CAD Software - Reverse engineering - 3D digitizing techniques - 3D Model Reconstruction. Pre-Processing in 3D Printing: Data Formats for CAD design and 3D Printing - Conversion of 3D CAD model into STL file - Errors in STL File - Part orientation and support structure design. model slicing - Tool path generation - 3D printing software's.		**CO2**
UNIT – III	**3d Printing Processes**	**Periods: 9**
Gangtray of 3D Printers - Polar, Cartesian and Delta 3D Printers, Prunisio: SL, DLP, CLIP - Material Jetting Process: M.J, NPJ, DOD - Binder Jetting process - Extrusion Process: FDM - Sheet Lamination		**CO3**

Process: LOM, UC - Powder bed fusion process and Directed Energy Deposition Process - Working principle, Materials, Process parameter, Process Selection for various applications, Advantages and Disadvantages		
UNIT – IV	**Materials for 3d Printing Processes**	**Periods: 9**
Different materials used in 3D Printing - polymers, metals, non-Metals, ceramics, composite materials, multifunctional and graded materials - Various forms of raw material- Liquid, Solid, Wire, Powder - Support Materials - Estimating cost and amount of raw material required for various applications. Emerging Materials: Shape memory material - Biomaterials - Nanomaterials - Bio ink - Concrete and food Printing.		**CO4**
UNIT – V	**Challenges and Future of Material Science in 3d Printing**	**Periods: 9**
Limitations of current 3D printing technologies - Sustainability and environmental impacts of 3D printing - Future materials for 3D printing: potentials and research directions- Safety considerations.		**CO5**

Lecture Periods: 45	**Tutorials Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Reference Books:

1. "Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing" by lan Gibson, David Rosen, and Brent Stucker, 2019
2. "3D Printing and Additive Manufacturing: Principles and Applications" by Chee Kai Chua and Kah Fai Leong, 2018
3. "Materials for Additive Manufacturing" by G. D. Janaki Ram, 2017
4. "Advances in 3D Printing & Additive Manufacturing Technologies" by David Ian Wimpenny et al., 2018
5. The 3D Printing Handbook: Technologies, design and applications" by Ben Redwood, Filemon Schöffer, and Brian Garret, 2008

CO-PO Mapping

Course Name: **3D Printing and Advanced Material Science** Course Code: **CEUI104**

Course outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	2	3	3	1	3	3	3	1	3	3
CO2	3	3	3	3	2	3	3	1	3	3	3	1	3	3
CO3	3	3	3	3	2	3	3	1	3	3	3	1	3	3
CO4	3	3	3	3	2	3	3	1	3	3	3	1	3	3
CO5	3	3	3	3	2	3	3	1	3	3	3	1	3	3