

PSN COLLEGE OF ENGINEERING AND TECHNOLOGY

(An Autonomous Institution Recognised by AICTE, New Delhi and Affiliated to Anna University, Chennai)

Accredited with A+ Grade by NAAC. An ISO 9001:2015 Certified Institution

Melathediyoore, Tirunelveli – 627 152



DEPARTMENT OF CIVIL ENGINEERING

B.E. – CIVIL ENGINEERING

CURRICULUM

(I TO VIII SEMESTER)

&

SYLLABUS

(III TO VI SEMESTER)

(REGULATION - 2022)

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REGULATIONS – R2022 (Full Time)

B.E. – CIVIL ENGINEERING

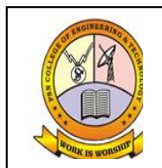
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INSTITUTE VISION
Emerge as a pioneer institute inculcating engineering education and skills research
INSTITUTE MISSION
IM-1: To achieve greater heights of excellence in technical knowledge and skill development through innovative teaching and learning practices.
IM-2: To develop the infrastructure to meet the demands of technological revolution.
IM-3: To improve and foster research in all dimensions for betterment of society.
IM-4: To develop individual competencies to enhance employability and entrepreneurship in students.
IM-5: To instill higher standards of discipline among students, inculcating ethical and moral values for societal harmony and peace.

DEPARTMENT VISION
To Produce competent, disciplined quality Engineers and administrators in accordance with global standards in Civil Engineering with capability of accepting new challenges.

DEPARTMENT MISSION
DM1: To train the students to meet dynamic needs of the society.
DM2: To promote research and continuing education.
DM3: To enhance professional and entrepreneurial skills through industry institute interaction.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)		
Sl. No.	Objective	PEOs
PEO1	Fundamental Knowledge	To impart Knowledge on the fundamental principles of mathematics, science, and sub-disciplines in the field of Civil Engineering
PEO2	Career Development	To make them undergo industrial training, and Professional development courses inculcating the habit of perceptual learning for career development.
PEO3	Social Identity	To develop effective communication skills and make them socially responsible to work cooperatively in all environments.

PROGRAM OUTCOMES			
PO'S No.	Knowledge	Statement	Appliance
1	Engineering Knowledge	Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of Complex engineering problems.	Theory/ Practical / Project work
2	Problem Analysis	Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	Theory / Practical / Projects
3	Design / Development of Solutions	Design solutions for complex engineering problems and design system components or processes that meet the needs with appropriate consideration for the public health and safety, and the cultural, Societal and environmental considerations.	Theory / Practical / Projects
4	Conduct Investigations of Complex Problems	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	Theory / Practical
5	Modern Tool usage	Create, select, and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.	Theory / Practical / Project work
6	The Engineer and Society	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	Theory / Industrial visit / In plant training
7	Environment and Sustainability	Understand the impact of the professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.	Theory / Industrial Visit/ In plant Training
8	Ethics	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	Theory / Industrial visit / In plant training

PROGRAM OUTCOMES			
PO'S No.	Knowledge	Statement	Appliance
9	Individual and Team Work	Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary settings.	Projects
10	Communication	Communicate effectively on complex engineering activities with the engineering community and with society at large such as being able to comprehend and write effective reports and design documentation, make effective presentations and give and receive clear instructions.	Projects/ Seminar/ Mini Project
11	Project Management and Finance	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	Projects
12	Life-long Learning	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	Projects / Higher Studies

PROGRAM SPECIFIC OUTCOMES (PSOs)	
PSO1	Ability to apply the knowledge of Mathematics, Sciences and Engineering Fundamentals to formulate, analyze and provide solutions to the problems related to Civil Engineering and communicating them effectively.
PSO2	Development of skill to deal with complex problems in the field of Civil Engineering to achieve design solutions with modern technological approach and application software.

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CURRICULUM – R 2022

B.E. –CIVIL ENGINEERING

SEMESTER - I

Sl.No	Course Code	Course Name		Classification	L	T	P	C
1.	IC610001	Professional English I	IC	Theory	2	0	0	2
2.	IC610002	Matrices and Calculus	IC	Theory	2	1	0	3
3.	IC610003	Engineering Physics	IC	Theory	3	0	0	3
4.	IC610004	Engineering Chemistry	IC	Theory	3	0	0	3
5.	IC610005	Problem Solving and 'C' Programming	IC	Theory	3	0	0	3
6.	ME610006	Engineering Graphics with CAD	IC	Theory with Practical	2	0	2	3
7.	IC610007	Tamil Marabu/Heritage of Tamil	IC	Theory	1	0	0	1
8.	IP610101	Physics & Chemistry Laboratory	IC	Practical	0	0	3	1.5
9.	IP610102	Programming in 'C' Laboratory	IC	Practical	0	0	3	1.5
10.		NCC/NSS/NSO *	IM	Institute Mandatory	1	0	0	0
Total					17	1	8	21

SEMESTER - II

Sl.No	Course Code	Course Name		Classification	L	T	P	C
1.	IC620008	Professional English II	IC	Theory with Practical	2	0	2	3
2.	IC620009	Transforms & Partial Differential Equations	IC	Theory	2	1	0	3
3.	IC620010	Engineering Materials (for Non Circuit Branches)	IC	Theory	3	0	0	3
	IC620011	Semiconductor Physics (for Circuit Branches)	IC		3	0	0	
4.	ME620012	Engineering Mechanics (for Non Circuit Branches)	PC	Theory with Project	3	0	0	3
	CS620013	Fundamentals of Artificial Intelligence (for Circuit Branches)			3	0	0	

5.	CS620014	Python Programming	IC	Theory	3	0	0	3
6.	ME620015	Basic Engineering	IC	Theory	3	0	0	3
7.	1C620016	Tamils and Technology	IC	Theory	1	0	0	1
8.	IM610401	Environmental Studies	IM	Institute Mandatory	2	0	0	0
9.	IP620103	Python Laboratory	IC	Practical	0	0	3	1.5
10.	IP620104	Engineering Practice Laboratory	IC	Practical	0	0	3	1.5
Total					25	1	8	22

***The curriculum framed and approved by under the first year board / chairman.**

SEMESTER – III

Sl.No	Course Code	Course Name		Classification	L	T	P	C
1.	IC630017	Numerical Methods and Statistics	IC	Theory	2	1	0	3
2.	CE630201	Surveying	PC	Theory	3	0	0	3
3.	CE630202	Concrete Technology	PC	Theory with Practical	2	0	2	3
4.	CE630203	Highway Engineering	PC	Theory with Project	3	0	0	3
5.	CE630204	Geotechnical Engineering I	PC	Theory	3	0	0	3
6.	#	Professional Elective I	PE	Theory	3	0	0	3
7.	CE630301	Surveying Laboratory	PC	Practical	0	0	3	1.5
8.	CE630302	Computer Aided Building Drawing	PC	Practical	0	0	3	1.5
9.	CE630501	Integrated Aptitude Skills - I (Lower)	EEC	Skill Based Course	0	0	1	0.5
10.	IM630402	Universal Human Values	IM	Theory	2	0	0	0
Total					18	01	09	21.5

SEMESTER – IV

Sl.No	Course Code	Course Name		Classification	L	T	P	C
1.	IC640018	Boundary Value Problems and Probability Distributions	IC	Theory	2	1	0	3
2.	CE640205	Mechanics of Materials	PC	Theory with Practical	2	0	2	3
3.	CE640206	Fluid Mechanics and Hydraulic Machinery	PC	Theory with Project	3	0	0	3
4.	CE640207	Geotechnical Engineering II	PC	Theory	3	0	0	3
5.	#	Professional Elective II	PE	Theory	3	0	0	3
6.	*	Institute Elective I	IE	Theory	3	0	0	3
7.	CE640303	Hydraulics Laboratory	PC	Practical	0	0	3	1.5
8.	CE640304	Geotechnical Engineering Laboratory	PC	Practical	0	0	3	1.5
9.	CE640502	Integrated Aptitude Skills - II (Lower)	EE C	Skill Based Course	0	0	1	0.5
10.	-	Inplant Training (2 Weeks)	IM		-	-	-	-
Total					16	01	09	21.5

SEMESTER – V

Sl.No	Course Code	Course Name		Classification	L	T	P	C
1.	CE650208	Structural Analysis I	PC	Theory with Practical	2	0	2	3
2.	CE650209	Design of RC Elements	PC	Theory with Project	2	1	0	3
3.	CE650210	Environmental Engineering	PC	Theory	3	0	0	3
4.	#	Professional Elective III	PE	Theory	3	0	0	3
5.	#	Professional Elective IV	PE	Theory	3	0	0	3
6.	\$	Institute Elective II	IE	Theory	3	0	0	3
7.	CE650801	Contract Laws for Civil Engineers	PM	Theory	2	0	0	0
8.	CE650305	Survey Field Practices Laboratory	PC	Practical	0	0	3	1.5
9.	CE650306	Concrete and Highway Engineering Laboratory	PC	Practical	0	0	3	1.5
10.	CE650503	Integrated Aptitude Skills - I (Higher)	EEC	Skill Based Course	0	0	2	1
Total					18	01	10	22

SEMESTER – VI

Sl.No	Course Code	Course Name		Classification	L	T	P	C
1.	CE660211	Structural Analysis II	PC	Theory with Practical	2	0	2	3
2.	CE660212	Design of Steel Structures	PC	Theory with Project	2	1	0	3
3.	CE660213	Construction Management	PC	Theory	3	0	0	3
4.	#	Professional Elective V	PE	Theory	3	0	0	3
5.	#	Professional Elective VI	PE	Theory	3	0	0	3
6.	*	Institute Elective III	IE	Theory	3	0	0	3
7.	IM660403	Professional Ethics	IM	Theory	2	0	0	0
8.	CE660307	Environmental Engineering Laboratory	PC	Practical	0	0	3	1.5
9.	CE660308	Environmental and Irrigation Drawing Laboratory	PC	Practical	0	0	3	1.5
10.	CE660504	Training in Centre for Excellence	EEC	Skill Based Course	0	0	2	1
	-	Internship	IM		-	-	-	-
Total					18	01	10	22

SEMESTER – VII

Sl.No	Course Code	Course Name		Classification	L	T	P	C
1.	CE670214	Design of RC Structures and Detailing	PC	Theory with Project	2	1	0	3
2.	CE670215	Estimation, Costing and Valuation	PC	Theory with Practical	2	0	2	3
3.	CE670216	Dynamics and Seismic Design of Structures	PC	Theory	3	0	0	3
4.	#	Professional Elective VII	PE	Theory	3	0	0	3
5.	#	Professional Elective VII	PE	Theory	3	0	0	3
6.	\$	Institute Elective IV	IE	Theory	3	0	0	3
7.	MG670019	Innovation Entrepreneurship and Startups	IC	Theory	3	0	0	3
8.	CE670309	Computer Aided Design and Drafting Laboratory	PC	Practical	0	0	3	1.5
9.	CE670310	Design Project	PC	Practical	0	0	3	1.5
10.	CE670505	Advanced Career Development	EEC	Skill Based Course	0	0	2	1
Total					19	01	10	25

SEMESTER – VIII

Sl.No	Course Code	Course Name		Classification	L	T	P	C
1.	CE680506	Project Work	PC	Practical	0	0	20	10
Total					0	0	20	10

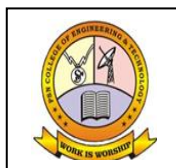
IC - Institute Core
 PC - Professional Core
 IM - Institute Mandatory
 EEC - Employment Enhancement Course
 IE - Institute Elective

PE - Programme Elective
 PM - Professional Mandatory

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PROGRAMME ELECTIVES

VERTICAL 1 –STRUCTURES

Sl. No	Course Code	Course Name		Classification	L	T	P	C
1.	CE606101	Prefabricated Structures	PE	Theory	3	0	0	3
2.	CE606102	Prestressed Concrete Structures	PE	Theory	2	1	0	3
3.	CE606103	Building Planning and Services	PE	Theory	3	0	0	3
4.	CE606104	Tall Buildings	PE	Theory	3	0	0	3
5.	CE606105	Corrosion of RC Structures	PE	Theory	3	0	0	3
6.	CE606106	Computer Aided Design of Structures	PE	Theory	3	0	0	3
7.	CE606107	Maintenance and Repair of Concrete Structures	PE	Theory	3	0	0	3
8.	CE606108	Design of Masonry Structures (NPTEL)	PE	Theory	3	0	0	3
9.	CE606109	Reinforced Concrete Road Bridges (NPTEL)	PE	Theory	3	0	0	3
10.	CE606110	Finite Element Method and Computational Structural Dynamics (NPTEL)	PE	Theory	3	0	0	3

Vertical 2 – Constructions

Sl. No	Course Code	Course Name		Classification	L	T	P	C
1.	CE606201	Construction Planning and Scheduling	PE	Theory	3	0	0	3
2.	CE606202	Energy Conservation Methods in Construction	PE	Theory	3	0	0	3
3.	CE606203	Advanced Construction Techniques	PE	Theory	3	0	0	3
4.	CE606204	Green Construction	PE	Theory	3	0	0	3
5.	CE606205	Environmental Impact Assessment for Construction Engineers	PE	Theory	3	0	0	3
6.	CE606206	Project Formulation and Appraisal	PE	Theory	3	0	0	3
7.	CE606207	Modern Construction Materials (NPTEL)	PE	Theory	3	0	0	3
8.	CE606208	Basic Construction Materials	PE	Theory	3	0	0	3
9.	CE606209	Development and Application of Special Concrete (NPTEL)	PE	Theory	3	0	0	3
10.	CE606210	Introduction to Lean Construction (NPTEL)	PE	Theory	3	0	0	3

VERTICAL 3 – WATER RESOURCES & ENVIRONMENTAL

Sl. No	Course Code	Course Name		Classification	L	T	P	C
1.	CE606301	Water Resources Engineering	PE	Theory	3	0	0	3
2.	CE606302	Industrial Waste Management	PE	Theory	3	0	0	3
3.	CE606303	Environmental Monitoring Instruments	PE	Theory	3	0	0	3
4.	CE606304	Air Pollution & Control	PE	Theory	3	0	0	3
5.	CE606305	Environmental Impact Assessment	PE	Theory	3	0	0	3
6.	CE606306	Environmental Policy and Legislations	PE	Theory	3	0	0	3
7.	CE606307	Ground Water Hydrology and Management (NPTEL)	PE	Theory	3	0	0	3
8.	CE606308	Surface Water Hydrology	PE	Theory	3	0	0	3
9.	CE606309	Computational Hydraulics (NPTEL)	PE	Theory	3	0	0	3
10.	CE606310	Rural Water Resources Management (NPTEL)	PE	Theory	3	0	0	3

VERTICAL 4 – SURVEYING

Sl. No	Course Code	Course Name		Classification	L	T	P	C
1.	CE606401	Hydrographic Surveying	PE	Theory	3	0	0	3
2.	CE606402	Geo- Informatics	PE	Theory	3	0	0	3
3.	CE606403	Satellite Image Processing	PE	Theory	3	0	0	3
4.	CE606404	Cartography	PE	Theory	3	0	0	3
5.	CE606405	Cadastral Surveying	PE	Theory	3	0	0	3
6.	CE606406	Higher Surveying	PE	Theory	3	0	0	3
7.	CE606407	Geographic Information Systems (NPTEL)	PE	Theory	3	0	0	3
8.	CE606408	Modern Surveying Techniques	PE	Theory	3	0	0	3
9.	CE606409	GPS Surveying (NPTEL)	PE	Theory	3	0	0	3
10.	CE606410	Digital Land Surveying and Mapping (NPTEL)	PE	Theory	3	0	0	3

VERTICAL 5– SOIL & FOUNDATION

Sl. No	Course Code	Course Name		Classification	L	T	P	C
1.	CE606501	Soil Dynamics	PE	Theory	3	0	0	3
2.	CE606502	Advanced Foundation Engineering	PE	Theory	3	0	0	3
3.	CE606503	Ground Improvement Techniques	PE	Theory	3	0	0	3
4.	CE606504	Earthquake Resistant and Design of Foundations	PE	Theory	3	0	0	3
5.	CE606505	Geotechniques for Infrastructure	PE	Theory	3	0	0	3
6.	CE606506	Earth and Earth Retaining Structures	PE	Theory	3	0	0	3
7.	CE606507	Soil Structure Interaction	PE	Theory	3	0	0	3
8.	CE606508	Geotechnical Earthquake Engineering (NPTEL)	PE	Theory	3	0	0	3
9.	CE606509	Unsaturated Soil Mechanics (NPTEL)	PE	Theory	3	0	0	3
10.	CE606510	Geosynthetics Engineering - In Theory and Practice (NPTEL)	PE	Theory	3	0	0	3

VERTICAL 6 – TRANSPORTATION

Sl. No	Course Code	Course Name		Classification	L	T	P	C
1.	CE606601	Railway Infrastructure Planning and Design	PE	Theory	3	0	0	3
2.	CE606602	Airport Infrastructure Planning and Design	PE	Theory	3	0	0	3
3.	CE606603	Waterway Infrastructure Planning and Design	PE	Theory	3	0	0	3
4.	CE606604	Road Safety System	PE	Theory	3	0	0	3
5.	CE606605	Intelligent Transportation Systems	PE	Theory	3	0	0	3
6.	CE606606	Environmental Impacts of Transportation	PE	Theory	3	0	0	3
7.	CE606607	Traffic Engineering and Management (NPTEL)	PE	Theory	3	0	0	3
8.	CE606608	Pavement Engineering	PE	Theory	3	0	0	3
9.	CE606609	Urban Planning and Development (NPTEL)	PE	Theory	3	0	0	3
10.	CE606610	GIS for Transportation Systems (NPTEL)	PE	Theory	3	0	0	3

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INSTITUTE ELECTIVES

INSTITUTE ELECTIVE I

Sl. No	Course Code	Course Name		Classification	L	T	P	C
1.	CE607103	Climate Change Adaptation and Mitigation	IE	Theory	3	0	0	3
2.	CE607104	Sustainable Development	IE	Theory	3	0	0	3
3.	CE607105	Watershed Conservation and Management	IE	Theory	3	0	0	3

INSTITUTE ELECTIVE II

Sl. No	Course Code	Course Name		Classification	L	T	P	C
1.	CE607203	Environmental Risk Management	IE	Theory	3	0	0	3
2.	CE607204	Energy Efficiency, Acoustics and Day Lighting in Building	IE	Theory	3	0	0	3

INSTITUTE ELECTIVE III

Sl. No	Course Code	Course Name		Classification	L	T	P	C
1.	CE607303	Plastic Waste Management	IE	Theory	3	0	0	3
2.	CE607304	Waste to Energy Conversion	IE	Theory	3	0	0	3

INSTITUTE ELECTIVE IV

Sl. No	Course Code	Course Name		Classification	L	T	P	C
1.	CE607402	Electronic Waste Management	IE	Theory	3	0	0	3
2.	CE607403	Environmental Quality Monitoring & Analysis	IE	Theory	3	0	0	3

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SUMMARY SHEET

SEMESTER	I	II	III	IV	V	VI	VII	VIII	Total
CREDIT	21	22	21.5	21.5	22	22	25	10	165

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III SEMESTER SYLLABUS

IC630017-NUMERICAL METHODS AND STATISTICS						
Course Category: Institute Core	Course Type: Theory	L	T	P	C	
		2	1	0	3	
COURSE OBJECTIVES:						
With the present development of the computer technology, it is necessary to develop efficient algorithms for solving problems in science, engineering and technology. This course gives a complete procedure for solving different kinds of problems that occur in engineering numerically.						
UNIT 1 - SOLUTION OF EQUATION AND EIGNVALUE PROBLEM						6+3
Solution of linear system of equation – Bijection method – fixed point Iteration method – Newton Raphson Method – RagulaFalsi method – Decomposition Method – Gauss Elimination Method – Gauss Jordan Method – Gauss Jacobi Method –Finding largest eigen value- Inverse of matrix by Jordan Method.						
UNIT 2 - INTERPOLATION AND APPROXIMATING POLYNOMIALS						6+3
Lagrangian polynomials – Divided difference formulae for equal intervals and unequal intervals – Interpolating with a cubic spline – Newton’s forward and backward difference formulas – Stirlings formula						
UNIT 3 - NUMERICAL DIFFERENTIATION AND INTEGRATION						6+3
Differentiation using interpolation formulae – Numerical integration by trapezoidal and Simpson’s 1/3 and 3/8 rule – Romberg’s Method – Double integrals using trapezoidal and Simpson’s rules.						
UNIT 4 - THEORY OF ESTIMATION						6+3
Estimation: Point and Interval estimates for population parameters of large sample and small samples, determining the sample size.						
UNIT 5 - TESTING OF HYPOTHESIS						6+3
Sampling distributions – Testing of hypothesis for mean – variance –proportions and differences using Normal–‘t’–Chi-square and F-distributions–Tests for independence of distributions of attributes and goodness of fit.						
TOTAL: 45 PERIODS						

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

CO1:	Compute the solutions of the variables using iterative methods..
CO2:	Understand and apply methods to find interpolating and approximating polynomials.
CO3:	Solve complicated differentiation and integration by numerical methods.
CO4:	Identify the type of estimations for small samples and large samples
CO5:	Solve the physical problems by small and large sampling theory

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	2	2	-	-	-	-	-	1	-	-	-
CO2	2	2	1	1	1	2	-	-	-	-	-	-	-	-
CO3	2	1	2	2	2	-	-	-	-	-	-	-	-	-
CO4	1	1	1	1	-	-	-	-	-	-	1	-	-	-
CO5	2	2	2	1	2	-	-	-	-	-	1	-	-	-

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. M.K. Jain, S.R.K. Iyengar and R.K. Jain “Numerical methods: for scientific and engineering computation” 2013. 6th ed.,
2. Devore, J.L., “Probability and Statistics for Engineering and the Sciences”, Cengage Learning, New Delhi, 8th Edition, 2014.
3. S.C. Gupta and V.K. Kapoor “Fundamentals of mathematical statistics” Eleventh thoroughly revised ed., Sultan Chand & Sons educational publishers, New Delhi (June 2003)
4. T. Veerarajan, “Probability, Statistics and Random Processes” Tata McGraw-Hill Publishing Company Limited, New Delhi(2006)

REFERENCE BOOKS:

1. Sankararao.K “Numerical Methods for Scientists and Engineers” -3rd edition Printice Hall of India Private Ltd. New Delhi-(2007).
2. Walpole, R.E., Myers, R.H., Myers, S.L. and YE. K., “Probability and Statistics For Engineers and Scientists”, 9th Edition, Pearson Education, Asia, 2010
3. 3. Dr. Singaravelu, “ Numerical Methods” 19th Edition, Meenakshi Agency, Chennai (Dec 2012)

WEB RESOURCES:

1. <https://lecturenotes.in/subject/24/numerical-methods-nm>
2. <https://www.worldscientific.com/worldscibooks/10.1142/2884>

CE630201-SURVEYING						
Course Category: Program Core	Course Type: Theory	L	T	P	C	
		3	0	0	3	
COURSE OBJECTIVES:						
<ul style="list-style-type: none">To study the basics of linear / angular measurement methods like chain surveying, compass surveying.To measure the height and distance by theodolite and trigonometric.To know about tachometric surveying in distance and height measurements.To find the setting out of simple curves by linear and instrument methodTo Study the total station surveying						
UNIT 1 - FUNDAMENTALS OF CONVENTIONAL SURVEYING AND LEVELLING						9
Classifications and basic principles of surveying - Equipment and accessories for ranging and chaining - Methods of ranging - Compass - Types of Compass - Bearing - Types - True Bearing - Magnetic Bearing - Levelling- Principles and theory of Levelling -Datum-BenchMarks-TemporaryandPermanentAdjustments-MethodsofLevelling-Booking-Reduction Sources of errors in Levelling – Curvature and refraction.						
UNIT 2 - THEODOLITEANDTRIGNOMETRICLEVELLING						9
Introduction- Classification of theodolite- Temporary and permanent adjustments – Measurements of horizontal and vertical angles- Theodolite traversing-Traversing computation-Balancing of traversing- Introduction to omitted measurements. Trigonometrical levelling: Heights and distances - Base of the object accessible and In accessible.						
UNIT 3 - TACHEOMETRIC SURVEYING AND CONTOURS						9
Introduction-Instruments-Different systems of tachometric measurements- Tacheometer - Stadia Constants - Analytic Lens -Tangential and Stadia Tacheometry surveying-Substense method: Vertical and horizontal measurements. Contour - Contouring - Characteristics of contours - Methods of contouring- Direct method-Indirect method- Contour gradient –Uses of contour plan and map-Measurements of area and volume.						
UNIT 4 - CURVESAND TRIANGULATION						9
Curves-Classifications-Elements of curves-Designation of curves-Setting out of simple curves: Linear and instrument method. Triangulation- Classification-Basic systems- Operation-Signals and towers-Satellite station.						
UNIT 5 - TOTAL STATION & GPS						9
Total station: Study of Total Station-Features-Recording-Advantages-Field procedure- Measuring						

Horizontal and vertical angles-Measurement of angles and height-Traversing using Total station and Area of Traverse - Determination of distance and difference in elevation between two inaccessible points using Total station. Global Positioning Systems: GPS elements- Application and uses-Advantages.

TOTAL: 45 PERIODS

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

CO1:	Conduct linear and angular measurement survey with the help of chain, tape and compass.
CO2:	Determine the horizontal and vertical distance by traversing using theodolite and measure difference in elevation and produce reduced level of the given points.
CO3:	Describe the methods of Tacheometric surveying and contouring.
CO4:	Describe the methods of setting out curves in the field and to determine the area and volume of structures.
CO5:	Handle total station instrument for making the horizontal and vertical measurements. Conduct the global positioning system for determining geographical location of the site

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	2	-	3	1	3	-	1	-	2	3	1
CO2	2	3	3	2	2	-	1	3	2	2	2	3	3	1
CO3	2	3	2	2	2	3	3	3	1	1	3	3	3	2
CO4	3	2	2	2	-	3	2	2	1	1	1	3	3	-
CO5	2	1	1	-	-	1	2	1	2	1	2	3	3	1

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Punmia B.C, "Surveying, Vol. I and II", Laxmi Publications, 16th Editions 2017
2. Basak N.N, "Surveying and Levelling", Tata Mc Graw Hill Publishing Company Ltd. 2nd Edition, 2017.
3. Kumar S., "Basics of Remote sensing and GIS", Laxmi Publication (P) Ltd, New edition, 2022.

REFERENCE BOOKS:

1. Arora K. R, "Surveying Vol. I and II", Standard Book House, 12th Edition, 2019.
2. Duggal S.K, "Surveying Vol. I and II", Tata McGraw Hill, New Delhi, 5th Edition, 2013.
3. Kanetkar T.P, "Surveying and Levelling Vols. I and II", United Book Corporation, Pune, 1st Edition, 2014.

WEB RESOURCES:

1. <https://archive.nptel.ac.in/courses/105/104/105104101/>
2. <https://nptel.ac.in/courses/105107122>
3. <https://archive.nptel.ac.in/courses/105/107/105107157/>

CE630202-CONCRETE TECHNOLOGY						
Course Category: Program Core	Course Type: Theory With Practical Component	L	T	P	C	
		2	0	2	3	
COURSE OBJECTIVES:						
<ul style="list-style-type: none">To have better knowledge about the chemical and mineral admixtures in concrete.To study the properties of concrete making materials.To familiarize with the IS method of mix design as per the latest code.To study the durability, corrosion and its preventive measures.To know the importance and applications of special concretes.						
UNIT 1 - INGREDIENTS OF CONCRETE						6
Cement–constituents–Hydration–Types of cement–Test on cement as per BIS specifications–Aggregates–Properties and tests as per BIS–Quality of water–Admixtures–Chemical admixture and mineral admixture						
UNIT 2 - PROPERTIES OF CONCRETE						6
Workability–Segregation–Bleeding–Strength–Stress–Strain characteristics–Modulus of Elasticity–Shrinkage–Creep –Permeability–Destructive tests–Non Destructive Tests.						
UNIT 3 - CONCRETE MIX DESIGN AND QUALITY CONTROL OF CONCRETE						6
Statistical quality control- Sampling and testing–Acceptance criteria –Factors influencing. The design mix – Mix Design by ACI and IS method.						
UNIT 4 - DURABILITY AND CONCRETE UNDER SPECIAL CIRCUMSTANCES						6
Durability–Chemical attack–Corrosion and its preventive measures–Underground Construction–Extreme weather concreting.						
UNIT 5 - SPECIAL CONCRETES						6
High Strength concrete – High Performance Concrete – Reactive powder concrete – Lightweight concrete–Mass concrete–Self Compacting Concrete–Polymer Concrete – Geopolymer Concrete–Fibre Reinforced Concrete–Ready Mix Concrete–Ferrocement–Shortcrete–Vacuum concrete						
LIST OF EXPERIMENTS (Not Included for End Semester Examinations)						
1. Determination of Consistency of Cement						
2. Determination of Initial & Final Setting time of Cement						
3. Determination of Compressive Strength of Cement						

4. Determination of Crushing Value of Coarse Aggregate														
5. Determination the Workability of Concrete using Flow Table Apparatus														
TOTAL: 45 PERIODS (30+15)														
COURSE OUTCOMES: At the end of the course, the student will be able to														
CO1:	Explain the suitability of ingredients of concrete and their testing methods.													
CO2:	Explain Properties of concrete and testing procedures of concrete in plastic and hardened State.													
CO3:	Infer quality control and design concrete mixes by various methods.													
CO4:	Summarize durability of concrete and concreting under special circumstances.													
CO5:	Outline the properties of special concrete sand its applications.													
CO-PO MAPPING														
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	2	-	1	-	-	-	2	-	2
CO2	1	2	3	-	-	2	-	1	-	-	-	2	-	2
CO3	1	3	-	-	2	2	-	1	-	-	-	2	2	-
CO4	1	2	3	-	-	2	-	1	-	-	-	2	2	-
CO5	1	2	3	-	-	2	-	1	-	-	-	2	-	2
1- low, 2 - medium, 3 - high, '-' no correlation														
TEXT BOOKS:														
1. M. S. Shetty & A K Jain “Concrete Technology: Theory and Practice”, S Chand Publishing, 8 th Edition, 2019.														
2. M.L. Gambhir, “Concrete Technology Theory and Practice”, McGraw Hill Education, 5 th Edition, 2017.														
3. Sachin Rohilla, Vipin Rohilla, “Concrete Technology”, S.K. Kataria& Sons, 1 st Edition, 2016.														
REFERENCE BOOKS:														
1. R. P. Rethaliya, “Concrete Technology”, Charotar Publishing House Pvt. Ltd, 2 nd Edition, 2018.														
2. A.R. Santhakumar, “Concrete Technology”Oxford University Press, 2 nd Edition, 2018.														
3. A.M. Neville, “Properties of Concrete”, Pearson publications, 5 th Edition, 2011														
4. IS10262-2019 Recommended Guidelines for Concrete Mix Design, Bureau of Indian Standards, New Delhi.														
WEB RESOURCES:														
1. https://old.amu.ac.in/emp/studym/1821.pdf														
2. https://archive.nptel.ac.in/courses/105/102/105102012/														

CE630203 -HIGHWAY ENGINEERING						
Course Category: Program Core	Course Type: Theory with Project Component	L	T	P	C	
		3	0	3	3	
COURSE OBJECTIVES:						
<ul style="list-style-type: none">To provide a coherent development to sector of like transportation engineering.To study the cross sectional elements of highwaysTo determine the flexible and rigid pavements.To study the highway construction materials, properties and testing methods.To learn the different pavement failure and evaluation systems.						
UNIT 1 - HIGHWAY PLANNING AND ALIGNMENT						9
Significance of highway planning – Modal limitations towards sustainability – History of road development in India – factors influencing highway alignment – Soil suitability analysis – Road ecology – Engineering surveys for alignment, objectives, conventional and modern methods – Classification of highways – Locations and functions – Typical cross-sections of Urban and Rural roads.						
UNIT 2 - GEOMETRIC DESIGN OF HIGHWAYS						9
Cross sectional elements – Sight distances – Horizontal curves, Super elevation, transition curves, widening at curves – Vertical curves – Gradients, Special consideration for hill roads – Hairpin bends – Lateral and vertical clearance at underpasses – simple problems.						
UNIT 3 - DESIGN OF FLEXIBLE AND RIGID PAVEMENTS						9
Pavement components and their role – Design principles -Design practice for flexible and rigid Pavements (IRC methods only) – Embankments- Problems in Flexible pavement design.						
UNIT 4 - HIGHWAY CONSTRUCTION						9
Highway construction materials, properties, testing methods – CBR Test for sub grade – tests on aggregate & bitumen – Test on Bituminous mixes-Construction practice including modern materials and methods, Bituminous and Concrete road construction, Polymer modified bitumen, Recycling, Different materials – Glass, Fiber, Plastic, Geo-Textiles, Geo-Membrane (problem not included) – Quality control measures – Highway drainage —Construction machineries						
UNIT 5 - HIGHWAY MAINTENANCE & REHABILITATION						9
Pavement failures: flexible pavement failures, rigid pavement failures, maintenance of different types of pavements: assessment and need for maintenance, pavement management system, and evaluation of pavements: structural evaluation of pavements, functional evaluation of pavements, strengthening of existing pavements: object of strengthening, types of overlays, design of different types of overlays.						

TOTAL: 45 PERIODS

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

CO1:	Get knowledge on planning and aligning of highway.
CO2:	Design the super elevation and curves.
CO3:	Design the geometric features of road network and components of pavement
CO4:	Know the highway construction materials, properties, testing methods
CO5:	Perform pavement evaluation and management.

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	2	-	3	1	3	-	1	-	2	3	1
CO2	2	3	3	2	2	-	1	3	2	2	2	3	3	1
CO3	2	3	2	2	2	3	3	3	1	1	3	3	3	2
CO4	3	2	2	2	-	3	2	2	1	1	1	3	3	-
CO5	2	1	1	-	-	1	2	1	2	1	2	3	3	1

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Khanna. S.K., Justo. C.E.G and Veeraragavan A."Highway Engineering "Publisher Nem Chand & Sons,10th Edition2020.
2. Kadiyali.L.R."Principles and Practice of Highway Engineering", Khanna Technical Publications, 6thEdition2015.
3. Subramanian K.P., "Highways, Railways, Airport and Harbour Engineering",Scitech Publications, 7th Edition 2017.

REFERENCE BOOKS:

IndianRoadCongress(IRC),GuidelinesfortheDesignofFlexiblePavements (ThirdRevision),IRC:37-2012

1. Indian Road Congress (IRC), Guidelines for the Design of Plain Jointed Rigid Pavements for Highways, (Third Revision), IRC:58-2012
2. Partha Chakraborty, Principles of Transportation Engineering, PHI learning, 2ndEdition 2013.
3. Sharma S. K, Principles, Practice and Design of Highway Engineering Including Airport Pavements, S. Chand Publishing, 2014

WEB RESOURCES:

1. <https://www.engineeringcivil.com/theory/highway-engineering>
2. <https://www.udemy.com/course/highway-engineering-full-course/>

CE630204 -GEOTECHNICAL ENGINEERING I					
Course Category: Program Core	Course Type: Theory	L	T	P	C
		3	0	0	3
COURSE OBJECTIVES:					
<ul style="list-style-type: none">To impart knowledge to classify the soil based on index properties and to assess their engineering properties based on the classification.To familiarize the fundamental concepts of compaction, flow through soilTo familiarize the concepts of stress transformation, stress distribution, consolidation and shear strength of soils.To impart knowledge of design of both finite and infinite slopes.					
UNIT 1 - SOIL CLASSIFICATION AND EFFECTIVE STRESS					9
Formation of soil - Soil description – Particle – Size, shape and colour – Composition of gravel, sand, silt, clay particles – Particle behaviour – Soil structure – Phase relationship – Index properties – Significance – BIS classification system – Unified classification system – Soil - water – Static pressure in water - Total, neutral and effective stress – principle of effective stress -Effective stress concepts in soils – Capillary phenomenon					
UNIT 2 - COMPACTION AND PERMEABILITY					9
Compaction of soils –Theory, Laboratory and field tests – Field Compaction methods – Factors influencing compaction of soils -Permeability interaction – Quick sand condition - Hydraulic conductivity – Darcy’s law – Determination of Hydraulic Conductivity – Laboratory Determination (Constant head and falling head methods) and field measurement pumping out in unconfined and confined aquifer – Factors influencing permeability of soils.					
UNIT 3 - STRESS DISTRIBUTION AND SETTLEMENT					9
Boussinesq’s and Westergaard’s theories for point load, uniformly loaded circular and rectangular areas, pressure bulb, variation of vertical stress under point load along the 10 vertical and horizontal plane, and Newmark’s influence chart for irregular areas. Consolidation settlement – Terzaghi’s one dimensional consolidation theory – Computation of rate of settlement - \sqrt{t} and log t methods– e-log p relationship					
UNIT 4 - SHEAR STRENGTH					9
Importance of shear strength – Mohr’s– Coulomb Failure theories –Types of laboratory tests for strength parameters – strength tests based on drainage conditions – strength envelopes – Shear strength of sands - dilatancy – critical void ratio.					
UNIT 5 - SLOPE STABILITY					9
Types of slopes–Failure mechanism of slopes-Total and effective stress analysis–Finite slopes Stability analysis for purely cohesive and – cohesion less soils – Method of slices - Friction circle method- Taylor's Stability number - Slope protection methods..					
TOTAL: 45 PERIODS					

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

CO1:	Demonstrate an ability to identify various types of soils and its properties, formulate and solve engineering problems.
CO2:	Show the basic application of flow through soil medium and its impact of engineering solution.
CO3:	Apply the basic concept of stress distribution in loaded soil medium and soil Settlement due to consolidation.
CO4:	Show the basic application of shear strength of soils and its impact of engineering Solutions to the loaded soil medium and also will be aware of contemporary issues on shear Strength of soils.
CO5:	Demonstrate an ability to design the stability of slopes, component and process as per needs and specifications.

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	2	-	3	1	3	-	1	-	2	3	1
CO2	2	3	3	2	2	-	1	3	2	2	2	3	3	1
CO3	2	3	2	2	2	3	3	3	1	1	3	3	3	2
CO4	3	2	2	2	-	3	2	2	1	1	1	3	3	-
CO5	2	1	1	-	-	1	2	1	2	1	2	3	3	1

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Murthy, V.N.S., “Soil Mechanics and Foundation Engineering”, CBS Publishers Distribution Ltd., New Delhi. Kindle edition, 2018
2. 2Gopal Ranjan and Rao, A.S.R., “Basic and Applied Soil Mechanics”, New Age Ltd. International Publisher New Delhi (India), 3rd Edition, 2016.
3. Jean-Louis Briaud, “Geotechnical Engineering: Unsaturated and Saturated Soils”,wiley publication, 2nd edition, 2022.

REFERENCE BOOKS:

1. Punmia, B.C., “Soil Mechanics and Foundations”, Laxmi Publications Pvt. Ltd. New Delhi, 18th edition, 2019
2. Das, B.M., “Principles of Geotechnical Engineering”. Brooks / Coles / Thompson Learning Singapore, 8th Edition, 2013.
3. McCarthy, D.F., “Essentials of Soil Mechanics and Foundations”. Prentice-Hall, 7th edition, 2007.

WEB RESOURCES:

1. <https://www.kobo.com/us/en/ebook/introduction-to-soil-mechanics>
2. <https://nptel.ac.in/courses/105105168>

CE630301- SURVEYING LABORATORY					
Course Category: Program Core	Course Type: Practical	L	T	P	C
		0	0	3	1.5
COURSE OBJECTIVES:					
<ul style="list-style-type: none">To train the students in taking field observations pertaining to some of the real world problems such as triangulation, contouring, Total Station, Drones etc.,To train the students in all the related calculations and in the preparation of the required maps.To impart intensive training in the use of surveying instrumentsTo train the students to appreciate practical difficulties in surveying on the field.To providing an opportunity to the students to develop team spirit.					
<p style="text-align: center;"><u>LIST OF EXPERIMENTS</u></p> <ol style="list-style-type: none">Study of chains and its accessories, Aligning, Ranging, Chaining and Marking Perpendicular offsetCompass Traversing – Measuring Bearings & arriving included anglesReduction of levels (Check and Fly levelling) - Height of collimation and Rise and Fall method.Measurements of horizontal angles by reiteration and repetition and vertical anglesDetermination of elevation of an object using single plane method when base is accessible/inaccessible.Measurement of height and distance using stadia and tangential system of tachometry.Setting out of a simple curve using linear method.Measurement of angles and height by total station.Traverse using Total station and Area of Traverse.Determination of distance and difference in elevation between two inaccessible points using Total station					
TOTAL: 45 PERIODS					

LIST OF EQUIPMENTS
(For a batch of 30 students)

Sl. No.	Description of Equipment's	Quantity
1.	Theodolites	At least 6 forevery30 students
2.	Dumpy level	At least 6 forevery30 students
3.	Plain table	At least 6 forevery30 students
4.	Pocket stereoscope	At least 6 forevery30 students
5.	Ranging rods	5 no's
6.	Arrows	10 no's
7.	Leveling staff	1for a set of 5students
8.	Cross staff	
9.	Chains	
10.	Tapes(20m&30m)	
11.	Total Station with Prism and Stand	At least 6 forevery30 students
12.	Prismatic compass	At least 6 forevery30 students
13.	Surveyor's compass	At least 6 forevery30 students
14.	GPS (Hand Held)	At least 6 forevery30 students
15.	Drones	01 no

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

CO1:	Impart knowledge on the usage of basic surveying instruments like chain/tape, compass and levelling instruments
CO2:	Understand the levelling and its applications.
CO3:	Execute a theodolite traverse.
CO4:	Find heights and distances using tachometry surveying.
CO5:	Use modern surveying instruments like total station and GPS, Drone.

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	-	-	-	-	-	2	-	3	3	3	-
CO2	1	2	1	3	2	-	-	1	2	2	-	3	3	1
CO3	1	3	1	2	2	-	-	-	2	-	-	3	1	3
CO4	3	2	1	-	2	-	-	-	2	1	-	3	-	3
CO5	3	2	1	1	2	-	-	-	2	2	-	3	1	2

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

- | |
|--|
| <ol style="list-style-type: none">1. T. P. Kanetkar and S. V. Kulkarni, Surveying and Levelling, Parts 1 & 2, Pune Vidyarthi Griha Prakashan, Pune, 24th edition, 20152. Dr. B. C. Punmia, Ashok K. Jain and Arun K Jain, Surveying Vol. I & II, Lakshmi Publications Pvt Ltd, New Delhi, 17th Edition, 20163. James M. Anderson and Edward M. Mikhail, Surveying, Theory and Practice, 7th Edition, McGraw Hill 2001 |
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REFERENCE BOOKS:

- | |
|---|
| <ol style="list-style-type: none">1. K. R. Arora, Surveying Vol. I & II, Standard Book house, 11th Edition, 20132. S. K. Roy, Fundamentals of Surveying, 2nd Edition, Prentice 'Hall of India 20043. David Clark and James Clendening, Plane and Geodetic Surveying for Engineers, Volume II, Constable and Company Ltd, London, CBS, 6th Edition, 2004. |
|---|

WEB RESOURCES:

- | |
|---|
| <ol style="list-style-type: none">1. https://sl-iitr.vlabs.ac.in/2. https://sl-iitr.vlabs.ac.in/List%20of%20experiments.html |
|---|

CE630302 – COMPUTER AIDED BUILDING DRAWING					
Course Category: Program Core	Course Type: Practical	L	T	P	C
		0	0	3	1.5
COURSE OBJECTIVES:					
<ul style="list-style-type: none">To impart knowledge on Software capabilities for drafting and modellingTo impart knowledge on Different types of buildings & their viewsTo draw the Isometric, 2D and 3D views of the simple objects					
<u>LIST OF EXPERIMENTS</u>					
PART A					
1. Symbols and Conventions in building drawing					
2. Drafting and annotation commands.					
3. Simple Drawings I					
4. Drawings using advanced commands					
5. Simple Drawings II					
PART B					
6. Planning of building based on as per building bye laws.					
7. Joinery Details (Doors & Windows)					
8. Plan, Section and Elevation of load bearing walls (Flat roof)					
9. Plan, Section and Elevation of load bearing walls (Sloped roof)					
10. Plan, Section and Elevation of RCC framed structures					
11. Plan, Section and Elevation of Industrial buildings					
12. Perspective view of Residential buildings					
13. Requirements of Drawings as per National Building Code					
TOTAL: 45 PERIODS					

LIST OF EQUIPMENTS

(For a batch of 30 students)

Sl. No.	Description of Equipment's	Quantity
1.	Computer system of Pentium IV or equivalent	1 for each student
2.	Licensed version of any reputed Analysis, Design & Drafting software	1 copy for a set of 3 students

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

CO1:	Draft drawings by using software.
CO2:	Understand different type of construction elements in a building.
CO3:	Learn the drawing as per National Building code.
CO4:	Describe knowledge about building components.
CO5:	Draw plan, section & elevation of different types of buildings & structures.

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	3	-	2	-	-	3	-	2	2	2
CO2	2	-	-	2	3	-	2	2	-	2	-	3	2	2
CO3	3	-	3	3	3	-	3	1	3	-	-	3	2	2
CO4	2	2	3	3	3	-	2	1	-	2	-	2	2	2
CO5	2	-	2	2	3	-	-	-	2	3	-	3	2	2

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Civil Engg. Drawing & House Planning – B.P. Verma, Khanna publishers, Delhi, 2006
2. Building drawing & detailing – Dr.Balagopal & T.S. Prabhu, Spades Publishers, Calicut, 2012.
3. Subhash C Sharma & Gurucharan Singh, —Civil Engineering Drawing, Standard Publishers, 7th Edition, 2014.

REFERENCE BOOKS:

1. B.P. Verma, —Civil Engineering Drawing, Khanna Publishers, New Delhi, 2006.
2. Dr. N. Kumara Swamy, A. Kameswara Rao. “Building Planning and Drawing”, Charotar Publishing House Pvt. Ltd., 7th Edition, 2014.
3. V.B Sikka, “A Course in Civil Engineering Drawing”, S.K. Kataria & Sons, Delhi, 2012.

WEB RESOURCES:

1. <https://nptel.ac.in/courses/112103019>
2. <https://civilguru.net/computer-aided-drawing-book-pdf-2/>

CE630501 – INTEGRATED APTITUDE SKILLS - I (LOWER)						
Course Category: EEC	Course Type: Practical (Skill Based Course)	L	T	P	C	
		0	0	1	0.5	
COURSE OBJECTIVES:						
<ul style="list-style-type: none">To understand the basic concepts of quantitative abilityTo understand the basic concepts of logical reasoning SkillsTo acquire satisfactory competency in use of verbal reasoning						
UNIT 1 - QUANTITATIVE APTITUDE						10
<ol style="list-style-type: none">Numbers – Number Systems, Types of Numbers, Series (Arithmetic Progression, Geometric Progression)Problem on AgesHCF & LCMProfit & LossProblems on Trains, Boats & StreamCalendar & ClocksTime & WorkSpeed & Distance (Or) Time & DistanceDecimal Fractions, Simplification (Including Expression & Evaluation)Square Root, Cubic RootAverageSurds & IndicesOdd Man Out & Series						
UNIT 2 - LOGICAL REASONING						10
<ol style="list-style-type: none">Series completionAnalogyClassificationCoding-DecodingBlood RelationPuzzle testSequential Output TracingDirection sense testLogical Venn DiagramAlphabet TestAlpha-numeric sequence PuzzleNumber, Ranking and Time sequence TestMathematical OperationsLogical Sequence of wordsArithmetical ReasoningInserting the missing character						

17. Data Sufficiency 18. Eligibility test 19. Assertions and Reasoning 20. Situation Reaction Test 21. Verification of truth of the statement

UNIT 3 - VERBAL ABILITY	10
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1. Vocabulary Based - Synonyms 2. Vocabulary Based - Antonyms 3. Spotting Errors 4. Spelling 5. Jumbled words 6. One word substitution 7. Sentence Correction 8. Idioms & Phrases. 9. Commonly confusing words 10. Statement and Conclusion 11. Change of Voice 12. Facts/Inferences and Judgment
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TOTAL: 30 PERIODS

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

CO1:	Develop strong foundational skills in mathematics, enabling them to confidently solve a variety of numerical and logical problems encountered in real-world scenarios.
CO2:	Develop strong logical reasoning and analytical skills, enabling them to solve a wide range of problems encountered in competitive exams, aptitude tests, and real-life situations.
CO3:	Develop a comprehensive understanding of English language usage, grammar, and vocabulary, enabling them to communicate effectively in both written and spoken contexts, as well as to analyze and evaluate written material critically as well as analyze and evaluate written material critically

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	-	-	-	-	-	-	2	-	1	2	2
CO2	2	2	2	-	-	-	-	-	-	2	-	1	2	2
CO3	2	2	2	-	-	-	-	-	-	2	-	1	2	2

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Agarwal R.S, "Quantitative Aptitude," S.Chand and Company Pvt. Ltd., New Delhi, First Edition 1989, Reprint, 2016.
2. Agarwal R.S, "A Modern Approach to Verbal and Non-Verbal Reasoning," S.Chand and Company Pvt.Ltd.,New Delhi, First Edition 1994, Reprint, 2016.
3. Agarwal R.S, "Objective General English," S.Chand and Company Pvt.Ltd.,New Delhi, First

Edition 1997, Reprint, 2016.

REFERENCE BOOKS:

1. Anand P A, “Quantitative Aptitude,” Wiley India Pvt. Ltd., New Delhi, Edition,2016
2. Arun Sharma, “How to Prepare for Logical Reasoning,” Tata-McGraw Hill Education Series.New Delhi, First Edition 2016.
3. Sharon Weiner Green, Ira K Wolf, “Barron’s GRE,” Barron Publishers. First Edition 1995, Reprint, 2016.
4. The Princeton Review, “Cracking the GRE”, Random House Publisher, Premium Edition 2016.

WEB RESOURCES:

1. www.indiabix.com.
2. <http://www.practiceaptitudetests.com>

IM630402-UNIVERSAL HUMAN VALUES						
Course Category: Institutive Mandatory	Course Type: Theory	L	T	P	C	
		2	0	0	0	
COURSE OBJECTIVES:						
<ul style="list-style-type: none">To help students distinguish between values and skills, and understand the need, basic guidelines, content and process of value educationTo help students initiate a process of dialog within themselves to know what they ‘really want to be’ in their life and professionTo help students understand the meaning of happiness and prosperity for a human being.To facilitate the students to understand harmony at all the levels of human living, and live accordingly.To facilitate the students in applying the understanding of harmony in existence in their profession and lead an ethical life.						
UNIT 1 - COURSE INTRODUCTION - NEED, BASIC GUIDELINES, CONTENT AND PROCESS FOR VALUE EDUCATION						6
Need for Value Education, basic guidelines, content and process for Value - the basic requirements for fulfilment of aspirations of every human being with their correct priority. Right Understanding, relationship and Physical Facility. Happiness and Prosperity correctly- understanding and living in harmony at various levels. Process of Value Education – Self-exploration.						
UNIT 2 - UNDERSTANDING HARMONY IN THE HUMAN BEING						6
Understanding the needs of Self (‘I’) and ‘Body’ - Sukh and Suvidha. Understanding the Body as an instrument of ‘I’ (I being the doer, seer and enjoyer). Understanding the characteristics and activities of ‘I’ and harmony in ‘I’. Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail Programs to ensure Sanyam and Swasthya						
UNIT 3 - UNDERSTANDING HARMONY IN THE FAMILY						6
Understanding harmony in the Family- the basic unit of human interaction. Understanding values in human-human relationship - the foundational values of relationship. Difference between intention and competence. Understanding the meaning of Samman, Difference between respect and differentiation; the other salient values in relationship.						
UNIT 4 - UNDERSTANDING THE HARMONY IN THE SOCIETY						6
Understanding the harmony in the society (society being an extension of family): Samadhan, Samridhi, Abhay, Sah-astitva as comprehensive Human Goals. Health and self-regulation. Harmony from Family Order to World Family Order – Process of Development of a Child – In an environment of Relationship.						

UNIT 5 - UNDERSTANDING HARMONY IN THE NATURE														6
Understanding the harmony in the Nature. Interconnectedness, Self-regulation and Mutual Fulfilment among the Four. Realizing Existence as Co-existence at All Levels. Holistic perception of harmony at all levels of existence.														
TOTAL: 30 PERIODS														
COURSE OUTCOMES: At the end of the course, the student will be able to														
CO1:	Understand the significance of value inputs in a classroom and start applying them in their life and profession													
CO2:	Distinguish between values and skills, happiness and accumulation of physical facilities, the Self and the Body, Intention and Competence of an individual, etc.													
CO3:	Understand the value of harmonious relationship based on trust and respect in their life and profession													
CO4:	Understand the role of a human being in ensuring harmony in society and nature.													
CO5:	Distinguish between ethical and unethical practices, and start working out the strategy to actualize a harmonious environment wherever they work.													
CO-PO MAPPING														
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	1	-	2	-	-	-	1	1	-
CO2	2	3	-	-	-	1	-	2	-	-	-	1	1	-
CO3	2	3	-	-	-	1	-	2	-	-	-	1	1	-
CO4	3	2	-	-	-	1	-	2	-	-	-	1	1	-
CO5	2	1	-	-	-	1	-	2	-	-	-	1	1	--
1- low, 2 - medium, 3 - high, '-' no correlation														
TEXT BOOKS:														
1. R R Gaur, R Sangal, G P Bagaria, 2009, A Foundation Course in Human Values and Professional Ethics.														
2. Ivan Illich, 1974, Energy & Equity, The Trinity Press, Worcester, and Harper Collins, USA														
3. E.F. Schumacher, 1973, small is Beautiful: a study of economics as if people mattered, Blond & Briggs Britain.														
REFERENCE BOOKS:														
1. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991														
2. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, Limits to Growth – Club of Rome’s report, Universe Books.														
3. A Nagraj, 1998, JeevanVidyaEkParichay, Divya Path Sansthan, Amarkantak.														
4. AICTE, FDP –Course material.														

IV SEMESTER SYLLABUS

IC630018-BOUNDARY VALUE PROBLEMS AND PROBABILITY DISTRIBUTION						
Course Category: Institute Core	Course Type: Theory	L	T	P	C	
		2	1	0	3	
COURSE OBJECTIVES:						
Objective of the subject is to provide a venue for the promotion, encouragement, and interdisciplinary collaboration of various fields using the theory, techniques, and applications of boundary value problems and Make predictions about the likelihood of specific events using the probability distribution for discrete random variables (general, binomial,). Students will use the normal distribution's fundamentals to calculate probability. Implement a normal distribution. Check out a normal distribution.						
UNIT 1 - INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS						6+3
Single Step Methods: Taylor Series Method Euler Method for First Order Equation Fourth Order Runge Kutta Method for Solving First and Second Order Equations Multistep Methods: Milnes and Adams Predictor and Corrector Methods						
UNIT 2 - BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS						6+3
Finite Difference Solution of Second Order Ordinary Differential Equation Finite Difference Solution of One Dimensional Heat Equation by Explicit and Implicit Methods One Dimensional Wave Equation and Two Dimensional Laplace and Poisson Equations.						
UNIT 3 - PROBABILITY AND RANDOM VARIABLES						6+3
Random experiment sample space concept of probability Axioms of Probability conditional probability Total probability - Bayes theorem - Discrete and continuous type of random variables - Moments - Moment generating functions and their properties.						
UNIT 4 - STANDARD DISTRIBUTIONS						6+3
Discrete distributions: Binomial, Poisson, Geometric, Negative Binomial Continuous distributions - Uniform, Normal, Exponential, Gamma, and Weibull distributions Mean and variance of distribution Method of finding Mean and variance using MGF.						
UNIT 5 - TWO DIMENSIONAL RANDOM VARIABLES						6+3
Joint distributions - Marginal and conditional distributions -Independent random variables - Covariance - Correlation and Regression - Transformation of random variables - Central limit theorem with its applications.						
TOTAL: 45 PERIODS						

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

CO1:	Apply the method of finding numerical solution for differential equation by initial value. problems and terminal problem
CO2:	Apply the method of finding numerical solution for differential equation by boundary value problems and with their application.
CO3:	Gain knowledge about conditional probability and applications of Bayes theorem.
CO4:	Identify the different types of distribution and apply in real life.
CO5:	Apply the discrete data to analyse the correlation and regression.

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2	-	-	-	-	-	1	-	3	3
CO2	3	3	1	2	1	3	-	-	-	-	-	-	3	3
CO3	3	2	3	3	3	-	-	-	-	-	1	-	3	2
CO4	3	2	2	1	2	3	-	-	-	-	-	-	3	2
CO5	3	1	2	3	2	-	-	-	-	-	-	-	3	1

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. M.K. Jain, S.R.K. Iyengar and R.K. Jain “Numerical methods: for scientific and engineering computation” 2013. 6th ed.,
2. M.K. Jain “Numerical solutions to differential equation” Wiley Eastern New Delhi 2015.
3. Devore, J.L., “Probability and Statistics for Engineering and the Sciences”, Cengage Learning, New Delhi, 8th Edition, 2014.
4. S.C. Gupta and V.K. Kapoor “Fundamentals of mathematical statistics” Eleventh thoroughly revised ed., Sultan Chand & Sons educational publishers, New Delhi (June 2003)
5. T. Veerarajan, “Probability, Statistics and Random Processes” Tata McGraw-Hill Publishing Company Limited, New Delhi(2006)

REFERENCE BOOKS:

1. Veerarajan.T and Ramachandran. T Numerical Methods with Programming in C second Ed., Tata Mc. Graw Hill Publishing. Co. Ltd (2007)
2. Sankararao.K Numerical Methods for Scientists and Engineers -3rd edition Printice Hall of India Private Ltd. New Delhi-(2007).
3. Walpole, R.E., Myers, R.H., Myers, S.L. and YE. K., Probability and Statistics for Engineers and Scientists, 9th Edition, Pearson Education, Asia, 2010.

WEB RESOURCES:

1. <https://www.worldscientific.com/worldscibooks/10.1142/2884>

CE640205-MECHANICS OF MATERIALS						
Course Category: Program Core	Course Type: Theory with Practical	L	T	P	C	
		2	0	2	3	
COURSE OBJECTIVES:						
<ul style="list-style-type: none">To learn the fundamental concepts of stress in simple and complex states.To know the mechanism of load transfer in beams and the induced stresses due to simple bending.To determine the deformation beams.To determinate beams and to know the basic concepts of analysis of indeterminate beams.To know the mechanism of load transfer in beams and the induced stresses due unsymmetrical bending.						
UNIT 1 - SIMPLE STRESSES AND STRAINS						6
Concept of stress and strain, stress and strain diagram, Hooke’s law, Young’s modulus, Poisson’s ratio, stress at a point, stresses and strains in bars subjected to axial loading, Modulus of elasticity, stress produced in compound bars subjected to axial loading. Temperature stress and strain calculations due to applications of axial loads and variation of temperature in single and compound walls. Torsion on circular shafts.						
UNIT 2 - BENDING OF BEAMS						6
Types of beams and transverse loadings - Shear force and bending moment for simply supported, cantilever and over-hanging beams (concentrated loads, uniformly distributed loads & uniformly varying loads over the whole span or part of span) - Theory of simple bending – Bending stress distribution – Section modulus - Shear stress distribution.						
UNIT 3 - DEFLECTION OF BEAMS						6
Double Integration method – Macaulay’s method – Area moment method – Conjugate beam method - Strain energy method for determinate beams.						
UNIT 4 - INDETERMINATE BEAMS						6
Propped Cantilever and Fixed Beams – Fixed end moments reactions, slope and deflection for standard cases of loading — Continuous beams – support reactions and moments –Theorem of three moments – Shear Force and Bending Moment Diagrams.						
UNIT 5 - ADVANCED TOPICS						6

Unsymmetrical bending of beams - shear center applied - Thick cylinders - Theories of failure – Principal stress, principal strain, shear stress, strain energy and distortion energy theories – application problems – deflection of helical spring.

LIST OF EXPERIMENTS

(Not Included for End Semester Examinations)

1. Determination of the hardness of the given material by brinell hardness test
2. Determination of the hardness of the given material by Shore D hardness test
3. Determination of the Impact strength on mild steel by impact testing machine(Izod)
4. Determination of Impact strength on mild steel by impact testing machine (Chorpy)
5. Determination of the stiffness, rigidity modulus and spring index using spring testing machine.
6. Determination of the flexural rigidity value of cantilever beam by deflection test.
7. Determination of the flexural rigidity value of simply supported beam by deflection test.
8. Determination of the tensile strength of mild steel rod.

TOTAL: 45 PERIODS (30+15)

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

CO1:	Understand the concepts of stress and strain.
CO2:	Determine Shear force and bending moment in beams and understand concept of theory of simple bending.
CO3:	Calculate the deflection of beams by different methods and selection of method for determining slope or deflection.
CO4:	Analyze propped cantilever, fixed beams and continuous beams for external loadings and support settlements.
CO5:	Determine the stresses due to Unsymmetrical bending of beams, locate the shear center, and study the various theories of failure.

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	-	2	1	2	1	2	2	3	3	1
CO2	3	3	3	3	-	2	1	2	1	2	2	3	3	1
CO3	3	3	3	3	-	2	1	2	1	2	2	3	3	1
CO4	3	3	3	3	-	2	1	2	1	2	2	3	3	1
CO5	3	3	3	3	-	2	1	2	1	2	2	3	3	1

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Rajput R.K. "Strength of Materials (Mechanics of Solids)", S.K. Kataria & Sons 7th Edition 2020.
2. Rattan.S.S, "Strength of Materials", Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2nd Edition 2017.
3. Bansal R. K, Strength of Materials - Mechanics of Solids (S.I. Units), Laxmi Publications, 6th Edition 2020.

REFERENCE BOOKS:

1. Punmia B.C., Ashok Kumar Jain and Arun Kumar Jain, " Theory of Structures" (SMTS) Vol-II, Laxmi Publishing Pvt Ltd, New Delhi 2012.
2. William A .Nash, "Theory and Problems of Strength of Materials", Schaum's Outline Series, Tata McGraw Hill Publishing company, 2017.
3. Beer. F.P. & Johnston.E.R. "Mechanics of Materials", Tata McGraw Hill, Sixth Edition, New Delhi 2010.

WEB RESOURCES:

1. <https://www.udemy.com/course/strength-of-materials-part-i/>
2. <https://nptel.ac.in/courses/112107146>

CE640206 -FLUID MECHANICS AND HYDRAULIC MACHINERY						
Course Category: Program Core	Course Type: Theory with Practical	L	T	P	C	
		3	0	0	3	
COURSE OBJECTIVES:						
<ul style="list-style-type: none">• To find fluid properties and theory of fluid at rest.• To know the basics of fluid in motion and about the measurement of flow.• To study the fundamentals of pipe flow, major and various minor losses encountered in the pipe flow.• To find the boundary layer formation and prevention, and hydraulic model studies.• To study the theories of different types of turbines and pumps.						
UNIT 1 - FLUID PROPERTIES AND FLUID STATICS						9
Scope of fluid mechanics - Definitions of a fluid - Methods of analysis - Dimensions and units - Viscosity, density, vapour pressure ,surface tension, capillarity - Basic equation of fluid statics - Pressure measurements - Manometers. - Buoyancy and floatation - Stability of floating bodies - Relative equilibrium.						
UNIT 2 - FLUID KINEMATICS AND DYNAMICS						9
Kinematics - Methods of describing fluid motion - Classification of flows and flow lines - Equation of continuity - Stream function and velocity potential function - Basics of flow nets Dynamics of fluid flow - Equation of energy momentum - Euler's equation of motion along a stream line - Bernoulli's equation - Applications to velocity and discharge measurements - Venturimeter, orifice meter and pitot tube.						
UNIT 3 - FLOW THROUGH PIPES						9
Laminar flow through pipes - Development of laminar and turbulent flows in pipes - Reynolds experiment - Hagen Poiseuille equation - Darcy-Weisbach equation - Moody diagram - Major and minor losses of flow in pipes - Pipes in series and in parallel - Equivalent pipes - Power transmission through pipes-Water hammer in pipes- Flow through open channel- Stream discharge measurement.						
UNIT 4 - BOUNDARY LAYER THEORY AND DIMENSIONAL ANALYSIS						9
Definition of boundary layer - Thickness and classification - Displacement , momentum and energy thickness - Boundary layer separation and prevention - Fundamental and derived units - Dimensional homogeneity - Similarities - Model studies - Dimensionless numbers - Hydraulic similitude – Modellaws – Reynold's model law – Froude's model law - Undistorted and distorted models - Scale effect						
UNIT 5 - TURBINES AND PUMPS						9

Turbines - Classification - Pelton wheel - Francis turbine - Propeller and Kaplan turbines - draft tube and cavitation - Performance of turbine - Specific speed - Centrifugal pumps - Minimum speed to start the pump - NPSH - Cavitation in pumps - Operating characteristics - Multistage pumps – Jet pump and submersible pumps (working principle only).

TOTAL: 45 PERIODS

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

CO1:	Compute fluid properties, pressure and stability of floating bodies.
CO2:	Compute the rate of fluid flowing through pipes.
CO3:	Compute the major and minor losses occurring in pipe flow.
CO4:	Compute the scale ratio for the hydraulic models.
CO5:	Relate the operational conditions and efficiencies of different turbines and pumps.

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	-	-	1	-
CO2	3	3	1	1	-	1	-	-	-	-	-	-	2	1
CO3	3	3	-	3	-	-	-	-	-	-	-	-	2	-
CO4	3	3	-	3	-	-	-	-	-	-	-	-	2	-
CO5	3	3	1	2	-	1	-	-	-	-	-	-	2	1

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. R.K.Bansal, “Fluid Mechanics and Hydraulic Machines”, Laxmi publications, New Delhi 2018.
2. Er. R.K. Rajput, “Fluid Mechanics and Hydraulic Machines”, S.Chand & Co., 2016.
3. Kumar K.L., “Engineering Fluid Mechanics”, S.Chand Publishing (P) Ltd., New Delhi, (2014)

REFERENCE BOOKS:

1. Subramanian. K, Fluid Mechanics including Hydraulic Machines”, Tata McGraw – Hill Education (India), 2009.
2. Jain A. K. "Fluid Mechanics including Hydraulic Machines”, Khanna Publishers, 1998.
3. Modi P.N and Seth, “Hydraulics and Fluid Mechanics including Hydraulic Machines”, Standard Book House, New Delhi, 2017.

WEB RESOURCES:

1. <https://nptel.ac.in/courses/105105203>
2. https://www.engineerclassroom.com/2019/01/a-textbook-of-fluid-mechanics-and_18.html

CE640207-GEOTECHNICAL ENGINEERING II						
Course Category: Program Core	Course Type: Theory	L	T	P	C	
		3	0	0	3	
COURSE OBJECTIVES:						
<ul style="list-style-type: none">• To study the soil characteristics• To study and understand various theories and principles governing earth pressures and retaining wall design• To study & understanding of foundation design principles, ensuring the safe and stable performance of structures on various soil types.• To learn the tools necessary to effectively design, analyze, and implement pile foundations for a wide range of engineering applications.• To select, design, and construct foundations that meet structural requirements, ensure stability, and withstand various environmental and loading conditions.						
UNIT 1 - SOIL EXPLORATION AND SELECTION OF FOUNDATION						9
Scope and objectives – Methods of exploration – Auguring and boring – Wash boring and rotary drilling – Depth and spacing of bore holes – Soil samples – Representative and undisturbed – Sampling methods – Split spoon sampler, Thin wall sampler, Stationary piston sampler– Data interpretation - Strength parameters and Evaluation of Liquefaction potential - Selection of foundation based on soil condition- Bore log report.						
UNIT 2 - EARTH PRESSURE THEORIES AND RETAINING WALLS						9
At-rest earth pressures, Rankine’s theory of earth pressure – earth pressures in layered soils– Coulomb’s earth pressure theory – Culmann’s graphical method, effect of pore water, earth pressure due to surcharge loads. Types of retaining walls – stability of gravity and cantilever retaining walls against overturning, sliding and, bearing capacity modes of failure, Drainage from backfill, introduction to reinforced earth walls.						
UNIT 3 - BEARING CAPACITY OF SHALLOW FOUNDATION						9
Introduction – Location and Depth of Foundation – Codal Provisions – Bearing Capacity of Shallow Foundation on homogeneous deposits – Terzaghi’s Formula and BIS Formula – Factors Affecting Bearing Capacity – Bearing Capacity from in-situ Tests (SPT, SCPT and Plate Load) – Allowable Bearing Pressure – Seismic Considerations in Bearing Capacity. Evaluation. Determination of Settlement of Foundations on Granular and Clay Deposits –Total and Differential Settlement – Allowable Settlements – Codal Provision – Methods of Minimizing Total And Differential Settlements.						

UNIT 4 - PILE FOUNDATION													9	
Types of piles and their functions – factors influencing the selection of pile – carrying capacity of Single pile in granular and cohesive soil – static formula – dynamic formulae (Engineering News and Hileys) – capacity from insitu tests (SPT, SCPT) – negative skin friction – uplift capacity- group Capacity by different methods (field’s rule, converse – labarra formula and block failure criterion) – Settlement of pile groups – interpretation of pile load test (routine test only), under reamed piles – Capacity under compression and uplift – codal Provision, Geosynthetics and Soil Reinforcement.														
UNIT 5 - FOOTINGS AND RAFTS													9	
Types of isolated footing, combined footing, mat foundation – contact pressure and settlement Distribution – proportioning of foundations for conventional rigid behavior – minimum depth for rigid Behavior – applications – floating foundation – special foundations – seismic force consideration – codal provision														
TOTAL: 45 PERIODS														
COURSE OUTCOMES: At the end of the course, the student will be able to														
CO1:		Demonstrate an ability to plan and execute a detailed site investigation to select geotechnical design parameters and type of foundation.												
CO2:		Demonstrate an ability to design retaining walls and to apply the concept of earth pressure theories, its component or process as per the needs and specifications.												
CO3:		Demonstrate an ability to design shallow foundations, its component or process as per the needs and specifications.												
CO4:		Demonstrate an ability to design deep foundations, its component or process as per the needs and specifications.												
CO5:		Demonstrate an ability to design combined footings and raft foundations, its component or process as per the needs and specifications.												
CO-PO MAPPING														
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	3	3	1	2	1	1	1	1	1	1	3	1
CO2	3	3	3	3	1	1	1	1	1	1	2	3	1	1
CO3	2	3	3	3	1	2	2	1	1	1	2	3	2	1
CO4	3	3	3	3	1	1	-	-	1	1	2	1	2	1
CO5	2	3	3	1	1	1	2	3	1	1	2	3	1	1
1- low, 2 - medium, 3 - high, '-' no correlation														
TEXT BOOKS:														
1. Murthy, V.N.S., “Soil Mechanics and Foundation Engineering”, CBS Publishers and Distributers Ltd., New Delhi, 2015.														
2. Gopal Ranjan and Rao A.S.R. “Basic and Applied soil mechanics”, New Age International (P) Ltd, New Delhi, 2006.														

3. Punmia, B.C., “Soil Mechanics And Foundations”, Laxmi Publications Pvt.Ltd., New Delhi, 2017

REFERENCE BOOKS:

1. Das,B.M.“Principles of Foundation Engineering” (Eighth Edition), Thompson Asia Pvt.Ltd. Singapore, 2017.
2. Kaniraj, S.R. “Design Aids in Soil Mechanics and Foundation Engineering”, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2017.
3. Varghese, P.C.,”Foundation Engineering”, Prentice Hall of India Private Limited, New Delhi, 2012.

WEB RESOURCES:

1. <https://nptel.ac.in/courses/105105203>
2. https://www.engineerclassroom.com/2019/01/a-textbook-of-fluid- mechanics-and _18.html

CE640303 – HYDRAULICS LABORATORY						
Course Category: Program Core	Course Type: Practical	L	T	P	C	
		0	0	3	1.5	
COURSE OBJECTIVES:						
<ul style="list-style-type: none">To provide hands on experience in calibration of flow meters.To perform the characteristics of pumps.To perform the characteristics of turbines.						
LIST OF EXPERIMENTS						
<ol style="list-style-type: none">Determination of co-efficient of discharge for venturi meter.Determination of co-efficient of discharge for orifice meter.Determination of co-efficient of discharge V-Notch and Mouthpieces.Calibration of rotameterVerification of Bernoulli’s theoremDetermination of friction losses in pipes.Determination of minor losses in pipes.Determination of Metacentric height.Determination of performance characteristics of centrifugal pumps (Constant speed) – Single stage.Determination of performance characteristics of centrifugal pumps (variable speed) – Single stage.Determination of performance on reciprocating pump.Determinations of performance characteristics of deep well pump (Submersible).Determination of performance characteristics of deep well pump (Jet pump).Determination of performance characteristics of gear oil pump.Determination of performance on Pelton turbine.Determination of performance on Francis turbine.						
TOTAL: 45 PERIODS						
LIST OF REQUIREMENTS						
S.No	Description of Equipment’s					Quantity
1.	Venturimeter with all accessories					1 Unit
2.	Orifice Meter with all accessories					1 Unit

3.	Flow measurement-open channel flow(Channel with provision for Fixing notches, Rectangular, triangular & trapezoidal forms)	1 Unit
4.	Bernoulli's theorem– Verification Apparatus with assembly	1No
5.	Ship model with accessories	1No
6.	Major loss–Friction loss with assembly	1 Unit
7.	Minor Losses with assembly	1 Unit
8.	Centrifugal pump assembly with accessories(single stage)	1 Unit
9.	Gear oil pump assembly set with accessories	1 Unit
10.	Reciprocating pump assembly with accessories	1 Unit
11.	Deep well pump (Submersible & jet) assembly set with accessories	1 Unit
12.	Pelton Impulse turbine assembly with fittings & accessories	1 Unit

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

CO1:	Apply Bernoulli equation for calibration of flow measuring devices.
CO2:	Measure friction factor in pipes.
CO3:	Determine the performance characteristics of roto dynamic pumps.
CO4:	Determine the performance characteristics of positive displacement pumps.
CO5:	Determine the performance characteristics of turbines.

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	3	1	2	2	1	2	1	1	2	2	1
CO2	3	2	1	3	1	2	2	1	2	1	1	2	3	1
CO3	3	3	2	3	1	2	2	1	3	1	1	2	3	1
CO4	3	3	2	3	1	2	2	1	3	1	1	2	3	1
CO5	3	3	2	3	1	2	2	1	3	1	1	2	3	1

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Bansal R.K., Fluid Mechanics and Hydraulic Machines, Laxmi Publications, 10th Edition 2019.
2. Khurmi R. S. Text Book of Hydraulics, Fluid Mechanics and Machinery, S. Chand Limited, 10th Edition 2000.
3. Rajput R. K, Fluid Mechanics and Hydraulic Machines, S Chand & Co Ltd, 6th Edition 2016

REFERENCE BOOKS:

1. Hydraulic Laboratory Manual, Centre for Water Resources, Anna University, 2015.
2. Modi P.N. and Seth S.M., Hydraulics and Fluid Mechanics. Standard Book House. New Delhi, 22nd Edition, 2019.
3. Subramanya K, Fluid Mechanics and Hydraulic Machines, Tata McGraw Hill Edu. Pvt. Ltd. 2nd Edition, 2018.

WEB RESOURCES:

1. <https://eerc03-iiith.vlabs.ac.in/>
2. <https://www.aboutcivil.org/fluid-mechanics-hydraulics-lab-experiments.html>

CE640304- GEOTECHNICAL ENGINEERING LABORATORY					
Course Category: Program Core	Course Type: Practical	L	T	P	C
		0	0	3	1.5
COURSE OBJECTIVES:					
<ul style="list-style-type: none">To gain experience regarding the determination of properties of different types of soils.To provide an opportunity to learn how to measure the shear strength of the soil and its importance.To impart knowledge about the foundation engineering.					
LIST OF EXPERIMENTS					
1. DETERMINATION OF INDEX PROPERTIES					
A. Specific gravity of soil solids					
B. Moisture content					
C. Grainsize distribution–Sieve analysis					
D. Grainsize distribution -Hydrometer analysis					
E. Liquid limit and Plastic limit tests					
F. Shrinkage limit					
2. DETERMINATION OF INSITU DENSITY AND COMPACTION CHARACTERISTICS					
A. Field density Test (Sand replacement method)					
B. Field density Test (Core cutter method)					
C. Determination of moisture– density relationship using standard proctor compaction test.					
3. DETERMINATION OF ENGINEERING PROPERTIES					
A. Permeability determination (constant head and falling head methods)					
B. One dimensional consolidation test (Determination of co-efficient of consolidation only)					
C. Direct shear test in cohesion less soil					
D. Unconfined compression test in cohesive soil					
E. Laboratory vane shear test in cohesive soil.					
F. Tri-axial compression test in cohesion less soil (Demonstration only)					
G. California Bearing Ratio Test					
4. TEST ON GEOSYNTHETICS (Demonstration only)					
A. Determination of tensile strength and inter facial friction angle.					
B. Determination of apparent opening sizes and permeability.					
TOTAL: 45 PERIODS					

LIST OF REQUIREMENTS

S.No	Description of Equipment's	Quantity
1	Sieves	2sets
2.	Hydrometer	2sets
3.	Liquid and Plastic limit apparatus	3sets
4.	Shrinkage limit apparatus	3sets
5.	Thermometer	3sets
6.	Sand replacement method accessories	2sets
7.	Core cutter method accessories	2sets
8.	Proctor Compaction apparatus	2sets
9.	Relative Density apparatus	2sets
10.	Permeability determination	1
	i. Constant head method	1
	ii. Falling head method	
11.	Three Gang Consolidation test device	1
12.	Direct Shear apparatus	1
13.	UTM of minimum of 20kN capacity	1
14.	Vane Shear apparatus	1
15.	Triaxial shear apparatus	1
16.	California bearing ratio test apparatus	1
17.	Weighing machine 20 capacity	1
18.	Weighing machine– 1kg capacity	3
19.	Moisture cans	10
20.	Oven	1

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

CO1:	Conduct tests to determine the index properties of soil.
CO2:	Determine the insitu density and compaction characteristics.
CO3:	Find the compressibility, permeability of the soil
CO4:	Determine the shear strength of soil.
CO5:	Understand the various tests on Geosynthetics

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	3	3	1	1	1	1	3	1	1	3	3	3
CO2	1	2	3	3	1	1	1	1	3	2	1	3	2	3
CO3	3	3	3	3	1	1	1	1	3	1	1	3	1	1
CO4	1	2	3	3	1	1	1	1	3	1	1	1	3	3
CO5	3	3	2	3	1	2	2	1	3	1	1	2	3	1

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Soil Engineering Laboratory Instruction Manual” published by Engineering College Co-operative Society, Anna University, Chennai, 2010.
2. “Saibaba Reddy, E. Ramasastri, K. “Measurement of Engineering Properties of Soils”, new age International (P) limited publishers, New Delhi, 2008.
3. Lambe T.W., “Soil Testing for Engineers”, John Wiley and Sons, New York, 1951. Digitized 2008.

REFERENCE BOOKS:

1. IS Code of Practice (2720) Relevant Parts, as amended from time to time, Bureau of Indian Standards, and New Delhi.
2. G.Venkatappa Rao and Goutham .K. Potable, “Geosynthetics Testing – A laboratory Manual”, Sai Master Geoenvironmental Services Pvt. Ltd., 1st Edition 2008.
3. Braja M. Das., “Soil Mechanics: Laboratory Manual”, Oxford University Press, eighth edition, 2012

WEB RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc22_ce60/preview

CE640502 – INTEGRATED APTITUDE SKILLS - II (LOWER)						
Course Category: EEC	Course Type: Practical (Skill Based Course)	L	T	P	C	
		0	0	1	0.5	
COURSE OBJECTIVES:						
<ul style="list-style-type: none">To understand the basic concepts of quantitative abilityTo understand the basic concepts of logical reasoning SkillsTo acquire satisfactory competency in use of verbal reasoning						
UNIT 1 - QUANTITATIVE APTITUDE						10
<ul style="list-style-type: none">1. Percentage2. Ratio & Proportions3. Pipes & Cisterns4. Permutations & Combinations5. Partnership6. Alligation (Or) Mixture7. Races & Games8. Stocks & Shares9. Height & Distance10. True Discount & Banker’s Discount11. Probability12. Mensuration (Area, Volume & Surface Area)13. Interest (Simple Interest, Compound Interest)14. Logarithm15. Chain Rule16. Data Interpretation (Tabulation, Bar Chart, Pie Chart, Line Graphs)						
UNIT 2 - LOGICAL REASONING						10
VERBAL REASONING:						
Logical Deduction <ul style="list-style-type: none">1. Logic2. Statement – Argument3. Statement – Assumptions4. Statement –Courses of action5. Statement –Conclusion6. Deriving Conclusion from passages						

7. Theme Detection 8. Cause and Effect reasoning NON-VERBAL REASONING 1. Series 2. Analogy 3. Classification 4. Analytical Reasoning 5. Mirror – Images 6. Water – Images 7. Spotting out the embedded figures 8. Completion of incomplete patterns 9. Figure Matrix 10. Paper Folding 11. Paper Cutting 12. Rule Detection 13. Grouping of identical figures 14. Cubes and Dice 15. Dot Situation 16. Construction of squares and triangles 17. Figure formation and analysis	
UNIT 3 - VERBAL ABILITY	10
1. Concord 2. Cloze Passage 3. Analogies or Reverse Analogies 4. Jumbled Sentences. 5. Error Deduction. 6. Reading Comprehension 7. Paragraph Formation 8. Completing Statements 9. Usage of Prepositions 10. Inference(Theme Detection) 11. Verification of Truth from the Statements 12. Change of Speech	
TOTAL: 30 PERIODS	

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

CO1:	Develop strong foundational skills in mathematics, enabling them to confidently solve a variety of numerical and logical problems encountered in real-world scenarios.
CO2:	Develop strong logical reasoning and analytical skills, enabling them to solve a wide range of problems encountered in competitive exams, aptitude tests, and real-life situations.
CO3:	Develop a comprehensive understanding of English language usage, grammar, and vocabulary, enabling them to communicate effectively in both written and spoken contexts, as well as to analyze and evaluate written material critically as well as analyze and evaluate written material critically

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	-	-	-	-	-	-	2	-	1	2	2
CO2	2	2	2	-	-	-	-	-	-	2	-	1	2	2
CO3	2	2	2	-	-	-	-	-	-	2	-	1	2	2

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Agarwal R.S, "Quantitative Aptitude," S.Chand and Company Pvt. Ltd., New Delhi, First Edition 1989, Reprint, 2016.
2. Agarwal R.S, "A Modern Approach to Verbal and Non-Verbal Reasoning," S.Chand and Company Pvt.Ltd.,New Delhi, First Edition 1994, Reprint, 2016.
3. Agarwal R.S, "Objective General English," S.Chand and Company Pvt.Ltd.,New Delhi, First Edition 1997, Reprint, 2016.

REFERENCE BOOKS:

1. Anand P A, "Quantitative Aptitude," Wiley India Pvt. Ltd., New Delhi, Edition,2016
2. Arun Sharma, "How to Prepare for Logical Reasoning," Tata-McGraw Hill Education Series. New Delhi, First Edition 2016.
3. Sharon Weiner Green, Ira K Wolf, "Barron's GRE," Barron Publishers. First Edition 1995, Reprint, 2016.
4. The Princeton Review, "Cracking the GRE", Random House Publisher, Premium Edition 2016.

WEB RESOURCES:

1. www.indiabix.com
2. <http://www.practiceaptitudetests.com>

V SEMESTER SYLLABUS

CE650208 – STRUCTURAL ANALYSIS I						
Course Category: Program Core	Course Type: Theory with Practical Component	L	T	P	C	
		2	0	2	3	
COURSE OBJECTIVES:						
<ul style="list-style-type: none">To study the computation of slopes and deflections using energy methods.To know the analysis of beams and frames by strain energy method.To study the indeterminate structures by slope deflection method.To study the indeterminate beams and frames for internal forces using moment distribution method.To study the indeterminate structures by theorem of three moments.						
UNIT 1 - FUNDAMENTAL OF STRUCTURAL ANALYSIS						6
Determination of static indeterminacy and kinematic indeterminacy – Deficiency for beams, frames and pin jointed trusses – Behaviour of structures – Principle of superposition – Analysis of pin-jointed space trusses by method of Tension coefficient.						
UNIT 2 - STRAIN ENERGY METHOD						6
Static indeterminacy - Strain energy method - analysis of indeterminate structures, beams, pin jointed and rigid jointed structures - temperature effect - bending moment and shear force diagram.						
UNIT 3 - SLOPE DEFLECTION METHOD						6
Kinematic indeterminacy- Slope deflection method - analysis of continuous beams and portals - bending moment and shear force diagram.						
UNIT 4 - MOMENT DISTRIBUTION METHOD						6
Moment distribution method - analysis of continuous beams and portals - bending moment and shear force diagram..						
UNIT 5 - THEOREM OF THREE MOMENTS						6
Static indeterminacy - Theorem of three moments- analysis of propped cantilevers- fixed & continuous beam - bending moment and shear force diagram.						
LIST OF EXPERIMENTS (Not included for End Semester Examinations)						
<ol style="list-style-type: none">Analysis and Design of Plane BeamAnalysis and Design of Cantilever BeamAnalysis and Design of Plane FrameAnalysis and Design of Two Storied Residential Building						

5. Analysis and Design of Truss

TOTAL: 45 PERIODS (30+15)

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

CO1:	Apply the fundamental concepts of static indeterminacy and kinematic indeterminacy of Structure
CO2:	Analyze the beams, pin jointed and rigid jointed structures using Strain energy method
CO3:	Analyze a structure using slope deflection method
CO4:	Analyze a structure using moment distribution method
CO5:	Analyze the beams by making use of theorem of three moments

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	2	3	-	-	1	-	-	-	-	3	2
CO2	3	2	-	2	3	-	-	1	-	-	-	-	2	1
CO3	3	2	-	2	3	-	-	1	-	-	-	-	1	2
CO4	3	2	-	2	3	-	-	1	-	-	-	-	2	1
CO5	3	2	-	2	3	-	-	1	-	-	-	-	2	2

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Reddy. C.S., "Basic Structural Analysis", Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2013.
2. Punmia.B.C, Ashok Kumar Jain and Arun Kumar Jain, "Theory of structures", Laxmi Publications Pvt. Ltd., New Delhi, 2004.
3. Vazirani&Ratwani (2003), Analysis of Structures, Vol. 1 &II ,Khanna publishers

REFERENCE BOOKS:

1. S.Ramamrutham (2004), Theory of structures, Dhanpat Rai publications.
2. L.S.Negi (2003), Structural Analysis, Tata Mc-GrawHill.
3. Rajasekharan & Sankara Subramanian (2000), Computational Structural Mechanics, Prentice-Hall of India.

WEB RESOURCES:

1. <https://archive.nptel.ac.in/courses/105/105/105105166/>
2. <https://www.newtondesk.com/structural-analysis-handwritten-study-notes/>

CE650209 – DESIGN OF RC ELEMENTS					
Use IS Code -875 Part I-III, IS 456 : 2000, SP16:1980 code book					
Course Category: Program Core	Course Type: Theory with Project	L	T	P	C
		2	1	0	3
COURSE OBJECTIVES:					
<ul style="list-style-type: none">To study the various methods for the design of concrete structures.To understanding of the design principles and methods for reinforced concrete (RC) beams, considering flexure, bond, anchorage, shear, torsion, and serviceability requirements.To gain foundational knowledge of slab structures and their types.To gain familiarity with different types of columns.To acquire the knowledge and skills necessary to effectively design various types of footings					
UNIT 1: METHODS OF DESIGN OF CONCRETE STRUCTURES					9
Concept of Elastic method, ultimate load method and limit state method – Advantages of Limit State Method over other methods- Design codes and specification- Introduction to working stress method, ultimate load design (Principles only) - Limit State philosophy as detailed in IS code – Design of rectangular beam and slabs by working stress method.					
UNIT 2: DESIGN OF BEAM, SHEAR & TORSION					9
Design of singly and doubly reinforced rectangular and flanged beams- Use of design aids for Flexure - Behaviour of RC members in bond and Anchorage - Design requirements as per current code - Behaviour of RC beams in shear and torsion - Design of RC members for combined bending, shear and torsion - serviceability.					
UNIT 3: DESIGN OF SLABS AND STAIRCASE					9
Introductions about slab - Partial Safety Factors –Design of one way, two way and continuous rectangular slabs subjected to uniformly distributed load for various boundary conditions – Types of Staircases – Design of dog-legged Staircase –Introduction to Flat Slab.					
UNIT 4: DESIGN OF COLUMNS					9
Column – Types – Concept of effective length and eccentricity of a column - Design of short rectangular and circular columns for axial, uniaxial and biaxial bending. Design of slender column.					
UNIT 5: DESIGN OF FOOTING					9
Footing – Types - Design of axially and eccentrically loaded Isolated, square and rectangular footings – Design of combined rectangular and Trapezoidal footing for two columns only. Design					

of wall footing.

TOTAL: 45 PERIODS

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

CO1:	Understand the various design methodologies for the design of RC elements
CO2:	Analyze and design rectangular and flanged RC beams
CO3:	Design and analyze reinforced concrete slabs and staircases.
CO4:	Design columns of different types and sizes for diverse structural applications
CO5:	Designing safe, efficient, and economical footings for a wide range of structural applications.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2	-	-	-	-	-	-	3	3	2
CO2	2	3	2	2	3	-	-	-	-	-	-	2	2	1
CO3	2	2	3	1	2	-	-	-	-	-	-	2	1	2
CO4	2	2	2	2	3	-	-	-	-	-	-	3	2	1
CO5	2	2	2	2	2	-	-	-	-	-	-	2	2	2

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Krishna Raju, N., “Design of Reinforced Concrete Structures”, CBS Publishers & Distributors, New Delhi, 2017

2. Sinha, S.N. “Reinforced Concrete Design”, Tata McGraw-Hill Publishing Company Ltd, New Delhi 2014.

3. Subramanian N,” Design of Reinforced Concrete Structures”, Oxford University Press, 2013

REFERENCE BOOKS:

1. Varghese, P.C., “Limit State Design of Reinforced Concrete”, Prentice Hall of India, Pvt. Ltd., New Delhi 2010.

2. Unnikrishna Pillai, S., Devdas Menon, “Reinforced Concrete Design”, Tata McGraw-Hill Publishing Company Ltd., New Delhi4th Edition 2021.

3. Punmia B. C, Ashok. Kumar Jain, Arun Kumar Jain “Limit State Design of Reinforced Concrete”, Laxmi Publications (P) Ltd, New Delhi 2007.

4. IS 456 : 2000 - Plain and Reinforced Concrete - Code of Practice 4th revision 2007

5. SP 16 : 1980 - Design Aids for Reinforced Concrete

WEB RESOURCES:

1. <https://archive.nptel.ac.in/courses/105/105/105105105/>

2. <https://www.newtondesk.com/reinforced-cement-concrete-rcc-psc-handwritten-study-notes/>

CE650210 – ENVIRONMENTAL ENGINEERING						
Course Category: Program Core	Course Type: Theory	L	T	P	C	
		3	0	0	3	
COURSE OBJECTIVES:						
<ul style="list-style-type: none">To study the principles of water supply system and planning the sources, conveyance of water.To realize the different water treatment techniques.To study the Planning, designing and execution of drainage system.To recognize the different primary and secondary treatment techniques of wastewater.To learn the principles of sludge management and disposal of wastewater.						
UNIT 1: PLANNING FOR WATERSUPPLY SYSTEM						9
Public water supply system - Planning - Objectives - Design period - Population forecasting -Water demand - Sources of water and their characteristics - Surface and Groundwater - Impounding reservoir well hydraulics - Development and selection of source - Water quality - Characterization -Water quality standards and parameters.						
UNIT 2: WATER TREATMENT						9
Objectives - Unit operations and processes - Principles, functions design and drawing of flash mixers, flocculators, sedimentation tanks and sand filters – Filter press – Disinfection - Ozonation and UV - Residue Management – TSDF – Co-processing and co-incineration.						
UNIT 3: PLANNING AND DESIGN OF SEWERAGE SYSTEM						9
Sources, Characteristics of sewage and its composition - population equivalent - Estimating quantity of sewage - Storm runoff estimation - Sewerage - separate, combined and partially separate system - Hydraulic design of flow in sanitary sewers - sewer materials -Laying and testing - sewer appurtenances – sewage pumping - Discharge standards for Effluents.						
UNIT 4: SEWAGE TREATMENT						9
Objectives – Unit Operations and Processes - Collection system - Selection of treatment processes - Primary treatment – Principles, functions and design of sewage treatment units - screens - grit chamber - primary sedimentation tanks - Onsite sanitation - Septic tank - Activated Sludge Process - Natural systems - Ponds and Lagoons - Trickling filters - Rotating biological contactors - Hybrid system - SBR - MBR - MBBR - FBR (Basics)- Anaerobic systems - Anaerobic filters .						
UNIT 5: SEWAGE DISPOSAL ANDSLUDGEMANAGEMENT						9
Dilution – Self-purification of surface water bodies - Oxygen sag curve – Streeter Phelps equation -						

Eutrophication - Land Disposal – Sewage farming – Sewage sickness - Sludge Digestion-characterization - Thickening – Dewatering – Drying - Disposal - Septage Management.

TOTAL: 45 PERIODS

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

CO1:	Examine the various sources of water and their characteristics
CO2:	Design the components of a water treatment plant
CO3:	Interpret the composition of sewage, estimate the wastewater generation and design of sewer system
CO4:	Attribute the type of treatment system and Select the suitable sewage treatment process
CO5:	Describe the concepts of self-purification of streams and sludge disposal methods

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	2	2	-	3	-	-	1	-	1	2	2	2
CO2	2	1	-	2	2	1	1	-	-	1	-	3	2	1
CO3	1	-	-	2	2	-	1	3	-	2	-	2	2	-
CO4	2	2	-	1	3	1	1	-	-	-	-	3	2	2
CO5	3	2	-	-	2	-	-	-	-	2	2	3	2	1

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Garg, S.K., —Environmental EngineeringI, Vol.1& II Khanna Publishers, New Delhi, 2015.
2. Punmia, B.C., Ashok K Jain and Arun K Jain, —Water Supply EngineeringI, LaxmiPublications Private Limited, New Delhi, 2014.

REFERENCE BOOKS:

1. Syed R. Qasim —Wastewater Treatment PlantsI, CRC Press, WashingtonD.C.,2010
2. Gray N.F, —Water TechnologyI, Elsevier India Pvt. Ltd., New Delhi, 2006.
3. Manual on Water Supply and Treatment, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 2013

WEB RESOURCES:

1. <https://archive.nptel.ac.in/courses/127/105/127105018/>
2. <https://easyengineering.net/ce6503-environmental-engineering-ee-1-5-html/>

CE650801 – CONTRACT LAWS FOR CIVIL ENGINEERS						
Course Category: Program Mandatory	Course Type: Theory	L	T	P	C	
		2	0	0	0	
COURSE OBJECTIVES:						
<ul style="list-style-type: none">To study the contract and arbitration laws.To know the fundamental constitutional rights and laws related to RTI.To study the human rights and labour laws.To learn the legal requirements and statutory regulations.To learn the copyright and patent laws related to products developed.						
UNIT 1: CONTRACT AND ARBITRATION LAWS						9
Indian contracts act - Elements - Types and features of contracts - Suitability - Design of contract documents - International and standard contract documents - Law of torts - Transparency in tenders act. Arbitration - Comparison of acts and laws – Agreements						
UNIT 2: FUNDAMENTAL CONSTITUTIONAL RIGHTS AND LAWS RELATED TO RTI						9
Constitutional Law - Fundamental Rights - Directive principles of State policy - Fundamental Duties - Emergency provisions - kinds, legal requirements and legal effects - Right to Information Act - Official Secret Act - Indian Evidence Act - Information Technology Act - Water Act.						
UNIT 3: HUMAN RIGHTS AND LABOUR LAWS						9
Introduction - Human Rights in Indian tradition and Western tradition - Civil & Political Rights - Economic, Social and Cultural Rights Laws for social security - Insurance and safety regulations - Workmen’s compensation Act -Indian factory Act – Tamilnadu factory Act - Child labour Act						
UNIT 4: LEGAL REQUIREMENTS						9
Insurance and bonding - Laws governing sale, purchase and use of urban and rural land - Land revenue codes - Tax laws - Income tax, Sales tax, Excise and Custom duties and their influence on construction costs - Legal requirements for planning						
UNIT 5: COPYRIGHT AND PATENT LAWS						9
Law relating to Intellectual property - Main forms of IP, Copyright, Trademarks, Patents and Designs - Secrets - International instruments on IP - International organizations relating to IPR - Law relating to Trademarks under Trademark Act - Law relating to Patents under Patents Act - Process of obtaining patent						

TOTAL: 45 PERIODS**COURSE OUTCOMES:** At the end of the course, the student will be able to

CO1:	Exercise the contract and arbitration laws during conflicts in projects
CO2:	Practice the fundamental constitutional rights and laws related to RTI
CO3:	Adopt human rights and labour laws for smooth project operations
CO4:	Apply tax and property laws during purchasing and selling of properties
CO5:	Register copyright and patent laws for the products developed

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	-	-	-	2	1	3	1	-	2	3	-	2
CO2	1	1	-	-	-	2	1	3	1	-	2	3	-	2
CO3	1	1	-	-	-	2	1	3	1	-	2	3	-	2
CO4	1	1	-	-	-	2	1	3	1	-	2	3	-	2
CO5	1	1	-	-	-	2	1	3	1	-	2	3	-	2

1- low, 2 - medium, 3 - high, '-' no correlation**TEXT BOOKS:**

1. Nikita Agarwal, Rishi Kumar, "Laws for Engineers", Genius Publications, 2016.
2. Abrahamson M.V, "Engineering Law and the I.C.E Contracts, 4th Edition, 2016.
3. Joseph T. Bockrath, "Contracts and the Legal Environment for Engineers and Architects", Seventh Edition, McGraw Hill, 2013

REFERENCE BOOKS:

1. Gajaria G.T., "Laws Relating to Building and Engineering Contracts in India", Lexis Nexis; Fourth edition, 2000.
2. Jimmie Hinze, "Construction Contracts", McGraw-Hill Education; 3rd edition, 2013.

WEB RESOURCES:

1. <https://dish.tn.gov.in/assets/pdf/FactoriesAct1948andTamilNaduFactoriesRules.pdf>
2. <http://www.legislation.gov.uk/ukpga/1988/48/contents>

CE650305 – SURVEY FIELD PRACTICES LABORATORY						
Course Category: Program Core	Course Type: Practical	L	T	P	C	
		0	0	3	1.5	
COURSE OBJECTIVES:						
<ul style="list-style-type: none">To learn the principles and techniques of conducting traverses using a total station.To make the students involve in field surveying worksTo gain a fundamental understanding of geoinformatics, including its principles, applications, and technologies.						
LIST OF EXPERIMENTS						
<div>1. Traverse - using Total station</div> <div>2. Contouring</div> <div>a. Radial tachometric contouring - Radial Line at Every 45 Degree and Length not less than 60 Meter on each Radial Line</div> <div>b. Block Level/ By squares of size at least 100 Meter x 100 Meter at least 20 Meter interval</div> <div>c. L.S & C.S - Road and canal alignment for a Length of not less than 1 Kilo Meter at least L.S at Every 30M and C.S at every 90 M</div> <div>3. Offset of Buildings and Plotting the Location</div> <div>4. Use of GPS to determine latitude and longitude and locate the survey camp location</div> <div>5. Traversing using GPS</div> <div>6. Curve setting by deflection angle</div> <div>7. Introduction to geo informatics (Study)</div> <div>8. Drone demonstration (Demonstration)</div>						
TOTAL: 45 PERIODS						
List of Requirements (Requirements for a batch of 30 students)						
Sl. No.	Description of Equipment's	Quantity				
1.	Theodolites	At least 6 forevery30 students				
2.	Dumpy level	At least 6 forevery30 students				
3.	Pocket stereoscope	At least 6 forevery30 students				
4.	Ranging rods	5 no's				
5.	Arrows	10 no's				
6.	Leveling staff	1for a set of 5students				
7.	Cross staff					

8.	Tapes(20m&30m)	
9.	Total Station with Prism and Stand	At least 6 forevery30 students
10.	GPS (Hand Held)	At least 6 forevery30 students
11.	Drones	01 no

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

CO1:	Apply traverse techniques using total station
CO2:	Perform Contouring using various methods
CO3:	Accurately offset buildings and plot locations & GPS surveying
CO4:	Understand Fundamentals of Geoinformatics:
CO5:	Demonstrate Drone Technology for Surveying

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	-	3	3	1	2	-	1	3	3	2
CO2	3	3	3	3	-	3	3	1	2	-	1	3	3	2
CO3	3	3	3	3	-	3	3	1	2	-	1	3	3	2
CO4	3	3	3	3	-	3	3	1	2	-	1	3	3	2
CO5	3	3	3	3	-	3	3	1	2	-	1	3	3	2

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Punmia B.C, "Surveying, Vol. I and II", Laxmi Publications, 2016.
2. Basak N.N, "Surveying and Levelling", Tata Mc Graw Hill Publishing Company Ltd., New Delhi, 2014.
3. Kumar S., " Basics of Remote Sensing and GIS", Laxmi Publication (P) Ltd,2015

REFERENCE BOOKS:

1. Arora K. R, "Surveying Vol. I and II", Standard Book House, 2015..
2. Duggal S.K, "Surveying Vol. I and II", Tata McGraw Hill, New Delhi, 2013.
3. Kanetkar T.P, "Surveying and Levelling Vols. I and II", United Book Corporation, Pune,2014

WEB RESOURCES:

1. <https://sliitr.vlabs.ac.in/>
2. <https://sl-iitr.vlabs.ac.in/List%20of%20experiments.html>

CE650306 – CONCRETE AND HIGHWAY ENGINEERING LABORATORY						
Course Category: Program Core	Course Type: Practical	L	T	P	C	
		0	0	3	1.5	
COURSE OBJECTIVES:						
<ul style="list-style-type: none">To characterize the physical properties of coarse aggregateTo evaluate the workability of concrete through different methodsTo assess the compressive strength of hardened concrete using both destructive and non-destructive testing methodsTo assess the split tensile strength of hardened concreteTo characterize the physical and mechanical properties of bitumen.						
LIST OF EXPERIMENTS						
<ol style="list-style-type: none">Finding the fineness modulus of the coarse aggregate.Finding the water absorption on the coarse aggregate.Finding the impact value of coarse aggregate.Finding the Specific Gravity of coarse Aggregate.Finding the flakiness index of Aggregate.Finding the elongation index of Aggregate.Determination of workability of concrete using slump cone apparatus.Determine of workability of concrete using compaction factor apparatus.Determination of workability of concrete using Vee Bee consistometer apparatusFinding the Compressive Strength of harden concrete (distractive and Non-distractive).Find the split tensile strength of hardened concrete.Determination of softening point of the asphalt/bitumen sample.Determination of penetration test on bitumen.Determination of bitumen viscosity.Determination of binder content of bitumen.To find the specific gravity of bitumen.						
TOTAL: 45 PERIODS						
List of Requirements (Requirements for a batch of 30 students)						
Sl. No.	Description of Equipment	Quantity required (No's)				
1.	CTM – 100 Tone Capacity	01				
2.	Vee Bee Consistometer	01				

3.	Aggregate Impact Testing Machine	01
4.	Concrete Cube Mould	06
5.	Concrete Cylinder Mould	03
6.	Concrete Prism Mould	02
7.	Concrete Beam Mould	03
8.	Mortar Cube Mold	03
9.	Sieves[80,40,16,12.5,10,4.75 mm & Pane]	1 Set
10.	Concrete Mixer	01
11.	Slump Cone	03
12.	Flow Table	01
13.	Trowels	03
14.	Blains Apparatus	02
15.	Flakiness Gauge	02
16.	Elongation Gauge	02
17.	Le Chatelier Apparatus	03 Set
18.	Steel Scale [1 m]	01
19.	Mixing Tray	02
20.	Density Basket	01
21.	Aggregate Crushing Apparatus	01
22.	Vernier Caliper	02
23.	Screw Gauge	02
24.	Penetration Test Apparatus	01
25.	Ring Ball Apparatus	01
26.	Bitumen Viscometer	01
27.	Hot Air oven	01
28.	Centrifuge Bitumen Extractor	01
29.	Vicat's Apparatus	01
30.	Pycnometer	03
31.	Compaction Factor Test Apparatus	01
32.	Rebound Hammer Test	01
33.	Specific gravity bottles.	01

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

CO1:	Diagnose the properties of aggregates with different testing methods.
CO2:	Prepare different concrete mixes and check the workability properties.
CO3:	Determine the strength of harden concrete.
CO4:	Evaluate the Consistency and Properties of Bitumen
CO5:	Determine the Bitumen Content in the Bituminous Mixes

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	3	2	1	1	1	1	3	3	1	3	3	1
CO2	3	1	3	2	1	1	1	1	3	3	1	3	3	1
CO3	3	1	3	2	1	1	1	1	3	3	1	3	3	1
CO4	3	1	3	2	1	1	1	1	3	3	1	3	3	1
CO5	3	1	3	2	1	1	1	1	3	3	1	3	3	1
1- low, 2 - medium, 3 - high, '-' no correlation														
TEXT BOOKS:														
<ol style="list-style-type: none"> Shetty,M.S, "Concrete Technology (Theory and Practice)", S.Chand and Company Ltd, New Delhi 28th Revised Edition 2021. Santhakumar,A.R; "Concrete Technology" , Oxford University Press, New Delhi, 2018 Kadiyali L R, Principles and Practice of Highway Engineering, Khanna Technical Publications, Delhi, 2015 														
REFERENCE BOOKS:														
<ol style="list-style-type: none"> IS10262-1982 Recommended Guidelines for Concrete Mix Design, Bureau of Indian Standards, New Delhi, 2018. IRC Standards (IRC 37 - 2001 & IRC 58 -1998). Gambir, M.L; "Concrete Technology",3rd Edition, Tata McGraw Hill Publishing Co Ltd, New Delhi, 2014. 														
WEB RESOURCES:														
<ol style="list-style-type: none"> https://nptel.ac.in/courses/105104030 https://www.youtube.com/watch?v=oD0qIR6PnlQ 														

CE650503 – INTEGRATED APTITUDE SKILLS - I (HIGHER)						
Course Category: EEC	Course Type: Practical (Skill Based Course)		L	T	P	C
			0	0	2	1
COURSE OBJECTIVES:						
<ul style="list-style-type: none">To understand the basic concepts of quantitative abilityTo understand the basic concepts of logical reasoning SkillsTo acquire satisfactory competency in use of verbal reasoning						
UNIT 1 - QUANTITATIVE APTITUDE						10
1. Numbers – Number Systems, Types of Numbers, Series (Arithmetic Progression, Geometric Progression)						
2. Problem on Ages						
3. HCF & LCM						
4. Profit & Loss						
5. Problems on Trains, Boats & Stream						
6. Calendar & Clocks						
7. Time & Work						
8. Speed & Distance (Or) Time & Distance						
9. Decimal Fractions, Simplification (Including Expression & Evaluation)						
10. Square Root, Cubic Root						
11. Average						
12. Surds & Indices						
13. Odd Man Out & Series						
UNIT 2 - LOGICAL REASONING						10
General Mental Ability						
1. Series completion						
2. Analogy						
3. Classification						
4. Coding-Decoding						
5. Blood Relation						
6. Puzzle test						
7. Sequential Output Tracing						
8. Direction sense test						

9. Logical Venn Diagram 10. Alphabet Test 11. Alpha-numeric sequence Puzzle 12. Number, Ranking and Time sequence Test 13. Mathematical Operations 14. Logical Sequence of words 15. Arithmetical Reasoning 16. Inserting the missing character 17. Data Sufficiency 18. Eligibility test 19. Assertions and Reasoning 20. Situation Reaction Test 21. Verification of truth of the statement	
UNIT 3 - VERBAL ABILITY	10
1. Vocabulary Based – Synonyms 2. Vocabulary Based - Antonyms 3. Spotting Errors 4. Spelling 5. Jumbled words 6. One word substitution 7. Sentence Correction 8. Idioms & Phrases. 9. Commonly confusing words 10. Statement and Conclusion 11. Change of Voice 12. Facts/Inferences and Judgment.	
TOTAL: 30 PERIODS	
COURSE OUTCOMES: At the end of the course, the student will be able to	
CO1:	Develop strong foundational skills in mathematics, enabling them to confidently solve a variety of numerical and logical problems encountered in real-world scenarios.
CO2:	Develop strong logical reasoning and analytical skills, enabling them to solve a wide range of problems encountered in competitive exams, aptitude tests, and real-life situations.
CO3:	Develop a comprehensive understanding of English language usage, grammar, and vocabulary, enabling them to communicate effectively in both written and spoken contexts, as well as to analyze and evaluate written material critically as well as analyze and evaluate written material critically
CO-PO MAPPING	

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	-	-	-	-	-	-	2	-	1	2	2
CO2	2	2	2	-	-	-	-	-	-	2	-	1	2	2
CO3	2	2	2	-	-	-	-	-	-	2	-	1	2	2
1- low, 2 - medium, 3 - high, '-' no correlation														
TEXT BOOKS:														
<ol style="list-style-type: none"> 1. Agarwal R.S, “Quantitative Aptitude,” S.Chand and Company Pvt. Ltd., New Delhi, First Edition 1989, Reprint, 2016. 2. Agarwal R.S, “A Modern Approach to Verbal and Non-Verbal Reasoning,” S.Chand and Company Pvt.Ltd.,New Delhi, First Edition 1994, Reprint, 2016. 3. Agarwal R.S, “Objective General English,” S.Chand and Company Pvt.Ltd.,New Delhi, First Edition 1997, Reprint, 2016. 														
REFERENCE BOOKS:														
<ol style="list-style-type: none"> 1. Anand P A, “Quantitative Aptitude,” Wiley India Pvt. Ltd., New Delhi, Edition,2016 2. Arun Sharma, “How to Prepare for Logical Reasoning,” Tata-McGraw Hill Education Series. New Delhi, First Edition 2016. 3. Sharon Weiner Green, Ira K Wolf, “Barron’s GRE,” Barron Publishers. First Edition 1995, Reprint, 2016. 4. The Princeton Review, “Cracking the GRE”, Random House Publisher, Premium Edition 2016. 														
WEB RESOURCES:														
<ol style="list-style-type: none"> 1. www.indiabix.com. 2. http://www.practiceaptitudetests.com/ 														

VI SEMESTER SYLLABUS

CE660211 - STRUCTURAL ANALYSIS II						
Course Category: Program Core	Course Type: Theory with Practical Component	L	T	P	C	
		2	0	2	3	
COURSE OBJECTIVES:						
<ul style="list-style-type: none">To study the matrix force methods for analyzing the indeterminate structures.To learn the stiffness matrix method to analyse indeterminate structures.To know the analysis of space truss and arch structures.To know the analysis of cable supported structures.To study the concept of plastic analysis for beams and rigid frames.						
UNIT 1 - MATRIX FLEXIBILITY METHOD						6
Equilibrium and compatibility - Determinate and Indeterminate structures - Indeterminacy - Primary structure - Compatibility conditions - Element to structure transformation - Analysis of indeterminate pin - Jointed plane frames, continuous beams, rigid jointed plane frames (with redundancy restricted to three).						
UNIT 2 - MATRIX STIFFNESS METHOD						6
Element and global stiffness matrices - Analysis of continuous beams - Co-ordinate transformations - Rotation matrix - Transformations of stiffness matrices, load vectors and displacements vectors - Analysis of pin-jointed plane frames and rigid frames (with redundancy limited to three).						
UNIT 3 - SPACE TRUSSES AND ARCHES						6
Space trusses - Method of tension coefficients - Arches - Types of arches - Analysis of three hinged, two hinged and fixed arches - Parabolic and circular arches - Settlement and temperature effects.						
UNIT 4 - CABLES AND SUSPENSION BRIDGES						6
Equilibrium of cable - Length of cable - Anchorage of suspension cables - Stiffening girders - Cables with three hinged stiffening girders - Influence lines for three hinged stiffening girders.						
UNIT 5 - PLASTIC ANALYSIS						6
Plastic theory - Statically indeterminate structures - Plastic moment of resistance - Plastic modulus - Shape factor - Load factor - Plastic hinge and mechanism - Length of plastic hinge - Collapse load - Static and kinematic methods - Upper and lower bound theorems.						
LIST OF EXPERIMENTS						
(Not included for End Semester Examination)						
1. Analysis and Design of Multi-Storied Building						
2. Analysis and Design of Circular Water Tank						

3. Analysis and Design of a Continuous Beam
4. Analysis and Design of 2D Frame
5. Analysis and Design of 3D Frame

TOTAL: 45 PERIODS (30+15)

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

CO1:	Employ matrix flexibility method for analysis of continuous beams, pin jointed trusses and rigid plane frames.
CO2:	Apply matrix stiffness approach for analysis of continuous beams, pin jointed trusses and rigid plane frames.
CO3:	Analyze space truss and arches.
CO4:	Analyze the suspension bridges with stiffening girders.
CO5:	Apply the plastic analysis method to compute collapse load in beams and rigid frames.

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2	-	-	-	2	-	-	1	3	1
CO2	3	3	3	2	2	-	-	-	2	-	-	1	3	1
CO3	3	3	3	2	2	-	-	-	2	-	-	1	3	1
CO4	3	3	3	2	2	-	-	-	2	-	-	1	3	1
CO5	3	3	3	2	2	-	-	-	2	-	-	1	3	1

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Punmia B.C., Ashok Kumar Jain and Arun Kumar Jain, "Theory of Structures", Laxmi Publications, 2017.
2. Vaidyanathan R. and Perumal P., "Comprehensive structural Analysis – Vol. I & II", Laxmi Publications, New Delhi, 2016.
3. Ghali.A, Nebille,A.M. and Brown,T.G. "Structural Analysis" A unified classical and Matrix approach" 6th edition. Spon Press, London and New York, 2013.

REFERENCE BOOKS:

1. Gambhir. M.L., "Fundamentals of Structural Mechanics and Analysis"., PHI Learning Pvt. Ltd., New Delhi, 2011.
2. BhavaiKatti, S.S, "Structural Analysis – Vol. 1 and Vol. 2", Vikas Publishing House Pvt. Ltd., New Delhi, 2010.
3. William Weaver Jr. & James M. Gere, "Matrix Analysis of Framed Structures", CBS Publishers and Distributors, Delhi, 2004.

WEB RESOURCES:

1. <https://archive.nptel.ac.in/courses/105/105/105105109/>
2. <https://easyengineering.net/ce8602-structural-analysis-ii-notes-nw/>

CE660212 - DESIGN OF STEEL STRUCTURES						
Use IS 800:2007 Code Book & Steel Table						
Course Category: Program Core	Course Type: Theory with Project	L	T	P	C	
		2	1	0	3	
COURSE OBJECTIVES:						
<ul style="list-style-type: none">To study the design of method of steel structures and connections.To study the different of design of tension membersTo know the different of design of compression members.To know the different flexural members.To study the various types of industrial shed elements.						
UNIT 1 - DESIGN METHODS AND CONNECTIONS FOR STEEL MEMBERS						9
Properties of steel–Structural steel sections–Limit State Design Concepts – Loads on Structures–Connections using rivets, welding, and bolting–Design of bolted and welded joints–Eccentric Connections–Efficiency of joints.						
UNIT 2 - STEEL TENSION MEMBERS						9
Tension Members - Types of Tension members and sections –Behaviour of Tension Members- modes of failure-Slenderness ratio- Net area – Net effective sections for Plates ,Angles and Tee in tension – Design of plate and angle tension members-design of built up tension Members- Use of lug angles.						
UNIT 3 - STEEL COMPRESSION MEMBERS						9
Types of compression members and sections–Behaviour and types of failures-Short and slender columns- Current code provisions for compression members - Effective Length, Slenderness ratio – Axially Loaded solid section Columns - Design of Built up Laced and Battened type columns – Design of column bases – Plate and Gusseted bases for Axially loaded columns- Splices for columns.						
UNIT 4 - STEEL FLEXURE MEMBERS						9
Types of steel Beam sections - Behaviour of Beams in flexure– Classification of cross sections - Flexural Strength and Lateral stability of Beams – Shear Strength-Web Buckling, Crippling and defection of Beams - Design of laterally supported Beams - Design of solid rolled section Beams - Design Strength of Laterally unsupported Beams.						
UNIT 5 - DESIGN OF TRUSSES						9
Introduction-Evaluation of design dead load, live load, wind load, design of truss using rolled steel sections – Purlins-Truss members-Supports.						
TOTAL: 45 PERIODS						

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

CO1:	Design the suitable connection for joints in steel structures.
CO2:	Design steel tension members using plates and angle sections.
CO3:	Design steel compression members like simple columns, built up columns and column bases.
CO4:	Design flexural members like beams and plate girders.
CO5:	Evaluate the various loads acting and design the trusses and purlins.

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	-	-	-	-	-	-	-	1	2	2
CO2	3	2	2	2	-	-	-	-	-	-	-	1	2	1
CO3	3	2	2	2	-	-	-	-	-	-	-	1	2	2
CO4	3	2	2	2	-	-	-	-	-	-	-	1	2	1
CO5	2	2	2	2	-	-	-	-	-	-	-	1	2	2

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Gambhir. M.L., “Fundamentals of Structural Steel Design”, McGraw Hill Education India Pvt.Ltd., 2013
2. Shiyekar. M.R., “Limit State Design in Structural Steel”, Prentice Hall of India Pvt. Ltd, Learning Pvt.Ltd., 2nd Edition, 2013.
3. Subramanian.N, “Design of Steel Structures”, Oxford University Press, New Delhi, 2013.

REFERENCE BOOKS:

1. Narayanan.R. “Teaching Resource on Structural Steel Design”, INSDAG, Ministry of Steel Publications, 2002.
2. Duggal. S.K, “Limit State Design of Steel Structures”, Tata McGraw Hill Publishing Company, 2005.
3. Bhavikatti.S.S, “Design of Steel Structures” By Limit State Method as per IS:800–2007, IK International Publishing House Pvt. Ltd., 2009.

WEB RESOURCES:

1. <https://nptel.ac.in/courses/105/105/105105162/>
2. <https://www.newtondesk.com/design-of-steel-structure-handwritten-study-notes/>

CE660213 - CONSTRUCTION MANAGEMENT						
Course Category: Program Core	Course Type: Theory	L	T	P	C	
		3	0	0	3	
COURSE OBJECTIVES:						
<ul style="list-style-type: none">To know the scope of construction ManagementTo knowledge about the necessity of planning in the diverse construction projectsTo study the various contract system and tender documentsTo know the approval and sanction of estimates and measurements of worksTo study the management information system.						
UNIT 1 - INTRODUCTION						9
Construction Management - Importance – Scope of construction Management – Principles – Management Functions – Construction stages - Constructor Sequence- Types of firms – Government – Private – Public sector – Owner-Builder Operation - Planning for materials – Machines – Organization of Project Participants Traditional Designer- Turnkey Operation -Leadership and Motivation for the Project Team						
UNIT 2 - PLANNING AND SCHEDULING						9
Construction Planning: Need – Collection of field data – Scheduling- Defining Activities- WBS creation, Project planning: Precedence Relation -Forms of scheduling – Bar charts – Milestone charts – Network analysis – CPM and PERT – Numbering events – Time calculations – Floats – Critical path – Time estimates – Time cost optimization – Resource levelling						
UNIT 3 - EXECUTION OF WORKS						9
Execution of work – Departmental execution – Contract system – Calling of tenders – Tender documents – Types of contracts – Contracting firms – Specifications, quality control – Legal implications – Penalties – Arbitration						
UNIT 4 - STORES AND ACCOUNTS						9
Measurements of works – Recording – Checking – Types of bills – Modes of payment – Cash Book –Imprest account – Temporary advance – Revised estimate – Approval and sanction of estimates – Budget -Completion report – Classification of stores – Maintenance – Inspection – Transfers – Surplus and shortage						
UNIT 5 - INDUSTRIAL MANAGEMENT						9
Relationship between management and labour – Industrial psychology – Motivating – Merit rating – Incentive plans – Leadership – Importance – Styles – Communication – Types – Methods – Process						

– Time and motion studies														
TOTAL: 45 PERIODS														
COURSE OUTCOMES: At the end of the course, the student will be able to														
CO1:	Explain the fundamental techniques in construction management.													
CO2:	Outline the system of scheduling by using software.													
CO3:	Build the system of labour management and safety measures.													
CO4:	Explain the engineering economics system and network analysis.													
CO5:	Classify the basic value of project management.													
CO-PO MAPPING														
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	2	3	3	2	2	3	2	2	1	2	1
CO2	1	-	2	1	3	-	1	1	1	2	1	1	2	1
CO3	-	-	3	3	1	-	1	3	1	2	1	1	2	1
CO4	1	-	1	1	-	2	-	1	-	-	-	1	3	1
CO5	1	2	2	3	2	-	-	2	3	-	3	1	2	1
1- low, 2 - medium, 3 - high, '-' no correlation														
TEXT BOOKS:														
1. Sengupta (2002), Construction Management, Tata McGraw-Hill														
2. Construction Management and accounts (2002) by J.L. Sharma, Satya Publications.														
3. Subramaniam (2001), Construction Management, Anuradha Agencies.														
REFERENCE BOOKS:														
1. Joseph.L (2000), Essential of Management, Prentice Hall of India.														
2. Mote Paul and Gupta (2001), Management Economics, Tata McGraw-Hill.														
3. Manie (2005), Essentials of Management, Prentice Hall of India.														
WEB RESOURCES:														
1. https://archive.nptel.ac.in/courses/105/104/105104161/														
2. https://www.gpjajpur.org/public/uploads/lres-485.pdf														

IM660403 - PROFESSIONAL ETHICS						
Course Category: Institute Mandatory	Course Type: Theory	L	T	P	C	
		2	0	0	0	
COURSE OBJECTIVES:						
<ul style="list-style-type: none">Students will understand the importance of Values and Ethics in their Personal lives and professional careersThe students will learn the rights and responsibilitiesResponsibilities of employee, team member and a global citizen.						
UNIT 1 - INTRODUCTION TO PROFESSIONAL ETHICS						6
Basic Concepts, Governing Ethics, Personal & Professional Ethics, Ethical Dilemmas, Life Skills, Emotional Intelligence, Thoughts of Ethics, Value Education, Dimensions of Ethics.						
UNIT 2 - BASIC THEORIES						6
Basic Ethical Principles, Moral Developments, Deontology, Utilitarianism, Virtue Theory, Rights Theory, Casuist Theory, Moral Absolution, Moral Rationalism, Moral Pluralism, Ethical Egoism, Feminist Consequentialism, Moral Issues, Moral Dilemmas, Moral Autonomy.						
UNIT 3 - PROFESSIONAL PRACTICES IN ENGINEERING						6
Professions and Norms of Professional Conduct, Norms of Professional Conduct vs. Profession; Responsibilities, Obligations and Moral Values in Professional Ethics, Professional codes of ethics, The limits of predictability and responsibilities of the engineering profession, Central Responsibilities of Engineers.						
UNIT 4 - WORK PLACE RIGHTS & RESPONSIBILITIES						6
Ethics in changing domains of Research, Engineers and Managers; Organizational Complaint Procedure, difference of Professional Judgment with in the Nuclear Regulatory Commission (NRC), the Hanford Nuclear Reservation. Ethics in changing domains of research.						
UNIT 5 - GLOBAL ISSUES IN PROFESSIONAL ETHICS						6
Introduction–Current Scenario, Technology Globalization of MNCs, International Trade, World Summits, Issues, Business Ethics and Corporate Governance, Sustainable Development Ecosystem, Energy Concerns, Ozone Deflection, Pollution, Ethics in Manufacturing and Marketing, Media Ethics; War Ethics; Bio Ethics, Intellectual Property Rights.						
TOTAL: 30 PERIODS						

COURSE OUTCOMES: At the end of the course, the student will be able to														
CO1:	Understanding basic purpose of profession, professional ethics and various moral and social issues.													
CO2:	Awareness of professional rights and responsibilities of a engineer, safety and risk benefit analysis of a engineer.													
CO3:	Acquiring knowledge of various roles of Engineer In applying ethical principles at various professional levels.													
CO4:	Professional Ethical values and contemporary issues.													
CO5:	Excelling in competitive and challenging environment to contribute to industrial growth.													
CO-PO MAPPING														
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	-	-	-	-	2	-	-	-	2	-	-
CO2	3	2	2	-	-	-	-	2	-	-	-	2	-	-
CO3	3	2	2	-	-	-	-	2	-	-	-	2	-	-
CO4	3	2	2	-	-	-	-	2	-	-	-	2	-	-
CO5	3	2	2	-	-	-	-	2	-	-	-	2	-	-
1- low, 2 - medium, 3 - high, '-' no correlation														
TEXT BOOKS:														
1. Professional Ethics: Subramanian R, Oxford University Press, 2015.														
2. Ethics in Engineering Practice & Research, Caroline Whit beck, 2e, Cambridge University Press 2015.														
REFERENCE BOOKS:														
1. Engineering Ethics, Concepts Cases: Charles E Harris Jr., Michaels Pritchard, Michael IJ Rabin's, 4e, Cengage learning, 2015.														
2. Business Ethics concepts & Cases: Manuel G Velasquez, 6e, PHI, 2008.														
WEB RESOURCES:														
1. https://online.courses.nptel.ac.in/noc22_mg54/preview														

CE660307 – ENVIRONMENTAL ENGINEERING LABORATORY						
Course Category: Program Core	Course Type: Practical	L	T	P	C	
		0	0	3	1.5	
COURSE OBJECTIVES:						
<ul style="list-style-type: none">To study the principles of sampling and preservation of water and wastewater.To know the principles of testing of water and wastewater.To learn the testing of bleaching powder and chlorinated water.To learn the analyzing methods for water and wastewater.To study the detection of gases by using analyzers.						
LIST OF EXPERIMENTS						
<ol style="list-style-type: none">Sampling and preservation methods and significance of characterization of water and wastewater.Determination of i) pH and turbidity ii)HardnessDetermination of residual chlorineDetermination of ChloridesDetermination of Ammonia NitrogenDetermination of Sulphate in water sampleDetermination of Optimum Coagulant DosageDetermination of chlorination of waterDetermination of Dissolved oxygen in drinking waterDetermination of Total solids, suspended solids, Dissolved solids, organic solids, inorganic solids in water and wastewater samplesDetermination of BODDetermination of CODIntroduction to Bacteriological Analysis (Demonstration only)						
TOTAL: 45 PERIODS						
List of Requirements (Requirements for a batch of 30 students)						
Sl. No.	Description of Equipment	Quantity required (No's)				
1.	Ph meter	01				
2.	Turbidity meter	01				
3.	Electric Conductivity meter	01				
4.	Refrigerator	01				

5.	BOD incubator	01
6.	Muffle furnace	01
7.	Hot air oven	01
8.	Magnetic stirrer with hot plates	05
9.	Desiccator	03
10.	Jar test apparatus	01
11.	Water bath	01
12.	Glass waves / Crucibles	05
13.	COD apparatus	01
14.	Kjeldane apparatus	01
15.	Heating mantles	03
16.	Calorimeter	01
17.	Chlorine comparator	01
18.	Beaker	10
19.	Standard flask	10
20.	Burette with stand	10
21.	Pipette	10
22.	Filtration assembly	02
23.	Chemicals	Lot

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

CO1:	Find pH and turbidity of water
CO2:	Explain the water quality parameters
CO3:	Estimate the BOD and COD of water sample
CO4:	Inspect the chemical characteristics of Water and Wastewater
CO5:	Test for Sodium in water samples using Flame photometer

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	-	3	3	1	2	-	1	3	3	1
CO2	3	3	3	3	-	3	3	1	2	-	1	3	3	1
CO3	3	3	3	3	-	3	3	1	2	-	1	3	3	1
CO4	3	3	3	3	-	3	3	1	2	-	1	3	3	1
CO5	3	3	3	3	-	3	3	1	2	-	1	3	3	1

1- low, 2 - medium, 3 - high, '-' no correlation

IS CODES:

1. IS 3025: Part 58:2006 Methods of sampling and test (Physical and Chemical) for water and wastewater: Chemical Oxygen Demand (COD).
2. IS 3025: Part 21: 2009 Methods of sampling and test (Physical and Chemical) for water and wastewater: Hardness.
3. IS 3025: Part 32: 1988 Methods of sampling and test (Physical and Chemical) for water and wastewater: Chloride.

4. IS 3025 : Part 16 : 1984 Methods of sampling and test (Physical and Chemical) for water and wastewater : Filterable Residue (Total Dissolved Solids)
5. IS 3025: Part 11: 1983 Methods of sampling and test (Physical and Chemical) for water and wastewater: pH Value.
6. IS3025:Part44:1993Methodsofsamplingandtest(PhysicalandChemical)forwaterandwastewater: Biochemical Oxygen Demand (BOD)

REFERENCE BOOKS:

1. American Public Health Association (APHA) 2005, Standard methods for the examination of water & wastewater. 21st edition, Eaton, A.D., Clesceri, L.S., Rice, E.W., Greenberg, A.E., Franson, M.A.H. APHA, Washington.
2. Garg, S.K., “Environmental Engineering Vol. I & II”, Khanna Publishers, New Delhi.
3. Modi, P.N., “Environmental Engineering Vol. I & II”, Standard Book House, Delhi-6

WEB RESOURCES:

1. <https://nptel.ac.in/courses/103107084>
2. <https://www.youtube.com/watch?v=q45S46dCrZw&list=PLt0YnX1QnknjkdL01bX1gga6xZvrNeib>

CE660308 – ENVIRONMENTAL AND IRRIGATION DRAWING LABORATORY						
Course Category: Program Core	Course Type: Practical	L	T	P	C	
		0	0	3	1.5	
COURSE OBJECTIVES:						
<ul style="list-style-type: none">To learn the canal storage head works.To study the canal diversion head works.To learn the cross drainage works.To study the water treatment system design.To learn the various waste water treatment system.						
LIST OF EXPERIMENTS						
<ol style="list-style-type: none">Design and drawing of Aeration tank ,screen chamber and Grit channelDesign and drawing of ClariflocculatorDesign and drawing of ClarifierDesign and drawing of Rapid sand filtersDesign and drawing of Service reservoirs, Pumping stationDesign and drawing of Activated sludge processDesign and drawing of Sludge digester, Sludge drying bedsDesign and drawing of Septic tanks and disposal arrangementsDrawing showing plan, elevation and foundation details of Gravity damDrawing showing plan, elevation and foundation details of Tank Surplus weirDrawing showing plan, elevation and foundation details of Tank sluice with tower headDrawing showing plan, elevation and foundation details of Aqueducts and Syphon AqueductsDrawing showing plan, elevation and foundation details of Super passage and Canal siphonDrawing showing plan, elevation and foundation details of Canal Drops and Canal escapeDrawing showing plan, elevation and foundation details of Proportional Distributors						
TOTAL: 45 PERIODS						
COURSE OUTCOMES: At the end of the course, the student will be able to						
CO1:	Understanding water treatment processes and design principles and factors influencing their efficiency.					
CO2:	Design the advanced treatment techniques for considerations for optimizing sedimentation and clarification.					

CO3:	Designing filtration and distribution systems.
CO4:	Designing biological treatment and sludge management.
CO5:	Understanding & design the infrastructure design for water control.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	3	-	-	1	2	-	2	1	-	3	2	1
CO2	3	1	3	-	-	1	2	-	2	1	-	3	2	1
CO3	3	1	3	-	-	1	2	-	2	1	-	3	2	1
CO4	3	1	3	-	-	1	2	-	2	1	-	3	2	1
CO5	3	1	3	-	-	1	2	-	2	1	-	3	2	1

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Modi, P.N., "Environmental Engineering I & II", Standard Book House, Delhi – 6, 2014.
2. Sathyanarayana Murthy "Irrigation Design and Drawing" Published by Mrs L.Banumathi, Tuni east Godavari District. A.P. 1998.
3. Sharma R.K. "Irrigation Engineering and Hydraulic Structures" S Chand Publishing, New Delhi 2017.

REFERENCE BOOKS:

1. Peary, H.S., ROWE, D.R., Tchobanoglous, G., "Environmental Engineering", McGraw- Hill Book Co., New Delhi, 2017.
2. Metcalf & Eddy, "Wastewater Engineering (Treatment and Reuse)", Tata McGraw-Hill, New Delhi, 2003.
3. Garg S.K., "Irrigation Environmental Engineering and design Structures", Khanna Publishers, New Delhi, 17th Reprint

WEB RESOURCES:

1. <https://www.youtube.com/watch?v=JIFkQ7cnwN8>

CE660504 – TRAINING IN CENTRE FOR EXCELLENCE (HYDRAULICS AND PNEUMATICS SYSTEM LAB)						
Course Category: Program Core	Course Type: Practical	L	T	P	C	
		0	0	2	1	
COURSE OBJECTIVES:						
<ul style="list-style-type: none">To explain the meaning of fluid powerTo differentiate between electrical, pneumatic and fluid power systems.To learn different valves used in hydraulic and pneumaticsTo learn the different metering methods Inlet & outlet flow control.To Explain the industrial applications of fluid power						
LIST OF EXPERIMENTS						
<ol style="list-style-type: none">Study of construction and working Hydraulic pumps, motors and Pneumatic CompressorsStudy of hydraulic and pneumatic valvesStudy of solenoid valve, limits switches.Study of Basic hydraulic circuit for the working of double acting cylinder and a hydraulic motor.Study of Basic pneumatic circuit for the working of single and double acting cylinder.Study of Speed control circuits. Different Metering methods Inlet & outlet flow control (meter-in & meter-out circuit).Study of Circuits for the Use of different direction control valves and valve actuation in single and double acting cylinder, and multi actuation circuit.Study of Hydraulic Counter-balancing circuit.Study of Circuit with cam operated pilot valves operating a pilot operated 4way direction control.Study of hydraulics and Pneumatics circuit, based on the industrial application						
TOTAL: 30 PERIODS						
List of Requirements (Requirements for a batch of 30 students)						
Sl. No.	Description of Equipment	Quantity required (No's)				
1.	Hydraulic Pumps, Motors, and Pneumatic Compressors	01				
2.	Hydraulic and Pneumatic Valves	01				
3.	Solenoid Valve and Limit Switches	01				
4.	Hydraulic Circuit for Double Acting Cylinder and Hydraulic Motor	01				
5.	Pneumatic Circuit for Single and Double Acting Cylinder	01				
6.	Speed Control Circuits and Metering	01				

7.	Circuits for Direction Control Valves and Valve Actuation	01
8.	Hydraulic Counter-balancing Circuit	05
9.	Circuit with Cam-Operated Pilot Valves	03
10.	Hydraulics and Pneumatics Circuit for Industrial Applications	01

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

CO1:	Understand the principles of operation and construction of hydraulic pumps, motors, and pneumatic compressors, exploring their roles in fluid power systems.
CO2:	Analyze the functionality and applications of hydraulic and pneumatic valves, including their types, functions, and control mechanisms within fluid power circuits.
CO3:	Investigate the operation of solenoid valves and limit switches, examining their roles in controlling fluid flow and actuation within hydraulic and pneumatic systems.
CO4:	Design and implement basic hydraulic circuits for controlling the movement of double-acting cylinders and hydraulic motors, emphasizing the practical application of fluid power principles.
CO5:	Develop fundamental pneumatic circuits for controlling the operation of single and double-acting cylinders, demonstrating proficiency in pneumatic system design and implementation.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	3	1	2	2	1	-	1	1	3	1	1
CO2	3	2	1	-	1	2	-	1	2	-	1	3	1	1
CO3	3	3	2	3	1	2	2	1	-	1	1	-	1	1
CO4	3	3	2	-	1	2	2	1	3	1	-	3	1	1
CO5	3	3	2	3	1	2	-	1	3	-	1	3	1	1

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. "Fluid Power with Applications" by Anthony Esposito, 7th Edition, Pearson, 2016.
2. "Hydraulics and Pneumatics: A Technician's and Engineer's Guide" by Andrew Parr, 3rd Edition, Butterworth-Heinemann, 2011.
3. "Industrial Hydraulics Manual" by Eaton Hydraulics Training Services, 6th Edition, Eaton Corporation, 2019.

REFERENCE BOOKS:

1. "Hydraulic Control Systems" by Noah D. Manring, 2nd Edition, Wiley, 2013.
2. "Pneumatic Systems: Principles and Maintenance" by S. R. Majumdar, 2nd Edition, CRC Press, 2018.
3. "Fluid Power Technology" by James R. Daines, 2nd Edition, Prentice Hall, 2003.

WEB RESOURCES:

1. <https://archive.nptel.ac.in/courses/112/106/112106300/>
2. <https://archive.nptel.ac.in/courses/112/105/112105047/>

VERTICALS 1

CE606101 – PREFABRICATED STRUCTURES						
Course Category: Program Elective	Course Type: Theory		L	T	P	C
			3	0	0	3
COURSE OBJECTIVES:						
<ul style="list-style-type: none">• The basic principles of prefabrication• The calculation of handling and erection stresses• The dimensioning and detailing of joint• The erection of structures• The design principles of prefabricated units						
UNIT 1 - INTRODUCTION						9
Modular co-ordination - Components - Prefabrication systems and structural schemes - Types of foundation - Design considerations - Economy of prefabrication - Prefabrication of load - Carrying members (wall panels, columns) - Disuniting of structures - Structural behaviour of precast structures						
UNIT 2 - HANDLING AND ERECTION STRESSES						9
Handling and erection stresses - Application of pre stressing of roof members - Floor systems - Two way load bearing slabs - Wall panels - Columns						
UNIT 3 - DIMENSIONING AND DETAILING OF JOINTS						9
Dimensioning and detailing of joints for different structural connections - Construction joints and expansion joints						
UNIT 4 - ERECTION OF STRUCTURES						9
Production - Transportation and Erection - Organizing of production - Storing and erection equipments - Shuttering and mould design - Dimensional tolerances, Partial and Total prefabricated buildings						
UNIT 5 - SELECTION OF PRE FABRICATION UNITS						9
Prefabricated units for Industrial structures - Multi-storied buildings and Water tanks etc., - Application of prestressed concrete in prefabrication - Design of cross section based on efficiency of material used - Introduction to Progressive collapse - Codal provisions						
TOTAL: 45 PERIODS						

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

CO1:	Apply the design considerations of prefabrication structures
CO2:	Calculate the handling and erection stresses of prefabricated members
CO3:	Formulate dimensioning and detailing of joints of structural connections
CO4:	Execute the Erection of the prefabricated structure
CO5:	Select the economical prefabrication units

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	1	1	1	2	-	1	1
CO2	3	3	2	1	-	-	-	1	1	1	2	-	1	1
CO3	3	3	3	3	-	1	-	1	1	1	2	-	1	1
CO4	3	3	2	2	-	-	-	1	1	1	2	-	1	1
CO5	3	2	2	2	-	-	-	1	1	1	2	-	1	1

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Hubert Bachmann, Alfred Steinle, "Precast Concrete Structures", Ernst and Sohn GMBH & Co., K.G., 2018.
2. "Structural design manual", Precast concrete connection details, Society for the studies in the use of precast concrete, Netherland BetorVerlag, 2009.
3. Levitt, M., "Precast concrete materials, Manufacture properties and usage", Applied Science Publishers, London, 2004.

REFERENCE BOOKS:

1. Kim S. Elliott, "Multi-Storey Precast Concrete Framed Structures" Wiley-Blackwell, 2014.
2. B.Lewicki, "Building with Large Prefabricates", Elsevier Publishing Company, Amsterdam / London / New York, 1966.
3. Laszlo Mokka, "Prefabricated Concrete for Industrial and Public Structures", C.R.Books, 1964.

WEB RESOURCES:

1. <https://studentbank.in/idea/nptel-prefabricated-structures-notes-pdf>
2. <https://www.scribd.com/document/378058062/Prefabricated-Structures-Lecture-Notes-Study-Material-and-Important-Questions-Answers>

CE606102 – PRESTRESSED CONCRETE STRUCTURES						
Course Category: Program Elective	Course Type: Theory		L	T	P	C
			2	1	0	3
COURSE OBJECTIVES:						
<ul style="list-style-type: none">• To develop an advanced understanding of the behavior• To have the knowledge on Design Concepts• To analyze the ultimate strength of continuous beams• To analyze and Design of Prestressed concrete tanks• To develop the Design procedure for Prestressed Composite Beams						
UNIT 1 – INTRODUCTION – THEORY AND BEHAVIOUR						9
Basic concepts – advantages – materials required – systems and methods of prestressing – analysis of sections – stress concept – strength concept – load balancing concept – effect of loading on the tensile stresses in tendons – effect of tendon profile on deflections – factors influencing deflections – calculation of deflections – short term and long term deflections – losses of prestress – estimation of crack width.						
UNIT 2 - DESIGN CONCEPTS						9
Flexural strength – simplified procedures- codal provision – strain compatibility method – basic concepts in selection of cross section for bending – stress distribution in end block - design of anchorage zone reinforcement – limit state design criteria – partial prestressing – applications.						
UNIT 3 - CONTINUOUS BEAMS						9
Analysis – incorporation of moment due to reactions- pressure line due to prestressing force – principle of linear transformation – concordant tendon profile – partially continuous beams – analysis for ultimate strength – moment redistribution.						
UNIT 4 - CIRCULAR PRESTRESSING						9
Introduction – General features of prestressed concrete tanks –Analysis and Design of prestressed concrete tanks – Design of cylindrical and non-cylindrical pipe.						
UNIT 5 - PRESTRESSED COMPOSITE BEAMS						9
Composite prestressed concrete beams – Design procedure – Calculation of stresses at important stages both for propped and unpropped constructions – Design of shear connectors – Shrinkage stresses.						
TOTAL: 45 PERIODS						

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

CO1:	Explain the terminology related to pre-stressing
CO2:	Analyze the sections using strength, stress load balancing concept and losses of prestressing
CO3:	Design the flexural member and stress distribution in the end block
CO4:	Design a prestress concrete pipes and tanks
CO5:	Design the composite prestressed concrete beams & Determine the stress and estimate the deflection for propped and unpropped constructions

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	2	1	-	-	-	-	-	-	2	3	1
CO2	3	3	2	2	1	1	1	-	-	-	-	2	3	1
CO3	3	3	2	-	-	1	1	-	-	-	-	2	2	1
CO4	3	3	2	-	-	1	1	-	-	-	-	2	2	1
CO5	3	3	2	-	-	-	1	-	-	-	-	2	2	-

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Krishna Raju N., "Prestressed concrete", Tata McGraw Hill Company, New Delhi, 2012.
2. Pandit.G.S. and Gupta.S.P., "Prestressed Concrete", CBS Publishers and Distributors Pvt. Ltd, 2012.

REFERENCE BOOKS:

1. Rajagopalan, N, "Prestressed Concrete", Alpha Science, 2002.
2. Dayaratnam.P., "Prestressed Concrete Structures", Oxford and IBH, 2013.
3. Lin T.Y. and Ned.H.Burns, "Design of prestressed Concrete Structures", Third Edition, Wiley India Pvt. Ltd., New Delhi, 2013.

WEB RESOURCES:

1. <https://nptel.ac.in/courses/105106117>
2. <https://easyengineering.net/design-of-prestressed-concrete-structures-by-lin-nw/>

CE606103 – BUILDING PLANNING AND SERVICES						
Course Category: Program Elective	Course Type: Theory		L	T	P	C
			3	0	0	3
COURSE OBJECTIVES:						
<ul style="list-style-type: none">To develop the Planning permissions & amenitiesTo have the knowledge an Electrical Systems And InstallationsTo have the knowledge on Lighting Services & HVACTo have the knowledge on fire fighting protection and resistanceTo develop the Building safety and security systems						
UNIT 1 – GENERAL PLANNING						9
classifications of buildings, Planning permissions, permitted activity, Area and height limitations, Community open spaces and amenities - Green buildings- Intelligent buildings.						
UNIT 2 - ELECTRICAL SYSTEMS AND INSTALLATIONS						9
Basics of electricity – Single and three phase supply- Protective devices in electrical installation – types of earthing , Planning electrical wiring for building- Electrical layout for residential buildings.						
UNIT 3 - LIGHTING SERVICES & HVAC						9
Classification of Lighting, - Energy conservation in lighting- Minimum level of illumination required for different types of buildings - Behavior of Heat Propagation, General methods of Thermal Insulation- Basic principles of Ventilation-Systems of ventilation, Basic principles and essentials of Air Conditioning.						
UNIT 4 - FIREFIGHTING SERVICES						9
Classification of buildings based on occupancy- fire fighting protection and fire resistance rating ,planning considerations in building for Fire protection-fire detection and fire fighting installation in buildings.						
UNIT 5 - MISCELLANEOUS						9
Building safety and security systems - Elevators and Escalators their standards and uses - Acoustic services - Necessity of integrated planning and designing of different services in buildings.						
TOTAL: 45 PERIODS						

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

CO1:	Understand the general planning and development control rules for different types of buildings
CO2:	Apply the relevant codes and manuals for the design of building services
CO3:	Apply the principles of electrical and lighting services for different uses in buildings & planning services for domestic and industrial needs
CO4:	Plan and design the requirements for HVAC system, firefighting and other necessary services for various types of buildings
CO5:	Incorporate the integrated planning and designing of necessary building services for better usage of building

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	-	-	-	2	2	3	1	1	-	1	1	2
CO2	1	1	-	-	-	2	2	2	2	1	-	1	1	2
CO3	2	2	3	1	-	2	2	2	1	2	-	1	2	2
CO4	2	2	3	1	-	2	2	2	1	2	-	1	2	2
CO5	1	3	3	3	-	2	2	2	2	2	-	2	2	2

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. National Building Code of India -2005.
2. Energy Conservation Building Code – 2007.

REFERENCE BOOKS:

1. Development Control Rules by Chennai Metropolitan Development Agency -2006.
2. CPHEEO Manual on Sewerage and sewage treatment systems – 2013.
3. Manual for environmental clearance for large construction projects – by Ministry of environment, forest and climate change.

WEB RESOURCES:

1. <https://nptel.ac.in/courses/105107156>
2. [https://www.scribd.com/document/415412140/Building-Planning- Architecture-Civil-Engineering-Second-Year-Notes-Books-eBook-PDF-Download](https://www.scribd.com/document/415412140/Building-Planning-Architecture-Civil-Engineering-Second-Year-Notes-Books-eBook-PDF-Download)

CE606104 – TALL BUILDINGS						
Course Category: Program Elective	Course Type: Theory		L	T	P	C
			3	0	0	3
COURSE OBJECTIVES:						
<ul style="list-style-type: none">• The Development of High Rise Building Structures• The Horizontal Bracing & Composite Floor Systems• The high-rise building structures and their behaviour under load• The structural analysis and design of buildings• The Modern trends in railways						
UNIT 1 – INTRODUCTION						9
Tall Building in the Urban Context -Tall Building and its Support Structure -Development of High Rise Building Structures - General Planning Considerations. Dead Loads - Live Loads- Construction Loads -Snow, Rain, and Ice Loads - Wind Loads-Seismic Loading, Water and Earth Pressure Loads - Loads - Loads Due to Restrained Volume Changes of Material - Impact and Dynamic Loads - Blast Loads -Combination of Loads						
UNIT 2 - THE VERTICAL STRUCTURE PLANE						9
Dispersion of Vertical Forces- Dispersion of Lateral Forces - Optimum Ground Level Space - Shear Wall Arrangement - Behaviour of Shear Walls under Lateral Loading. Floor Structure or Horizontal Building Plane Floor Framing Systems-Horizontal Bracing- Composite Floor Systems-High - Rise Building as related to assemblage Kits Skeleton Frame Systems – Load Bearing Wall Panel Systems - Panel Frame Systems - Multistory Box Systems						
UNIT 3 - COMMON HIGH-RISE BUILDING STRUCTURES AND THEIR BEHAVIOUR UNDER LOAD						9
Bearing Wall Structure-Shear Core Structure - Rigid Frame Systems- The Wall - Beam Structure: Interspatial and Staggered Truss Systems - Frame - Shear Wall Building Systems - Flat Slab Building Structures - Shear Truss - Frame Interaction System with Rigid - Belt Trusses - Tubular Systems- Composite Buildings - Comparison of High - Rise Structural Systems Other Design Approaches Controlling Building Drift Efficient Building Forms - The Counteracting Force or Dynamic Response						
UNIT 4 - APPROXIMATE STRUCTURAL ANALYSIS AND DESIGN OF BUILDINGS						9
Approximate Analysis of Bearing Wall Buildings -Cross Wall Structure -Long Wall Structure The Rigid Frame Structure Approximate Analysis for Vertical Loading - Approximate Analysis for Lateral Loading - Approximate Design of Rigid Frame Buildings-Lateral Deformation of Rigid Frame						

Buildings Rigid Frame - Shear Wall Structure - Vierendeel Structure - Hollow Tube Structure														
UNIT 5 - ADVANCES IN RAILWAYS														9
Introduction to modern trends in Indian Railways in the design of high speed tracks - Modern trends in railway track alignment - Railways for Urban area - LRT & MRTS - Mono Rail – Metro Rail - Hyper loop- Recent developments in railway projects														
TOTAL: 45 PERIODS														
COURSE OUTCOMES: At the end of the course, the student will be able to														
CO1:	Design the tall building based on different load conditions													
CO2:	Analyse the shear wall and load bearing wall panel systems													
CO3:	Comparison of Composite Buildings and High Rise Structural Systems													
CO4:	Design and analysis of Composite Buildings and High Rise Structural Systems													
CO5:	Analyse of High Rise Suspension Systems and Pneumatic High Rise Buildings													
CO-PO MAPPING														
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	-	-	-	-	-	-	3	-	1	1	1
CO2	3	3	2	-	2	-	-	3	-	-	-	1	1	1
CO3	2	2	2	1	2	-	-	-	-	-	-	1	1	1
CO4	2	3	2	-	3	2	-	2	-	-	1	1	1	1
CO5	2	2	1	-	1	-	-	1	-	-	-	1	1	1
1- low, 2 - medium, 3 - high, '-' no correlation														
TEXT BOOKS:														
1. Taranath B.S., “Structural Analysis and Design of Tall Buildings”, McGraw Hill, 2016.														
2. Smith B.S and Coull. A, “ Tall Building structures – Analysis and Design” John Rile and sons , 2018.														
REFERENCE BOOKS:														
1. WOLFGANG SCHUELLER " High - rise building Structures", John Wiley and Sons														
2. Bryan Stafford Smith and Alex Coull, " Tall Building Structures ", Analysis and Design, John Wiley and Sons, Inc., 1991														
WEB RESOURCES:														
1. https://nptel.ac.in/courses/124105015														
2. https://www.sefindia.org/forum/files/tall_building_books1_118.pdf														

CE606105 – CORROSION OF RC STRUCTURES						
Course Category: Program Elective	Course Type: Theory		L	T	P	C
			3	0	0	3
COURSE OBJECTIVES:						
<ul style="list-style-type: none">• The mechanism of corrosion and its effects.• Various types of corrosion monitoring techniques and life cycle assessment.• The corrosion control measures.• Repair of corrosion affected structures.• Recent trends in area of corrosion engineering.						
UNIT 1 - INTRODUCTION TO CORROSION						9
Basics of corrosion in concrete – Concrete as electrolyte - Physical, chemical, biological, mechanical and structural factors - Effects of rebar corrosion - Initiation and propagation of corrosion - Corrosion rate.						
UNIT 2 - CORROSION MONITORING						9
Methods to assess the deterioration of concrete - Gravimetric Method - Electrochemical methods of corrosion monitoring of rebar - Surface potential measurements, half-cell potential measurements, electrical resistance probe technique, and instantaneous corrosion rate by linear polarization method - Service life prediction.						
UNIT 3 - CORROSION CONTROL METHODS						9
Corrosion control methods - Chemical and mineral admixtures - Coatings to Concrete surface - Supplementary cementitious materials in concrete - Blended cements - Corrosion inhibitors.						
UNIT 4 - REPAIR OF CONCRETE STRUCTURES						9
Basic principles of repair - Concrete removal, surface preparation – Various grades of steel - Preparation of the reinforcement - Quality assurance, the use of materials for concrete - Filling cracks and cavities in concrete - Effects of cover thickness on cracking - Crack width measurements - Carbonation depth, chloride profile tests, Slant shear tests - Repair materials - Properties, and selection - Repair Techniques - Guniting , shotcrete techniques.						
UNIT 5 - RECENT ADVANCEMENTS						9
Systematic investigation of failure analysis - Use of nanotechnology in corrosion studies - Introduction to simulation of corrosion problems - Software applications - Technology transfer to real time application.						
TOTAL: 45 PERIODS						

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

CO1:	Explain the causes and effects of corrosion in RC structures
CO2:	Converse various types of corrosion monitoring methods to RC structures
CO3:	Select appropriate corrosion control methods to distressed concrete structures
CO4:	Suggest suitable repair and rehabilitation techniques to corrosion affected concrete structures
CO5:	Apply state of art technology for corrosion related problems

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	3	1	1	-	1	1	-	-	-	1	1	1
CO2	3	1	3	-	1	-	1	1	-	-	-	1	1	1
CO3	2	2	3	-	1	-	1	-	-	-	1	1	1	1
CO4	2	1	2	1	1	-	1	1	-	-	-	1	1	1
CO5	2	1	3	-	1	-	1	-	-	-	-	1	1	1

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. P.C.Varghese, "Maintenance, repair and rehabilitation and minor works of buildings", PHI Pvt Ltd, 2014.
2. Chatterjee U. K., "Environment degradation metals", CRC press, Marcel Dekker Inc., 2001.
3. Mohamed A. El-Reddy, "Steel-Reinforced Concrete Structures – Assessment and Repair of Corrosion", CRC Press, 2008.

REFERENCE BOOKS:

1. Kenneth.R.Trethewey and John Chamberlain, "Corrosion for Science and Engineering", Longman Inc., 1996
2. Rajnarayan, "Metallic Corrosion and Prevention", Oxford Publications, 1988
3. John P. Broomfield, "Corrosion of steel in concrete-Understanding, investigation and Repair", Taylor & Francis, 2007.
4. Zaki Ahmad, Digby Macdonald, "Principles of Corrosion Engineering and Corrosion Control", ButterworthHeinemann, 2013.

WEB RESOURCES:

1. <https://archive.nptel.ac.in/courses/105/106/105106202/>
2. https://www.usb.ac.ir/FileStaff/5128_2020-2-8-17-56-58.pdf

CE606106 – COMPUTER AIDED DESIGN OF STRUCTURES						
Course Category: Program Elective	Course Type: Theory	L	T	P	C	
		3	0	0	3	
COURSE OBJECTIVES:						
<ul style="list-style-type: none">• Basic graphic primitives, transformations and 2-D drafting of computer graphics.• Computer methods of structural analysis.• Algorithm for finding load carrying capacity of steel columns• Structural design concepts.• Basics of Artificial Intelligence.						
UNIT 1 - COMPUTER GRAPHICS						9
Graphic primitives - Transformations - Basics of 2-D drafting - Modeling of curves and surfaces – Wire frame modeling - Solid modeling - Graphic standards - Drafting software packages and usage.						
UNIT 2 - STRUCTURAL ANALYSIS						9
Banded and semi-banded matrices - element stiffness matrix – structure stiffness matrix –algorithm for solving trusses by matrix stiffness method – simple applications.						
UNIT 3 - STEEL STRUCTURES						9
Algorithm for finding load carrying capacity of steel columns – algorithm for moment carrying capacity of steel beams – simple applications.						
UNIT 4 - PRESTRESSED CONCRETE STRUCTURES						9
Algorithm for analysis of prestressed rectangular and I sections in flexure – algorithm for finding losses in prestress – simple applications.						
UNIT 5 - ARTIFICIAL INTELLIGENCE						9
Introduction to artificial intelligence - Knowledge based expert systems – Rules and decision tables - Inference mechanisms - simple applications.						
TOTAL: 45 PERIODS						
COURSE OUTCOMES: At the end of the course, the student will be able to						
CO1:	Draft 2 D drawings using drafting software.					
CO2:	Formulate algorithm for solving equations by matrix method and construct algorithm for Computer aided design of truss problems.					
CO3:	Construct algorithm for computer aided design of steel members.					
CO4:	Construct algorithm for analysis of prestressed concrete members.					
CO5:	Acquire the knowledge in Artificial Intelligence and Knowledge based expert Systems.					

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	-	3	-	2	3	3	3	-	-	2	2
CO2	3	3	3	-	3	-	2	3	3	3	-	-	2	2
CO3	3	3	3	-	3	-	2	3	3	3	-	-	2	2
CO4	3	3	3	-	3	-	2	3	3	3	-	-	2	2
CO5	3	3	3	-	3	-	2	3	3	3	-	-	2	2

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Krishnamoorthy C.S and Rajeev S., "Computer Aided Design", Narosa Publishing House, New Delhi, 2005.
2. Rao. S.S., "Optimisation Theory and Applications ", Wiley Eastern Limited, New Delhi 2009.

REFERENCE BOOKS:

1. Groover M.P. and Zimmers E.W.Jr., " CAD/CAM, Computer Aided Design and Manufacturing", Prentice Hall of India Ltd, New Delhi, 2006.
2. Harrison H.B., "Structural Analysis and Design VolI and II", Pergamon Press, 1991.
3. Hinton .Eand Owen D.R.J., "Finite Element Programming", Academic Press 1977.
4. Richard Forsyth (Ed.), "Expert System Principles and Case Studies", Chapman and Hall, 1996.

WEB RESOURCES:

3. <https://archive.nptel.ac.in/courses/105/106/105106202/>
4. https://www.usb.ac.ir/FileStaff/5128_2020-2-8-17-56-58.pdf

CE606107 – MAINTENANCE AND REPAIR OF CONCRETE STRUCTURES						
Course Category: Program Elective	Course Type: Theory		L	T	P	C
			3	0	0	3
COURSE OBJECTIVES:						
<ul style="list-style-type: none">To learn the maintenance and repair.To learn the strength and durability of concrete.To study the repair materials and special types of concrete.To study the production methods and health monitoring systems.To learn the various types cracks method and demolitions procedures.						
UNIT 1 - MAINTENANCE AND REPAIR STRATEGIES						9
Maintenance, Repair and Rehabilitation, retrofit and strengthening, need for rehabilitation of structures- Service life behaviour - importance of Maintenance, causes and effects of deterioration. Non-destructive Testing Techniques						
UNIT 2 - STRENGTH AND DURABILITY OF CONCRETE						9
Quality assurance for concrete based on Strength, Durability and Microstructure of concrete - NDT techniques- Cracks- different types, causes – Effects due to Environment, Fire, Earthquake, Corrosion of steel in concrete, Mechanism, quantification of corrosion damage						
UNIT 3 - REPAIR MATERIALS AND SPECIAL CONCRETES						9
Repair materials-Variou repair materials, Criteria for material selection, Methodology of selection, Special mortars and concretes- Polymer Concrete and Grouting materials- Bonding agents-Latex emulsions, Epoxy bonding agents, Protective coatings-Protective coatings for Concrete and Steel, FRP sheets.						
UNIT 4 - PROTECTION MONITORING METHODS AND STRUCTURAL HEALTH						9
Concrete protection methods – reinforcement protection methods- cathodic protection - Sacrificial anode - Corrosion protection techniques – Corrosion inhibitors, concrete coatings- Corrosion resistant steels, Coatings to reinforcement, Structural health monitoring.						
UNIT 5 - REPAIR, RETROFITTING AND DEMOLITION OF STRUCTURES						9
Various methods of crack repair, Grouting, Routing and sealing, Stitching, Dry packing, Autogenous healing, Repair to active cracks, Repair to dormant cracks. Repair of various corrosion damaged of structural elements (slab, beam and columns) Jacketing Techniques, Strengthening Methods for Structural Elements. Engineered Demolition -Case studies						
TOTAL: 45 PERIODS						

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

CO1:	Explain the importance of maintenance assessment and repair strategies.
CO2:	Acquire knowledge of strength and durability properties and their effects due to climate and temperature.
CO3:	Gain knowledge of recent developments in repair.
CO4:	Applying the testing techniques for repair and protection methods
CO5:	Explain the repair, rehabilitation and retrofitting of structures and demolition methods

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	-	-	-	1	1	2	1	-	2	2	1
CO2	3	2	3	-	-	-	1	1	1	1	-	2	2	1
CO3	3	2	3	-	-	-	1	1	1	1	-	2	2	1
CO4	2	2	3	-	-	-	1	1	1	1	-	2	2	1
CO5	2	2	3	-	-	-	1	1	1	1	-	2	2	1

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Shetty.M.S. Jain A K., Concrete Technology - Theory and Practice, S.Chand and Company, 8th Edition , 2019
2. Vidivelli B, Rehabilitation of Concrete Structures Standard Publishes Distribution.1st Edition 2009.
3. Varghese P. C, Maintenance Repair and Rehabilitation & Minor works of building, Prentice Hall India Pvt Ltd 2014.

REFERENCE BOOKS:

1. Ravishankar.K. Krishnamurthy. T.S, Structural Health Monitoring, Repair and Rehabilitation of Concrete Structures, Allied Publishers, 2004.
2. Dodge Woodson, Concrete Structures, Protection, Repair and Rehabilitation, Butterworth-Heinemann, Elsevier, New Delhi 2012.
3. Hand Book on “Repair and Rehabilitation of RCC Buildings” – Director General works CPWD, Govt of India, New Delhi – 2002.

WEB RESOURCES:

1. <https://archive.nptel.ac.in/noc/courses/noc20/SEM1/noc20-ce26/>
2. https://onlinecourses.nptel.ac.in/noc22_ce12/preview

CE606108 – DESIGN OF MASONRY STRUCTURES (NPTEL)						
Course Category: Program Elective	Course Type: Theory	L	T	P	C	
		3	0	0	3	
COURSE OBJECTIVES:						
<ul style="list-style-type: none">To enable learning of theories on mechanical behaviour of masonry assemblages.To learn the present working stress and limit states.To learn the unreinforced, reinforced and confined masonry structures.To study the vertical and lateral loads, including earthquake loads.To review procedures for structural assessment and strengthening of existing masonry structures.						
UNIT 1 - MASONRY CONSTRUCTION UNITS, MATERIALS, TYPES & MASONRY						9
Brick, stone and block masonry units – strength, modulus of elasticity and water absorption of masonry materials – classification and properties of mortars, selection of mortars. Defects and errors in masonry construction, cracks in masonry, types, reasons for cracking, methods of avoiding cracks.						
UNIT 2 - STRENGTH AND STABILITY						9
Strength and Stability of concentrically loaded masonry walls, effect of unit strength, mortar strength, joint thickness, rate of absorption, and effect of curing, effect of ageing, workmanship, strength formulae and mechanism of failure for masonry subjected to Axial compression, eccentric compression, direct and flexural tension, shear and compression, biaxial state of stresses, P-M interaction and Deformation characteristics.						
UNIT 3 - DESIGN OF REINFORCED MASONRY						9
Basic principles and methods of reinforcing, Working stress and limit states design, Serviceability limit states (deflection, cracking), Design for combined out-of-plane bending and axial compression, Design for in-plane flexure.						
UNIT 4 - DESIGN OF MASONRY WALLS AND REINFORCED MASONRY						9
Detailing requirements, International design standards and Multi-storey building design. Confined masonry: Development and application, Configuration, Response under seismic loads, Seismic resistance verification, Design of load bearing masonry for building up to 3 storeys using IS : 1905 and SP : 20 procedure. Application, flexural and compression elements, shear walls.						
UNIT 5 - MASONRY WALLS IN COMPOSITE ACTION						9
Infilled frames - behaviour - modelling and design - composite wall-beam elements- assessment and strengthening of existing masonry structure.						

TOTAL: 45 PERIODS

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

CO1:	Acquired the knowledge about masonry types, properties and construction method.
CO2:	Analysis the strength and stability of masonry structures.
CO3:	Design the reinforced masonry structures.
CO4:	Develop the application of masonry wall and reinforced masonry.
CO5:	Design the composite wall.

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	2	-	2	2	2	1	1	1	2	2	1
CO2	3	3	2	2	-	2	2	2	1	1	1	2	2	1
CO3	3	3	3	3	-	2	2	2	1	1	1	2	2	1
CO4	3	3	3	2	-	2	2	2	1	1	1	2	2	1
CO5	3	3	3	3	-	2	2	1	1	1	1	2	2	1

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Drysdale, R.G., Hamid, A.A., and Baker, L.R., Masonry Structures: Behaviour and Design, Prentice Hall, 1994, 2nd Edition.
2. Taly, N., Design of Reinforced Masonry Structures, Mc-Graw Hill Companies, 2010, 2nd Edition.
3. Klingner, R E, Masonry Structural Design, McGraw-Hill Companies, 2017, 2nd Edition.

REFERENCE BOOKS:

1. Priestley, M.J.N. and Paulay, T., Seismic Design and Assessment of Reinforced Concrete and Masonry Buildings, John Wiley and Sons, 1997.
2. IS 1905 Code of Practice for Structural use of Unreinforced Masonry, Bureau of Indian Standards
3. SP 20: 1981 Explanatory Handbook on Masonry Code, Bureau of Indian Standards.

WEB RESOURCES:

1. <https://archive.nptel.ac.in/courses/105/106/105106197/>
2. <https://www.youtube.com/watch?v=KZGNmzH7IdA>

CE606109 – REINFORCED CONCRETE ROAD BRIDGE (NPTEL)						
Course Category: Program Elective	Course Type: Theory	L	T	P	C	
		3	0	0	3	
COURSE OBJECTIVES:						
<ul style="list-style-type: none">To introduce bridge structures & their typesTo learn loading and response condition of bridge.To study the bridge deck analysis and lateral load distribution.To make capable to analyse and design simple reinforced concrete slab bridge.To make capable to analyse and design simple reinforced concrete T beam bridge						
UNIT 1 - INTRODUCTION						9
Bridge and its components - Types of bridges and their characteristics - Selection of bridge type - Essential design data and their acquisition - General design requirements – IRC loading – Design codes.						
UNIT 2 - BRIDGE LOADING AND RESPONSES						9
Bridge Loads - Bridge Responses - Working stress method – Limit state method of design as per IS 456-2000 and IRC 112-2011.						
UNIT 3 - BRIDGE DECK ANALYSIS AND LATERAL LOAD DISTRIBUTION						9
General principle and methods of bridge deck analysis Effective Width Method - Courbon's Method - Distribution Coefficient Method - Hendry Jaeger Method - Longitudinal and lateral positioning of moving loads and response calculation.						
UNIT 4 - DESIGN OF RC SLAB BRIDGE						9
General principle – classification – component - Design of RC Slab Bridge - Design of abutment.						
UNIT 5 - DESIGN OF RC BEAM BRIDGE						9
General principle – classification – component - Design of RC T beam bridge.						
TOTAL: 45 PERIODS						

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

CO1:	Acquired the knowledge about selection of bridge and design codes using.
CO2:	Apply the loading condition and response of bridge as IS Codes.
CO3:	Analysis the bridge deck methods and load distribution.
CO4:	Design the reinforced concrete slab bridge
CO5:	Design the reinforced concrete T beam bridge

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	2	-	2	2	1	-	1	1	2	2	1
CO2	3	2	2	2	-	2	2	1	-	1	1	2	2	1
CO3	3	3	3	3	-	2	2	1	-	1	1	2	2	1
CO4	3	3	3	3	1	2	2	2	2	2	1	2	2	1
CO5	3	3	3	3	1	2	2	2	2	2	1	2	2	1

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Victor, D.J, "Essential of Bridge Engineering", Oxford and IBH Publishing Company, New Delhi 2017
2. Rakshit, R.S, "Design and Construction of Highway Bridges", New Central Book Agency, New Delhi 2004
3. Klingner, R E, Masonry Structural Design, McGraw-Hill Companies, 2017, 2nd Edition.

REFERENCE BOOKS:

1. Priestley, M.J.N. and Paulay, T., Seismic Design and Assessment of Reinforced Concrete and Masonry Buildings, John Wiley and Sons, 1997.
2. Raina V K, "Concrete Bridge Practice: Construction, Maintenance and Rehabilitation", Tata McGraw – Hill 1988.
3. Standard Specifications and Codes of Practices for Road Bridges, IRC 5, 6, 21, 22, 24, 40, 78, 83

WEB RESOURCES:

1. <https://archive.nptel.ac.in/courses/105/105/105105165/>
2. <https://www.digimat.in/nptel/courses/video/105105165/L14.html>

CE606110 – FINITE ELEMENT METHOD AND COMPUTATIONAL STRUCTURAL DYNAMICS (NPTEL)						
Course Category: Program Elective	Course Type: Theory		L	T	P	C
			3	0	0	3
COURSE OBJECTIVES:						
<ul style="list-style-type: none">To have the knowledge on Differential Equations & SolutionsTo have the knowledge on Finite Elements of 1DTo identifying the Finite Elements of 2D & 3DTo provides knowledge on Numerical Solution of Initial Value ProblemsTo identifying the Discrete Fourier Transform						
UNIT 1 - MATHEMATICAL MODELLING, DIFFERENTIAL EQUATIONS AND APPROXIMATE SOLUTIONS						9
Mathematical Modelling in Engineering - Approximation via Method of Weighted Residuals - Approximation via Variational Principles - Convergence of the Approximate Solution - From Continua to Discontinua.						
UNIT 2 - FINITE ELEMENTS OF ONE-DIMENSION						9
Introduction - Finite Elements of C^0 Continuity - Finite Elements of C^1 Continuity - Finite Element Modelling for Shear Flexible Beams - Finite Element Modelling for Beam & Column - Finite Element Modelling for Grillage System						
UNIT 3 - FINITE ELEMENTS OF TWO AND THREE DIMENSIONS						9
Weighted Residual Formulation and the Weak Form - Approximations for Two-Dimensional Elasticity - Finite Elements for Two-Dimensional Domains - Finite Elements for Three- Dimensional Domains - Development of Finite Element Equations						
UNIT 4 - TIME MARCHING: NUMERICAL SOLUTION OF INITIAL VALUE PROBLEMS						9
Introduction - Methods based on Taylor Series Expansion - Direct Methods for Vibration Problems - Analysis of Time Marching Schemes (Stability of Single-Step Methods & Consistency of Single-Step Methods)						
UNIT 5 - DISCRETE FOURIER TRANSFORM						9
Introduction - Discrete Time Data - Discrete Fourier Transform - Fast (Finite) Fourier Transform - DFT Applications (Convolution and Deconvolution & Vibration Data Processing)						
TOTAL: 45 PERIODS						

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

CO1:	Develop Differential Equations & Solutions
CO2:	Modeling in Finite Elements of 1D
CO3:	Analyze Finite Elements of 2D & 3D
CO4:	Analyze the Numerical Solution of Initial Value Problems
CO5:	Discrete Fourier Transform

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	3	1	2	1	1	1	1	2	2	2
CO2	3	2	2	2	3	1	2	2	1	1	1	2	2	2
CO3	3	2	2	2	3	1	2	1	1	1	1	2	2	2
CO4	3	2	2	2	3	1	2	2	1	1	1	2	2	2
CO5	3	2	2	2	3	1	2	1	1	1	1	2	2	2

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Finite Element Method and Computational Structural Dynamics-Phi-Shrikhande, Manish-2014-Edn-1
2. R.D. Cook, D.S. Malkus and M.E. Plesha, Concepts and Applications of Finite Element Analysis, John Wiley & Sons, 2002.
3. O.C. Zienkiewicz, R.L. Taylor and J.Z. Zhu, Finite Element Method Its Basis and Fundamentals, Elsevier, 2005.

REFERENCE BOOKS:

1. P. Seshu, Textbook of Finite Element Analysis, PHI Learning Pvt. Ltd., 2003.
2. T.R. Chandrupatla and A.D. Belegundu, Introduction to Finite Elements in Engineering, Prentice Hall, 2003.
3. K.J. Bathe, Finite Element Procedures, Prentice Hall of India Pvt. Ltd., 2002.

WEB RESOURCES:

1. <https://archive.nptel.ac.in/courses/105/107/105107209/>
2. <https://www.classcentral.com/course/swayam-finite-element-method-variational-methods-to-computer-programming-19868>

VERTICALS 2

CE606201 – CONSTRUCTION PLANNING AND SCHEDULING						
Course Category: Program Elective	Course Type: Theory	L	T	P	C	
		3	0	0	3	
COURSE OBJECTIVES:						
<ul style="list-style-type: none">To study and understand the concept of planning.To impart concepts in Network representation and analysis.To impart concepts in Precedence Network analysis.To impart concepts in resource scheduling.To learn Concepts in project monitoring and controlling.						
UNIT 1 - CONSTRUCTION PLANNING						9
Basic Concepts in the Development of Construction Plans – Choice of Technology and Construction Method – Defining Work Tasks and Work Break down Levels – Defining Precedence Relationships among Activities – Estimating Activity Durations – Estimating Resource Requirements for Work Activities – Coding Systems - Planning Project Schedule and Budget.						
UNIT 2 - NETWORK REPRESENTATION AND ANALYSIS						9
Duration Estimation – Gantt / Bar Chart – Types of Network and Techniques – Introduction to Floats, Types of Floats, usage of Floats for Project Decisions - Presenting Project Schedules – Scheduling for Activity-on-Node and with Leads, Lags, and Windows – Critical Path Method (CPM) Network Analysis - PERT Network Modelling and Time Analysis - Case Illustrations.						
UNIT 3 - PRECEDENCE NETWORK ANALYSIS						9
Introduction to Precedence Diagramming Method (PDM) - PDM network representation, Procedure and Analysis, Issues in PDM, Case Illustrations, Defining Relationship, Project Monitoring and Control Process.						
UNIT 4 - SCHEDULING PROJECT WORK AND RESOURCE SCHEDULING						9
Work Scheduling Fundamentals – Bar chart method of Work scheduling – Network Based Project Scheduling – Line of Balance Scheduling for Repetitive Projects - Scheduling with Uncertain Durations – Resources Scheduling Considerations – Crashing and Time/Cost Trade-offs- Case Illustrations – Use of Project management Software for scheduling Process.						
UNIT 5 - PROJECT MONITORING AND CONTROLLING						9
The Cost Control Approach – Direct and Indirect Cost Control – Activity Cost Control – Financial Accounting Systems and Cost Accounts – Control of Project Cash Flows - Performance Control using Earned Value Management Concepts – Time progress monitoring and Controlling – Time Reduction						

Techniques – Guidelines for reviewing project Time and Cost Progress.

TOTAL: 45 PERIODS

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

CO1:	Identify and estimate the activity in the construction.
CO2:	Schedule the networking of activities using the critical path method.
CO3:	Evaluate the project budget required for the particular construction project.
CO4:	Recognize the various quality control tool required in the construction industry.
CO5:	Explain the different databases that can be maintained in the construction industry using computers.

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	3	-	1	-	1	-	2	2	1	-	1	1
CO2	2	2	2	-	1	-	2	1	1	2	1	1	1	2
CO3	1	1	1	-	-	-	2	-	-	3	2	1	1	1
CO4	1	1	1	2	-	1	1	1	-	1	1	2	2	1
CO5	1	3	2	1	-	1	1	1	1	1	-	1	1	1

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Albert Lester, Project Management, Planning and Control, 7th Edition, Butterworth Heinemann, USA, 2017.
2. Chitkara K K., Construction project management, planning, scheduling and control, McGraw Hill (INDIA) publishers, New Delhi, third edition 2014.
3. Chris Hendrickson and Tung Au, Project Management for Construction – Fundamental Concepts for Owners, Engineers, Architects and Builders, Prentice Hall, Pittsburgh, 2000.

REFERENCE BOOKS:

1. Calin M. Popescu, Chotchai Charoenngam, Project Planning, Scheduling and Control in Construction: An Encyclopaedia of terms and Applications, Wiley, New York, 1995.
2. Halpin, D. W., Financial and Cost Concepts for Construction Management, John Wiley & Sons, New York, 1985.

WEB RESOURCES:

1. <https://www.coursera.org/lecture/construction-project-management/project-planning-and-scheduling-ylsgt>
2. <https://archive.nptel.ac.in/courses/105/103/105103093/>

CE606202 – ENERGY CONSERVATION METHODS IN CONSTRUCTION						
Course Category: Program Elective	Course Type: Theory	L	T	P	C	
		3	0	0	3	
COURSE OBJECTIVES:						
<ul style="list-style-type: none">To provide an understanding of the concept of energy consumption in buildings.To optimize passive solar performance and energy efficiency.Develop skills in evaluating site-specific conditions.Implementing heat control and ventilation strategies.To optimize energy efficiency, thermal comfort, and indoor environmental quality across different climatic regions.						
UNIT 1 – INTRODUCTION						9
Climate adapted and climate rejecting buildings – Heat Transfer – Measuring Conduction – Thermal Storage – Measurement of Radiation – The Greenhouse Effect – Convection – Measuring latent and sensible heat – Psychrometry Chart – Thermal Comfort – Microclimate, Site Planning and Development – Temperature – Humidity – Wind – Optimum Site Locations – Sun Path Diagrams – Sun Protection – Types of Shading Devices – Design responses to energy conservation strategies.						
UNIT 2 - PASSIVE SOLAR HEATING AND COOLING						9
General Principles of passive Solar Heating – Key Design Elements – Sunspace – Direct gain –Trombe Walls, Water Walls – Convective Air loops – Concepts – Case Studies – General Principles of Passive Cooling – Ventilation – Principles – Case studies – Courtyards – Roof Ponds– Cool Pools – Predicting ventilation in buildings – Window Ventilation Calculations – Room Organization Strategies for Cross and Stack Ventilation – Radiation – Evaporation and dehumidification – Wind Catchers –Mass Effect – Zoning – Load Control – Air Filtration and odor removal.						
UNIT 3 - DAYLIGHTING AND ELECTRICAL LIGHTING						9
Materials, components and details – Insulation – Optical materials – Radiant Barriers – Glazing materials – Glazing Spectral Response – Day lighting – Sources and concepts – Building Design Strategies – Case Studies – Daylight apertures – Light Shelves – Codal requirements – Day lighting design – Electric Lighting – Light Distribution – Electric Lighting control for day lighted buildings – Switching controls – Coefficient of utilization – Electric Task Lighting – Electric Light Zones – Power Adjustment Factors.						
UNIT 4 - HEAT CONTROL AND VENTILATION						9
Hourly Solar radiation – Heat insulation – Terminology – Requirements – Heat transmission through						

building sections – Thermal performance of Building sections – Orientation of buildings – Building characteristics for various climates – Thermal Design of buildings – Influence of Design Parameters – Mechanical controls – Examples. Ventilation – Requirements – Minimum standards for ventilation – Ventilation Design – Energy Conservation in Ventilating systems – Design for Natural Ventilation – Calculation of probable indoor wind speed

UNIT 5 - DESIGN FOR CLIMATIC ZONES

9

Energy efficiency – An Overview of Design Concepts and Architectural Interventions – Embodied Energy – Low Embodied Energy Materials – Passive Downdraft Evaporative Cooling – Design of Energy Efficient Buildings for Various Zones – Cold and cloudy – Cold and sunny – Composite – Hot and dry – Moderate – Warm and humid – Case studies of residences, office buildings and other buildings in each zones – Commonly used software packages in energy efficient building analysis and design - Energy Audit – Certification.

TOTAL: 45 PERIODS

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

CO1:	Explain environmental energy supplies on buildings
CO2:	Explain the passive solar heating, cooling system
CO3:	Discuss the various aspects of day-lighting and electrical lighting in a building
CO4:	Predict and design building ventilation and heat control for indoor comfort
CO5:	Design a building for climatic zone and apply simulation programs of buildings to perform energy calculations

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	1	-	1	2	3	-	1	-	1	1	2	2
CO2	2	1	-	-	2	1	2	-	-	-	1	1	3	2
CO3	1	1	1	-	1	2	1	-	-	-	2	1	2	1
CO4	1	2	1	2	1	2	1	1	1	-	1	2	1	2
CO5	3	1	-	1	3	2	2	2	1	1	1	1	1	1

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Energy Conservation Building Code, cau of Energy Efficiency, New Delhi, 2018.
2. Handbook on Functional Requirements of Buildings Part 1 to 4 SP : 41 (S and T) 1995
3. Residential Energy: Cost Savings and Comfort for Existing Buildings by John Krigger and Chris Dorsi, Published by Saturn Resource Management, 2013.

REFERENCE BOOKS:

1. Majumdar, M (Ed), Energy - Efficient Buildings in India, Tata Energy Research Institute, Ministry of Non-Conventional Energy Sources, 2009.
2. Brown, G.Z. and DeKay, M., Sun, Wind and Light - Architectural Design Strategies, John Wiley and Sons Inc, 3rd Edition, 2014

WEB RESOURCES:

1. <https://elearn.nptel.ac.in/shop/iit-workshops/completed/design-principles-of-building-energy-conservation/>
2. <https://www.dexma.com/blog-en/10-ways-to-reduce-energy-consumption-on-construction-sites/>

CE606203 – ADVANCED CONSTRUCTION TECHNIQUES						
Course Category: Program Elective	Course Type: Theory	L	T	P	C	
		3	0	0	3	
COURSE OBJECTIVES:						
<ul style="list-style-type: none">To study and understand the latest construction techniques applied to engineering construction for sub structure, super structure, special structures, rehabilitation and strengthening techniques and demolition techniques.						
UNIT 1 – SUB STRUCTURE CONSTRUCTION						9
Construction Methodology - Box jacking - Pipe jacking - Under water construction of diaphragm walls and basement - Tunneling techniques - Piling techniques - Driving well and caisson - sinking cofferdam - cable anchoring and grouting - Driving diaphragm walls, Sheet piles - Laying operations for built up offshore system - Shoring for deep cutting - Large reservoir construction - well points - Dewatering for underground open excavation.						
UNIT 2 - SUPER STRUCTURE CONSTRUCTION FOR BUILDINGS						9
Vacuum dewatering of concrete flooring – Concrete paving technology – Techniques of construction for continuous concreting operation in tall buildings of various shapes and varying sections – Erection techniques of tall structures, Large span structures – launching techniques for heavy decks – in-situ prestressing in high rise structures, Post tensioning of slab- aerial transporting – Handling and erecting lightweight components on tall structures.						
UNIT 3 - CONSTRUCTION OF SPECIAL STRUCTURES						9
Erection of lattice towers - Rigging of transmission line structures – Construction sequence in cooling towers, Silos, chimney, sky scrapers - Bow string bridges, Cable stayed bridges – Launching and pushing of box decks – Construction of jetties and break water structures – Construction sequence and methods in domes – Support structure for heavy equipment and machinery in heavy industries – Erection of articulated structures and space decks.						
UNIT 4 - REHABILITATION AND STRENGTHENING TECHNIQUES						9
Seismic retrofitting - Strengthening of beams - Strengthening of columns - Strengthening of slab - Strengthening of masonry wall, Protection methods of structures, Mud jacking and grouting for foundation – Micro piling and underpinning for strengthening floor and shallow profile - Sub grade water proofing, Soil Stabilization techniques.						
UNIT 5 - DEMOLITION						9
Demolition Techniques, Demolition by Machines, Demolition by Explosives, Advanced techniques						

using Robotic Machines, Demolition Sequence, Dismantling Techniques, Safety precaution in Demolition and Dismantling.

TOTAL: 45 PERIODS

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

CO1:	Understand the modern construction techniques used in the sub structure construction.
CO2:	Demonstrate knowledge and understanding of the principles and concepts relevant to super structure construction for buildings
CO3:	Understand the concepts used in the construction of special structures
CO4:	Knowledge on Various strengthening and repair methods for different cases
CO5:	Identify the suitable demolition technique for demolishing a building

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	1	-	2	2	3	2	-	1	2	1	2	2
CO2	2	1	3	-	1	1	-	1	-	2	3	2	1	3
CO3	1	2	1	1	-	2	-	2	-	1	2	2	1	3
CO4	2	2	-	2	-	2	1	1	1	1	1	1	1	1
CO5	1	1	1	1	1	3	2	1	2	1	1	1	2	1

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Jerry Irvine, Advanced Construction Techniques, CA Rocket, 1984
2. Patrick Powers. J., Construction Dewatering: New Methods and Applications, John Wiley & Sons, 1992.
3. Peter H.Emmons, "Concrete repair and maintenance illustrated", Galgotia Publications Pvt. Ltd., 2001.Press, 2008.

REFERENCE BOOKS:

1. Robertwade Brown, Practical foundation engineering hand book, McGraw Hill Publications,1995.
2. Sankar, S.K. and Saraswati, S., Construction Technology, Oxford University, New Delhi, 2008

WEB RESOURCES:

1. <https://www.civilengineeringweb.com/advanced-construction-technologies/page/3>

CE606204- GREEN CONSTRUCTION						
Course Category: Program Elective	Course Type: Theory	L	T	P	C	
		3	0	0	3	
COURSE OBJECTIVES:						
<ul style="list-style-type: none">To analyze the social and economic implications of unsustainable building practices, including health impacts, economic costs, and social equity considerations.To minimize embodied energy and enhance the sustainability of the built environment.To integrate comfort considerations into architectural design processes and building codes.To design and implement solar energy solutions that meet building energy needs.To create resilient, energy-efficient, and environmentally friendly built environments.						
UNIT 1 – ENVIRONMENTAL IMPLICATIONS OF BUILDINGS						9
Energy use, carbon emissions, water use, waste disposal; Building materials: sources, methods of production and environmental Implications. Embodied Energy in Building Materials: Transportation Energy for Building Materials; Maintenance Energy for Buildings.						
UNIT 2 - IMPLICATIONS OF BUILDING TECHNOLOGIES EMBODIED ENERGY OF BUILDINGS						9
Framed Construction, Masonry Construction. Resources for Building Materials, Alternative concepts. Recycling of Industrial and Buildings Wastes. Biomass Resources for buildings.						
UNIT 3 - COMFORTS IN BUILDING						9
Thermal Comfort in Buildings- Issues; Heat Transfer Characteristic of Building Materials and Building Techniques. Incidence of Solar Heat on Buildings-Implications of Geographical Locations.						
UNIT 4 - UTILITY OF SOLAR ENERGY IN BUILDINGS						9
Utility of Solar energy in buildings concepts of Solar Passive Cooling and Heating of Buildings. Low Energy Cooling. Case studies of Solar Passive Cooled and Heated Buildings.						
UNIT 5 - GREEN COMPOSITES FOR BUILDINGS						9
Concepts of Green Composites. Water Utilisation in Buildings, Low Energy Approaches to Water Management. Management of Solid Wastes. Management of Sullage Water and Sewage. Urban Environment and Green Buildings. Green Cover and Built Environment.						
TOTAL: 45 PERIODS						

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

CO1:	Evaluate the environmental implications of buildings.
CO2:	Evaluate the ideologies of implications on building technologies embodied energy of buildings.
CO3:	Evaluate the concepts of comforts in buildings.
CO4:	Understand the utility of solar energy in buildings.
CO5:	Create the basic ideas of green composites for buildings.

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	3	-	2	2	2	2	1	-	1	1	1	3	1
CO2	1	2	-	1	1	1	2	2	-	2	2	1	2	2
CO3	1	3	1	1	2	-	3	3	1	3	2	1	2	1
CO4	2	2	1	2	1	-	1	2	2	1	1	1	1	2
CO5	1	1	2	1	2	1	2	1	3	2	1	2	1	3

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Green Building, A to Z Paperback – Import, 1 October 2007 by Jerry Yudelson, New Society Publishers.
2. Building Green: A Complete How-to Guide to Alternative Building Methods Paperback – Import, 28 January 2006 by Clarke Snell, Lark Books Publications

REFERENCE BOOKS:

1. Fundamentals of Integrated Design for Sustainable Building: Principles and Practice Hardcover – Import, 5 June 2009 by Marian Keeler, Bill Burke, John Wiley & Sons publishers.
2. The HOK Guidebook to Sustainable Design Hardcover – Import, 9 December 2005 by Sandra F. Mendler, William Odell, Mary Ann Lazarus, John Wiley & Sons publishers.

WEB RESOURCES:

1. <https://archive.epa.gov/greenbuilding/web/html/>

CE606205 – ENVIRONMENTAL IMPACT ASSESSMENT FOR CONSTRUCTION ENGINEERS							
Course Category: Program Elective	Course Type: Theory		L	T	P	C	
			3	0	0	3	
COURSE OBJECTIVES:							
<ul style="list-style-type: none">To impart the knowledge and skills required for understanding the various impacts of infrastructure projects on the environment.To impart knowledge about prediction and assessment of EIA.To impart the knowledge of health and socio-economic impact assessment.To impart the knowledge and expose the students to the various methodologies available to assess.To impart the knowledge to develop the skill to prepare Environmental Impact Assessment Report.							
UNIT 1 – INTRODUCTION							9
Sustainable Development challenges and needs - Key approaches for Impact Assessment – EIA approach: historical development - Legal and Regulatory aspects in India - Types and Objectives, Components, Process of EIA.							
UNIT 2 - PREDICTION AND ASSESSMENT							9
Prediction and Assessment: tools - impact on air, water, soil & Noise - Role of Biodiversity impact Assessment - Identification, Prediction and Evaluation of Impacts on Biodiversity - Techniques of Biodiversity impact assessment - EIA Report Preparation - Environmental Management Plan: Preparation and implementation - Mitigation and Rehabilitation plans – Post Project Audit.							
UNIT 3 - HEALTH AND SOCIO-ECONOMIC IMPACT ASSESSMENT							9
Health Assessment: Impact of Environment on Health - Developing framework for Health impact analysis, tools, and techniques - Socio-Economic Impact Assessment: Overview and Scope of Social Impact Assessment - SIA model and the planning process - Land acquisition: Legal aspects, Resettlement & Rehabilitation, and Development.							
UNIT 4 - INTEGRATED ANALYSIS							9
Integrated Analysis of Environmental, Social, and Health Impacts - Challenges for Integrated Approach - Scope for Integrated approach in economic analysis - CBA, Social CBA, and Cost effectiveness Analysis - Analytic Hierarchy process-based Approach – Emerging Dimensions and Future Directions.							
UNIT 5 - IMPACT OF INFRASTRUCTURE AND ENVIRONMENTAL SERVICES							9
Case Studies: EIA for Mining, extraction of natural resources and power generation - Primary Processing and Material Production - Material Processing, Manufacturing/Fabrication - Service Sectors - Physical							

Infrastructure including Environmental Services - Building and Construction Projects - Area Development Projects and Townships - Strategic Environmental Assessment, Technological Assessment, and Risk Assessment

TOTAL: 45 PERIODS

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

CO1:	Apply the knowledge of science and engineering fundamentals to sustainable development challenges.
CO2:	Explain the identification, prediction, and evaluation of impacts that will be caused by projects or industries on biodiversity.
CO3:	Identify the legal requirements of environmental impact assessment for projects.
CO4:	Develop the ability to perform integrated analysis by considering environmental, social, and health impacts.
CO5:	Select appropriate methods for environmental impact assessment for Infrastructure and environmental service.

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	3	-	2	-	2	1	3	2	2	2	1	2
CO2	1	3	2	-	1	-	1	2	2	1	3	1	1	1
CO3	2	2	1	1	1	-	1	2	-	1	1	2	2	2
CO4	1	1	2	1	1	1	2	1	-	1	2	1	1	1
CO5	1	3	1	2	1	2	1	2	1	1	1	1	1	2

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Anjaneyulu, Yerramilli, and Valli Manickam, "Environmental impact assessment methodologies", Hyderabad: BS Publications, Third Edition 2022.
2. Lawrence, D.P., "Environmental Impact Assessment – Practical Solutions to recurrent problems", Wiley-Interscience, New Jersey, 2003.
3. Petts, J., "Handbook of Environmental Impact Assessment", Vol., I and II, Blackwell Science, London, 1999.

REFERENCE BOOKS:

1. Canter, L.W., "Environmental Impact Assessment", McGraw Hill, New York, 1996.
2. World Bank – Source Book on Environmental Impact Assessment, 2010

WEB RESOURCES:

1. https://www.researchgate.net/publication/228322154_Environmental_Impact_Assessment_of_Civil_Engineering_Infrastructure_Development_Projects

CE606206 – PROJECT FORMULATION AND APPRAISAL						
Course Category: Program Elective	Course Type: Theory		L	T	P	C
			3	0	0	3
COURSE OBJECTIVES:						
<ul style="list-style-type: none">To demonstrate proficiency in project formulation.To identifying cost components, collecting relevant data, and applying cost estimation techniques.To evaluate the feasibility, viability, and potential impacts of projects across various sectors.To negotiate financing terms and manage financial relationships.To advocate for and facilitate private sector participation in projects.						
UNIT 1 - PROJECT FORMULATION						9
Project – Concepts – Capital investments - Generation and Screening of Project Ideas - Project identification – Preliminary Analysis, Market, Technical, Financial, Economic and Ecological - Pre Feasibility Report and its Clearance, Project Estimates and Techno-Economic Feasibility Report, Detailed Project Report – Different Project Clearances required.						
UNIT 2 - PROJECT COSTING						9
Project Cash Flows – Principles – Types – New Project and Replacement Project – Biases in Cash flow Estimation – Time Value of Money – Present Value – Future Value – Single amount - Annuity – Cost of Capital – Cost of Debt, Preference, Equity – Proportions - Cost of Capital Calculation – Financial Institutions Considerations.						
UNIT 3 - PROJECT APPRAISAL						9
NPV – BCR – IRR – ARR – Urgency – Pay Back Period – Assessment of Various Methods – Indian Practice of Investment Appraisal – International Practice of Appraisal – Analysis of Risk – Different Methods – Selection of a Project and Risk Analysis in Practice.						
UNIT 4 - PROJECT FINANCING						9
Project Financing – Means of Finance – Financial Institutions – Special Schemes – Key Financial Indicators – Ratios – financial cost-benefit analysis, social-cost benefit analysis.						
UNIT 5 - PRIVATE SECTOR PARTICIPATION						9
Private sector participation in Infrastructure Development Projects - BOT, BOLT, BOOT-Technology Transfer and Foreign Collaboration - Scope of Technology Transfer.						
TOTAL: 45 PERIODS						

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

CO1:	Perform Formulations Of Projects
CO2:	Analyze Project Costing
CO3:	Evaluate Project Appraisal
CO4:	Apply Project Financing
CO5:	Perform Private Sector Participation & Implementation

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	3	2	1	2	1	1	2	1	1	1	2	1
CO2	2	1	2	1	2	1	3	-	-	-	2	2	1	2
CO3	2	2	3	2	1	2	2	-	2	1	1	1	2	2
CO4	2	1	2	-	2	1	1	-	1	2	2	-	1	1
CO5	1	2	2	-	-	2	2	2	-	1	1	-	2	1

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Barcus, S.W. and Wilkinson.J.W., Hand Book of Management Consulting Services, McGraw Hill, New York, first edition, 1995.
2. Joy P.K., Total Project Management - The Indian Context, New Delhi, Laxmi Publications Pvt. Ltd, First edition 2017.
3. Prasanna Chandra., Projects – Planning, Analysis, Selection, Implementation Review, McGraw Hill Publishing Company Ltd., New Delhi., Ninth edition, 2019.

REFERENCE BOOKS:

1. United Nations Industrial Development Organisation (UNIDO) Manual for the Preparation of Industrial Feasibility Studies, (IDBI Reproduction) Bombay, 1995.
2. Raina V.K, “Construction Management Practice – The inside Story”, Tata McGraw Hill Publishing Limited, 2005

WEB RESOURCES:

1. https://www.academia.edu/6310590/Preparation_of_project_project_Identification_and_formulation_project_appraisal_and_sources_of_Finance

CE606207 – MODERN CONSTRUCTION MATERIALS (NPTEL)						
Course Category: Program Elective	Course Type: Theory	L	T	P	C	
		3	0	0	3	
COURSE OBJECTIVES:						
<ul style="list-style-type: none">• Understanding and evaluating structural materials used in construction.• To integrate innovative and sustainable materials and finishes into architectural design and construction practices.• To design, fabricate, and test composite components and structures.• To analyze the performance, durability, and sustainability of different special concretes under various loading conditions.• To enhance performance, efficiency, and functionality in diverse engineering and manufacturing domains.						
UNIT 1 - STRUCTURAL MATERIALS						9
Wood and Wood Product - Metals - Types of Steels – Manufacturing process of steel – Advantages of new alloy steels – Properties and advantages of aluminum and its products – Types of Coatings & Coatings to reinforcement – Applications of Coatings.						
UNIT 2 - NON-STRUCTURAL MATERIALS, ASSOCESSORIES AND FINISHES						9
Introduction of Non-Structural Materials and Criteria for Selection - Types and properties of Water Proofing Materials – Types of Non-weathering Materials and its uses – Types of Polymer Floor Finishes - Paint - Tiles - Acoustic Treatment materials - Dry Walls - Anchors.						
UNIT 3 - COMPOSITES						9
Types of Plastics – Polymer - Properties & Manufacturing process – Advantages of Reinforced polymers – Types of FRP – FRP on different structural elements – Applications of FRP - Bituminous Materials - Glass - Closure - Environmental Concerns.						
UNIT 4 - SPECIAL CONCRETES						9
Concretes - Behavior of concretes – Properties and Advantages of High Strength and High Performance Concrete – Properties and Applications of Fibre Reinforced Concrete, Self- compacting concrete, Geo Polymer Concrete, Alternate Materials to concrete on high performance & high Strength concrete.						
UNIT 5 - SMART AND INTELLIGENT MATERIALS						9
Types & Differences between Smart and Intelligent Materials – Special features – Nano Concrete - Nano Technology in Construction - Case studies showing the applications of smart & Intelligent						

Materials.														
TOTAL: 45 PERIODS														
COURSE OUTCOMES: At the end of the course, the student will be able to														
CO1:	Explain the various types of special concretes													
CO2:	Select the different processing of steel and applications of coating													
CO3:	Explain the manufacturing process and applications of polymer composites													
CO4:	Identify the different flooring materials and application of façade materials													
CO5:	Apply the knowledge of smart and intelligent materials in construction field													
CO-PO MAPPING														
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	3	2	-	3	2	2	-	3	2	2	1	2
CO2	2	1	2	2	-	2	3	3	-	2	2	-	1	2
CO3	1	2	1	3	2	1	2	2	-	1	1	-	2	1
CO4	1	2	2	2	3	1	2	1	2	1	1	-	1	1
CO5	2	2	1	2	2	1	1	1	1	1	2	1	1	1
1- low, 2 - medium, 3 - high, '-' no correlation														
TEXT BOOKS:														
1. N.Subramanian ,”Building Materials Testing and Sustainability”, Oxford Higher Education, 2. Shetty M.S, Concrete Technology: Theory and Practice, S.Chand & Company Ltd., 2019														
REFERENCE BOOKS:														
1. Ganapathy, C. “Modern Construction Materials”, Eswar Press, 2015. 2. SanthakumarA.R. “Concrete Technology”, Oxford University press, New Delhi, 2006.														
WEB RESOURCES:														
1. https://www.planradar.com/gb/top-15-innovative-construction-materials/ 2. https://archive.nptel.ac.in/courses/105/106/105106053/														

CE606208 – BASIC CONSTRUCTION MATERIALS						
Course Category: Program Elective	Course Type: Theory		L	T	P	C
			3	0	0	3
COURSE OBJECTIVES:						
<ul style="list-style-type: none">• Understanding and utilizing stones, bricks, and concrete blocks in construction applications.• Understanding and utilizing lime, cement, aggregates, and mortar in construction applications.• To gain a comprehensive understanding of the properties, characteristics, and applications of concrete.• Understanding and evaluating timber and other materials used in construction applications.• Understanding and evaluating various modern materials used in construction applications.						
UNIT 1 - STONES – BRICKS – CONCRETE BLOCKS						9
Stone as building material – Criteria for selection – Tests on stones – Deterioration and Preservation of stone work – Bricks – Classification – Manufacturing of clay bricks – Tests on bricks – Compressive Strength – Water Absorption – Efflorescence – Bricks for special use – Refractory bricks – Concrete blocks – Lightweight concrete blocks.						
UNIT 2 - LIME – CEMENT – AGGREGATES – MORTAR						9
Lime – Preparation of lime mortar – Cement – Ingredients – Manufacturing process – Types and Grades – Properties of cement and Cement mortar – Hydration – Compressive strength – Tensile strength – Fineness– Soundness and consistency – Setting time – fine aggregates – river sand – crushed stone sand – properties – coarse Aggregates – Crushing strength – Impact strength – Flakiness Index – Elongation Index – Abrasion Resistance – Grading						
UNIT 3 - CONCRETE						9
Concrete – Ingredients – Manufacturing Process – Batching plants –mixing – transporting – placing – compaction of concrete –curing and finishing – Ready mix Concrete – Mix specification.						
UNIT 4 - TIMBER AND OTHER MATERIALS						9
Timber – Market forms – Industrial timber– Plywood – Veneer – Thermocol – Panels of laminates – Steel – Aluminum and Other Metallic Materials – Composition – Aluminium composite panel – Market forms – Mechanical treatment – Paints – Varnishes – Distempers – Bitumens.						
UNIT 5 - MODERN MATERIALS						9
Glass – Ceramics – Sealants for joints – Fibre glass reinforced plastic – Clay products – Refractories – Composite materials – Types – Applications of laminar composites – Fibre textiles– Geomembranes						

and Geotextiles for earth reinforcement.

TOTAL: 45 PERIODS

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

CO1:	Compare the properties of most common and advanced building materials.
CO2:	Understand the typical and potential applications of lime, cement and aggregates
CO3:	Know the production of concrete and also the method of placing and making of concrete elements
CO4:	Understand the applications of timbers and other materials
CO5:	Understand the importance of modern material for construction.

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	3	-	2	-	2	2	2	2	1	1	1	1
CO2	1	1	2	-	1	-	1	1	2	2	2	1	2	2
CO3	2	1	1	-	1	-	1	2	1	2	1	2	-	2
CO4	1	2	1	1	2	2	2	2	1	2	2	2	1	2
CO5	1	1	2	2	1	1	1	2	2	1	2	2	1	2

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Varghese.P.C, "Building Materials", PHI Learning Pvt. Ltd, New Delhi, 2015.
2. Rajput. R.K., "Engineering Materials", S. Chand and Company Ltd., 2008.

REFERENCE BOOKS:

1. Jagadish.K.S, "Alternative Building Materials Technology", New Age International, 2007.
2. Gambhir. M.L., & Neha Jamwal., "Building Materials, products, properties and systems", Tata McGraw Hill Educations Pvt. Ltd, New Delhi, 2012.

WEB RESOURCES:

1. <https://www.classcentral.com/course/youtube-civil-building-materials-and-construction-47666>

CE606209 – DEVELOPMENT AND APPLICATION OF SPECIAL CONCRETE (NPTEL)						
Course Category: Program Elective	Course Type: Theory	L	T	P	C	
		3	0	0	3	
COURSE OBJECTIVES:						
<ul style="list-style-type: none">To know the proper mixing proportion of normal concrete.To know the curing methods of normal and special concrete.To know the uses and application of specific concrete.To know the uses and application of fibre reinforced concrete.To know the proper mixing proportion of special concrete.						
UNIT 1 - NORMAL CONCRETE						9
Concrete as composite materials- Basic properties over fresh concrete- Basic properties over hardened concrete – fundamentals of proportioning concrete mixes – analysis and adjustments – pores and porosity in concrete- admixtures in concrete.						
UNIT 2 - CONCRETE CURING METHODS						9
Curing of concrete – cold weather concreting- hot weather concreting – importance of right methods and specifications-heat of hydration of cement and thermal stresses- antiwashout underwater concrete- concreting underwater-roller compacted concrete.						
UNIT 3 - SELF COMPACTING CONCRETE						9
Introduction to concrete – its proportion- mixing – strength and properties - uses – applications						
UNIT 4 - FIBRE – REINFORCED CONCRETE						9
Introduction to fibre reinforced concrete– its proportion- mixture strength and properties – uses – applications						
UNIT 5 - SPECIAL CONCRETE						9
Shotcrete- High Strength Concrete – using polymers in concrete – improving the quality of cover concrete – compaction of concrete – precast concrete						
TOTAL: 45 PERIODS						

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

CO1:	Evaluate the normal concrete uses and its methodologies.
CO2:	Create the concepts of concrete curing methods.
CO3:	Understand the concepts of self compacting concrete its proportions, uses and applications.
CO4:	Understand the concepts of fibre reinforced concrete its proportions, uses and applications.
CO5:	Understand the concepts of special concrete its proportions, uses and applications.

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	2	2	1	-	2	1	-	2	-	1	2	2
CO2	2	3	3	1	2	-	1	2	-	1	-	2	3	3
CO3	1	1	2	1	1	-	1	1	-	1	2	1	2	1
CO4	1	2	1	1	1	1	-	1	1	1	1	2	2	2
CO5	1	1	1	1	-	2	-	-	2	-	1	2	2	1

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Mehta, P.K., and Monteiro P.J.M., Concrete – Microstructure, Properties and Materials, 3rd Edition, McGraw Hill Education (India) Private Limited, New Delhi, Prentice-Hall, Inc., 2006
2. Neville, A.M., Properties of concrete, 5th Edition, Pitman Publishers, New Delhi, India 1996.
3. Shetty, M.S., Concrete Technology (Theory and Practice), 7th Edition, S. Chand & Company Ltd., New Delhi, 2013.

REFERENCE BOOKS:

1. Sidney, M., Young, J.F., and Darwin, D., Concrete, 2nd Edition, Prentice-Hall, Pearson Education, Inc., New Jersey, 2003.
2. Kosmatka, S.H., Kerkhoff, B., and Panarese, W.C., Design and Control of Concrete Mixtures, 14th Edition, Portland Cement Association, Skokie, Illinois, USA, 2003.

WEB RESOURCES:

1. <https://archive.nptel.ac.in/courses/105/104/105104206/>

CE606210 – INTRODUCTION TO LEAN CONSTRUCTION (NPTEL)						
Course Category: Program Elective	Course Type: Theory		L	T	P	C
			3	0	0	3
COURSE OBJECTIVES:						
<ul style="list-style-type: none">To impart knowledge about the basics of lean construction.To impart knowledge about the lean principles.To impart knowledge about the core concepts of lean construction.To impart knowledge about the lean tools and techniques.To impart knowledge about the basics of lean implementation in the construction industry.						
UNIT 1 - INTRODUCTION						9
Introduction and overview of the construction project management -Review of Project Management & Productivity Measurement Systems – Productivity in Construction– Daily Progress Report-The state of the industry for its management practices –construction project phases - Essential features of contemporary construction management techniques - The problems with current construction management techniques– Current production planning.						
UNIT 2 - LEAN MANAGEMENT						9
Introduction to lean management – Toyota's management principle-Evolution of lean in the construction industry - Production theories in construction –Lean construction value - Value in construction - Target value design – Lean project delivery system- Forms of waste in the construction industry – Waste Elimination.						
UNIT 3 - CORE CONCEPTS IN LEAN						9
Concepts in lean thinking – Principles of lean construction – Variability and its impact – Traditional construction and lean construction – Traditional project delivery - Lean construction and workflow reliability – Work structuring – Production control.						
UNIT 4 - LEAN CONSTRUCTION TOOLS AND TECHNIQUES						9
Value Stream Mapping – Work sampling – Last planner system – Flow and pull-based production – Last Planner System – Look ahead schedule – constraint analysis – weekly planning meeting- Daily Huddles – Root cause analysis – Continuous improvement – Just in time.						
UNIT 5 - LEAN CONSTRUCTION IMPLEMENTATION						9
Lean construction implementation- Enabling lean through information technology – Lean in design - Design Structure Matrix Location Based Management System-BIM (Building Information Modelling) - IPD (Integrated Project Delivery) – Sustainability through lean construction approach						

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

CO1:	Explain the contemporary management techniques and the issues in the present scenario.
CO2:	Apply the basics of lean management principles and their evolution from the manufacturing industry to the construction industry.
CO3:	Develops a better understanding of core concepts of lean construction tools and techniques and their importance in achieving better productivity.
CO4:	Apply lean techniques to achieve sustainability in construction projects.
CO5:	Apply lean construction techniques in design and modeling.

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	2	3	3	2	3	-	2	2	-	2	3	1
CO2	1	2	1	2	2	1	-	-	1	1	-	1	2	2
CO3	2	1	1	1	1	2	-	-	2	2	-	2	2	3
CO4	3	1	1	1	1	2	1	2	-	-	2	2	1	2
CO5	2	2	2	2	2	1	2	1	-	-	1	1	1	1

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Corfe, C. and Clip, B., Implementing lean in construction: Lean and the sustainability agenda, CIRIA, 2013.
2. Shang Gao and Sui Pheng Low, Lean Construction Management: The Toyota Way, Springer, 2014.
3. Dave, B., Koskela, L., Kiviniemi, A., Owen, R., and Tzortzopoulos, P., Implementing lean in Construction: Lean construction and BIM, CIRIA, 2013.

REFERENCE BOOKS:

1. Ballard, G., Tommelein, I., Koskela, L. and Howell, G., Lean construction tools and techniques, 2002.
2. Salem, O., Solomon, J., Genaidy, A. and Luegring, M., Site Implementation and Assessment

WEB RESOURCES:

1. <https://archive.nptel.ac.in/courses/105/106/105106213/>

VERTICALS 3

CE606301 –WATER RESOURCES ENGINEERING						
Course Category: Program Elective	Course Type: Theory		L	T	P	C
			3	0	0	3
COURSE OBJECTIVES:						
<ul style="list-style-type: none">To impart knowledge on Hydrological cycle and rainfall measurement methodsTo familiarize the students about the runoff and hydrograph analysisTo acquaint about the methods of irrigation and crop requirement details.To illustrate the river training worksTo outline drought management and water resources management.						
UNIT 1 - INTRODUCTION						9
Hydrological Parameters: Hydrological cycle, Water balance concept, Climate and availability of water, types and forms of precipitation, Variability in rainfall, Measurement & Data analysis of precipitation, Evaporation and its measurement, Transpiration and its measurement, Measurement of Evapotranspiration, Potential and actual evapotranspiration, Penman Monteith method. Infiltration indices, Factors affecting infiltration, Horton’s equation and Green Ampt method.						
UNIT 2 - SURFACE RUNOFF						9
Runoff: Drainage basin and watershed characteristics, Types of runoff, Surface, subsurface flow, base flow. Hydrographic Analysis: Mass curve, Hyetograph, Hydrograph with types, assumptions, rationale and limitations of unit hydrograph, Derivation of unit hydrograph and its conversions, S-hydrograph and its uses, Snyder’s Hydrograph, Flow duration curve and its uses						
UNIT 3 - IRRIGATION						9
Developments in India, Necessity & types advantages and disadvantages of irrigation, Function of water in plant growth, Methods of irrigation, Water requirement of crops, Irrigation frequency, Irrigation efficiencies, Principal crops & crop season, Crop rotation						
UNIT 4 - REGULATION AND CONTROL OF CANAL SYSTEM						9
Purpose, types of canal regulation works and their functional aspects, River training: Objective & need, Classification of rivers training works, Meandering, Methods of river training, River bank protection Earth Dam: Classification, Causes of failure, Introduction to stability analysis. Gravity Dam: Forces, Methods of analysis, Modes of failure and factor of safety stability analysis, Galleries.						
UNIT 5 - DROUGHT MANAGEMENT AND WATER HARVESTING						9
Definition of drought, Causes and types of drought, measures for water conservation and augmentation, drought contingency planning and execution. Water harvesting: rainwater collection,						

small dams, runoff enhancement, runoff collection, ponds, tanks, rooftop model of rainwater harvesting.

TOTAL: 45 PERIODS

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

CO1:	Remember the basic concepts of rainfall occurrence and its data interpretation
CO2:	Construct unit hydrograph and S-hydrograph, and compute peak flood flow and design
CO3:	flood for hydraulic structures
CO4:	The basic requirements of irrigation and various irrigation techniques, requirements of the crops
CO5:	Examine the various types of forces, suitable location and design of weirs, impounding

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2	1	-	1	1	-	1	2	1	2	3	2
CO2	3	2	3	2	-	1	1	-	2	1	1	2	2	3
CO3	1	2	3	2	-	1	2	-	1	1	3	2	2	2
CO4	2	2	3	-	-	3	1	-	1	1	2	2	1	1
CO5	3	3	3	-	-	1	3	1	2	1	2	2	1	1

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. P.N. Modi, Irrigation Water Resources and Water Power Engineering Standard BookHouse, New Delhi, 1990.
2. Asawa, G.L. "Irrigation and Water Resources Engg.", New Age International.

REFERENCE BOOKS:

1. LINSLEY, R.K. WATER RESOURCES ENGG., MC GRAW HILL
2. LARRY W, WATER RESOURCES ENGG., JOHN WILEY

WEB RESOURCES:

1. <http://nptel.ac.in/courses/105104103/>
2. <http://nptel.ac.in/courses/105105110/>
3. <https://nptel.ac.in/courses/105104029>

CE606302 – INDUSTRIAL WASTE MANAGEMENT						
Course Category: Program Elective	Course Type: Theory		L	T	P	C
			3	0	0	3
COURSE OBJECTIVES:						
<ul style="list-style-type: none">To acquire theoretical knowledge of industrial processes, operations, manufacturing.To illustrate waste characterization studyTo classify industrial wasteTo outline pollution prevention methodsTo summarize solid waste treatment methods						
UNIT 1 – INTRODUCTION						9
Properties of Water, Polar & Non-polar Solvents, True Solutions, Emulsification, Colloidal Suspensions, and Mixtures made stable by Chelating Agents. Management of Industrial Wastes: Solid, Liquid and Gaseous waste, Management of Industrial Wastewater, Management of Solid Wastes from Industries, and Management of Discharges to the Air.						
UNIT 2 - WASTE CHARACTERIZATION						9
Waste Characterization Study, Wastes Audit, Characteristics of Industrial Wastewater, Characteristics of Discharges to the Air, Characteristics of Solid Waste Streams from Industries.						
UNIT 3 - POLLUTION FROM MAJOR INDUSTRIES						9
Textile Wastes; Dairy wastes; Slaughterhouse, Poultry and fish processing waste; Tannery Wastes; Sugar Mill Wastes; Pulp and Paper Mill Waste; Fermentation Industry Waste; Engineering Industry Waste; Petroleum and Petrochemical wastes; Fertilizer and Pesticides Industry waste; Wastes from vegetable, food and allied industries, Rubber Waste						
UNIT 4 - POLLUTION PREVENTION & METHODS						9
Pollution Prevention: General Approach, Source Reduction, Waste minimization, strength and volume reduction, segregation, reuse, recycle, material conservation, recovery, Benefits of Pollution Prevention.						
Methods for Treating Wastewaters from Industry: Wastewater Treatment Mechanisms, Waste Equalization, pH Control, Chemical Methods of Wastewater Treatment, Biological Methods of Wastewater Treatment, Physical Methods of Wastewater Treatment						
UNIT 5 - TREATMENT AND DISPOSAL OF SOLID WASTES FROM INDUSTRY						9
Landfilling, Incineration, Composting Industrial Wastes, Solidification and Stabilization of Industrial Solid Wastes. Methods for Treating Air Discharges from Industry: Reduction at Source, Containment,						

Treatment.														
TOTAL: 45 PERIODS														
COURSE OUTCOMES: At the end of the course, the student will be able to														
CO1:	Introduction to types of industrial waste, characterization and management.													
CO2:	Identify the the characteristics of various industrial wastes													
CO3:	Study of manufacturing processes and wastes generated in various industries. to plan minimization of industrial wastes													
CO4:	Design facilities for the processing and reclamation of industrial waste water													
CO5:	Discovering the sources, characteristics and Treatment and Disposal of Solid Wastes.													
CO-PO MAPPING														
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	2	1	-	2	1	2	1	2	2
CO2	3	2	-	-	-	2	1	-	2	-	2	2	1	2
CO3	3	3	-	-	-	1	1	-	2	-	-	2	2	2
CO4	3	3	-	-	-	2	1	-	3	1	2	2	2	2
CO5	3	2	-	-	-	2	1	-	2	1	2	2	2	2
1- low, 2 - medium, 3 - high, '-' no correlation														
TEXT BOOKS:														
1. Eckenfelder W.W. Jr., “Industrial Water Pollution Control”, McGraw Hill Book Company, NewDelhi, 2000.Handbook on Functional Requirements of Buildings Part 1 to 4 SP : 41 (S and T) 1995														
2. Patwardhan.A.D., “Industrial Wastewater Treatment”, Prentice Hall of India, New Delhi 2010														
REFERENCE BOOKS:														
1. Nemerow NL () Industrial Waste Treatment: Contemporary Practice and Vision for the Future, Butterworth-Heinemann														
2. Frank Woodard (2001) Industrial Waste Treatment Handbook, Butterworth–Heinemann, ISBN 0-7506-7317-6														
3. WEF Manual of Practice No. FD-3, Industrial Wastewater Management, Treatment,And Disposal, Water Environment Federation, Third Edition, McGraw Hill														
WEB RESOURCES:														
1. https://nptel.ac.in/courses/105105048														
2. https://nptel.ac.in/courses/105105160														

CE606303 - ENVIRONMENTAL MONITORING INSTRUMENTS						
Course Category: Program Elective	Course Type: Theory	L	T	P	C	
		3	0	0	3	
COURSE OBJECTIVES:						
<ul style="list-style-type: none">To introduce the principles and application of different instruments.To gain knowledge of various types of machinery and equipment used in environmental control.Learn about various air pollution control technologies and strategies.Learn about various water pollution control technologies and strategies.To evaluate the effectiveness of pollution control measures in achieving environmental sustainability and social equity.						
UNIT 1 – INTRODUCTION						9
Necessity of Instrumentation & Control for environment, sensor requirement for environment- Study of machinery, electric motors types and characteristics, other prime covers, pumps, capacity, operation and maintenance of pumping machinery, air compressors preventive maintenance, break down maintenance, schedules – Factors to be considered in the selection of the equipment.						
UNIT 2 - INSTRUMENTATION						9
pH meter – Flame Emission Spectrometry. Absorption spectrometry – Nephelometry – Atomic Absorption Spectrometry – Gas chromatography – working principle and components. Total carbon analyzer – Mercury Analyzer polar graph for metal estimation and organic compounds – Ion selective Electrode -SO2 and CO analyser – Instrument components and its working principle						
UNIT 3 - AIR POLLUTION						9
Impact of man of the environment: An overview, Air pollution sources and effects, Metrological aspect of air pollutant dispersion, Air pollution sampling and measurement, Air pollution control methods and equipment, Air sampling techniques, soil pollution and its effects, Gas analyzer, Gas chromatography, Control of specific gaseous pollutants, Measurement of automobile pollution, Smoke level meter, CO/HC						
UNIT 4 - WATER POLLUTION						9
Sources And classification of water pollution, Waste water sampling and analysis, marine pollution, Waste water sampling techniques and analyzers, Gravimetric, Volumetric, Calometric, Potentiometer, Flame photometry, Atomic absorption spectroscopy, Ion chromatography, Instruments used in waste water treatment and control, Solid waste management techniques.						

UNIT 5 – POLLUTION MANAGEMENT													9	
Management of radioactive pollutants, Noise level measurement techniques, Instrumentation for environmental pollution, Monitoring and audit, Instrumentation setup for pollution abatement. Noise pollution and its effects, social and political involvement in the pollution management system														
TOTAL: 45 PERIODS														
COURSE OUTCOMES: At the end of the course, the student will be able to														
CO1:	Understand the various instruments and equipment used in measurement													
CO2:	Describe the operation of a range of sensors and transducers with particular reference to monitoring of water and air quality													
CO3:	Perform air pollution sampling and measurement, air pollution control methods and equipment, air sampling techniques													
CO4:	Justify the use of an analytical instrument in monitoring and maintaining the quality of water and air for solving real world environmental problem.													
CO5:	Summarize the pollution management system													
CO-PO MAPPING														
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2	-	-	2	2	-	1	2	1	2	3	2
CO2	3	2	3	-	-	2	2	-	2	1	1	2	2	3
CO3	1	2	3	-	-	1	2	-	1	1	3	2	2	2
CO4	2	2	3	-	-	3	1	-	1	1	2	2	1	1
CO5	3	3	3	-	-	1	3	-	2	1	2	2	1	1
1- low, 2 - medium, 3 - high, '-' no correlation														
TEXT BOOKS:														
1. Instrumental Methods of Analysis by Willard, Merritt, Dean and Settle, 7th Edition, CBS Publishers and Distributors, India, 1988.														
2. Bhatia, H.S., A Text Book in Environmental Pollution and control, Galgotia Publication (1998).														
3. Trivedy R. K. & Goel P.K., Chemical and Biological methods for water pollution studies, Environmental publication, Karat, 1986.														
4. Cox C.R., Operation and Control of Water Treatment Processes, World Health Organisation, Geneva, 1964.														

REFERENCE BOOKS:
<ol style="list-style-type: none">1. Dhameja, S.K., Environmental Engineering and Management, S.K Kataria (2000).2. Rao, M.N. and Rao, H.V., Air Pollution, Tata McGraw Hill (2004).3. Rao. C.S., Environmental Pollution Control, New Age International (P) Limited,Publishers (2006) 2nd ed.
WEB RESOURCES:
<ol style="list-style-type: none">1. http://nptel.ac.in/video.php2. http://www.nptel.ac.in/courses/105102089/9

CE606304 - AIR POLLUTION & CONTROL						
Course Category: Program Elective	Course Type: Theory		L	T	P	C
			3	0	0	3
COURSE OBJECTIVES:						
<ul style="list-style-type: none">• Introduction to Air Pollution and its effects, Sampling and measurement.• Study the Property of Atmosphere, Metrological Variables and plume behaviour.• To develop an understanding of the pollution control methods of particulate matter.• Gaseous pollution control methods and Automobile pollutions.• To give the concept Air population legislation in India and current topics.						
UNIT 1 – SOURCES AND CLASSIFICATION						9
Sources and classification of Air Pollution Effects of Air Pollution on Human health, plants, Animals and Property. Sampling and measurement in ambient, Work Place and stack.						
UNIT 2 - METEOROLOGY						9
Meteorology- Concept of Atmosphere, wind movements, Windrose Diagram and Measurement of Meteorological Variables. Atmospheric lapse rates, Adiabatic lapse rate and their consequences, Plume behavior. Plume rise-equation, estimation of stack height.						
UNIT 3 - POLLUTION CONTROL METHOD						9
Pollution control Method of a Particulate matter: Types of Particulate control methods - Settling chambers, cyclone separators, scrubbers, filters and Electrostatic precipitators- Mechanism, Their design and application.						
UNIT 4 - GASEOUS POLLUTION CONTROL METHOD						9
Gaseous Pollution control method and Automobile Pollution: Types of gaseous Pollution Control method- absorption, adsorption and combustion process. Automobile pollution- Sources of pollution, composition of auto exhaust & control method.						
UNIT 5 - AIR POLLUTION LEGISLATION AND GLOBAL PROBLEM						9
Air Pollution Legislation and Global Problem: Air Quality Standard, Ambient Air Quality Standard and Emission standard. Air Pollution, legislation and regulation in India. Air Pollution Indices. Global problem of air pollution and its remedial measure. Air Pollution from major Industrial Operations- Case study						
TOTAL: 45 PERIODS						

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

CO1:	Learned about Air Pollution, its effects and measurement.
CO2:	Understanding of the Metrological concept and Plume behaviour
CO3:	Understanding of control of particulate Matter by Different Methods.
CO4:	Learned about Control of Gaseous Pollutants and automobile Pollution.
CO5:	Awareness of Air Pollution Legislation in India and current topic

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	-	-	-	1	2	-	1	1	1	2	1	2
CO2	3	2	-	-	-	2	2	-	1	-	2	2	2	2
CO3	3	2	-	-	-	2	2	-	2	-	2	2	2	2
CO4	3	2	-	-	-	2	2	-	1	-	2	2	2	2
CO5	3	2	-	-	-	2	2	2	1	1	2	2	1	2

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Air Pollution M.N. RAO and H.V. RAO, M C Graw Hill Education.
2. Introduction to Environmental Engineering and Science: - G. M. Masters
3. Environmental Pollution and Control – C.S. Rao

REFERENCE BOOKS:

1. Cooper, C.D., Alley, F.C. Air pollution control: A design approach, 2. bask1, Waveland Press, Inc., ABD.
2. Theodore, L. Air pollution control equipment calculations, John Wiley & Sons, Inc., ABD.
3. Spellman, F. R., Whiting, N. E., (2004). Environmental engineer's mathematics handbook by crc press.

WEB RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc23_ce14/preview
2. <https://archive.nptel.ac.in/courses/105/104/105104099/>

CE606305 - ENVIRONMENTAL IMPACT ASSESSMENT							
Course Category: Program Elective	Course Type: Theory		L	T	P	C	
			3	0	0	3	
COURSE OBJECTIVES:							
<ul style="list-style-type: none">To expose the students to the need, methodology, documentation and usefulness of environmental impact assessment.To minimize adverse effects and promote environmental sustainability.To develop the skill to prepare environmental management plan.To provide knowledge related to the broad field of environmental risk assessment.To predict and manage the human health risks.							
UNIT 1 – INTRODUCTION							8
Historical development of Environmental Impact Assessment (EIA). EIA in Project Cycle. Legal and Regulatory aspects in India. – Types and limitations of EIA –.EIA process- screening – scoping - setting – analysis – mitigation. Cross sectoral issues and terms of reference in EIA – Public Participation in EIA EIA Consultant Accreditation.							
UNIT 2 - IMPACT IDENTIFICATION AND PREDICTION							10
Matrices – Networks – Checklists –Cost benefit analysis – Analysis of alternatives – Software packages for EIA – Expert systems in EIA. Prediction tools for EIA – Mathematical modeling for impact prediction – Assessment of impacts – air – water – soil – noise – biological - Cumulative Impact Assessment							
UNIT 3 - SOCIAL IMPACT ASSESSMENT AND EIA DOCUMENTATION							8
Social impact assessment - Relationship between social impacts and change in community and institutional arrangements. Individual and family level impacts. Communities in transition Documentation of EIA findings – planning – organization of information and visual display materials.							
UNIT 4 - ENVIRONMENTAL MANAGEMENT PLAN							7
EIA Report preparation. Environmental Management Plan - preparation, implementation and review – Mitigation and Rehabilitation Plans – Policy and guidelines for planning and monitoring programmes – Post project audit – Ethical and Quality aspects of Environmental Impact Assessment- Case Studies							
UNIT 5 - ENVIRONMENTAL RISK ASSESSMENT AND MANAGEMENT							12
Environmental risk assessment framework-Hazard identification -Dose Response Evaluation – Exposure Assessment – Exposure Factors, Tools for Environmental Risk Assessment– HAZOP and FEMA methods – Event tree and fault tree analysis – Multimedia and multipath way exposure modeling of							

contaminant- Risk Characterization Risk communication - Emergency Preparedness Plans –Design of risk management programs

TOTAL: 45 PERIODS

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

CO1:	Identify and analyse the international sustainable development initiatives and reports
CO2:	Understand the features Impact Identification and Prediction
CO3:	Understand the process of Social impact assessment and EIA documentation
CO4:	Analyse and document environmental projects and prepare management plan
CO5:	Know about the legal requirements of Environmental and Risk Assessment for projects

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	-	-	-	2	3	-	1	1	2	2	1	2
CO2	2	3	-	-	-	1	3	-	1	1	2	2	2	2
CO3	2	3	-	-	-	2	3	-	2	2	2	2	2	2
CO4	2	3	-	-	-	2	3	2	2	1	2	2	2	2
CO5	2	3	-	-	-	1	3	2	2	1	2	2	2	2

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Anjaneyulu. Y and Manickam. V., Environmental Impact Assessment Methodologies, B.S. Publications, Hyderabad, 2007
2. Barthwal, R. R., Environmental Impact Assessment, New Age International Publishers, 2002
3. Environmental Impact Assessment: Larry Canter. McGraw Hill Publication.

REFERENCE BOOKS:

1. Disaster Management- Edited by R. B. Singh. Rawat Publications. India.
2. Environmental Impact Assessment- A. K. Shrivastava. APH Pub. India.
3. ISBN: 9780128111390, Butterworth-Heinemann.
4. Environmental Audit: A.K.Shrivastava. APH pub Corp. New Delhi.
5. ISO 14000: Environmental Management 1st Edition, David L. Goetsch , Stanley
6. Davis. ISBN-13: 978-0130812360. Jenson Books In

WEB RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc22_ar07/preview
2. https://onlinecourses.nptel.ac.in/noc22_ag10/preview

CE606306 - ENVIRONMENTAL POLICY AND LEGISLATIONS						
Course Category: Program Elective	Course Type: Theory		L	T	P	C
			3	0	0	3
COURSE OBJECTIVES:						
<ul style="list-style-type: none">• Introduction to environmental policies, evolution of environmental legislation in India, environmental standards etc.• To assess the effectiveness of regulatory interventions in reducing pollution levels, improving environmental quality, and safeguarding public health and the ecosystem.• Learn about international standards and best practices in environmental regulation and how they influence domestic standards.• To prevent or minimize exposures and environmental contamination.• Contribute to sustainable development efforts in accordance with the latest rules and notifications.						
UNIT 1 - INTRODUCTION						8
Environmental Policies; National and International trends, Changes in global perspective, International treaties. National Policies: National Environmental Policy, National Forest Policy, National Water Policy, Rehabilitation and Resettlement Policy, CSR policy						
UNIT 2 - WATER & AIR (PREVENTION AND CONTROL OF POLLUTION) ACT						10
Water (Prevention and control of pollution) act 1974 as amended upto 1988, Water (Prevention and control of pollution) rules 1975 , Water (Prevention and control of pollution) (Procedures for Transaction of Business) rules 1975., Water (Prevention and control of pollution) cess Act, 1977 as amended by amendment act, 1991, Water (Prevention and control of pollution) cess rules, 1978 Air (PrevenEvolution of environmental legislation in India, Legal provisions for environmental protection; various Acts, Rules and Regulations. Notifications issued under various Acts and Rulestion and control of pollution) act, 1981 as amended by amendment act, 1987, Air (Prevention and control of Pollution) rules, 1982.						
UNIT 3 - ENVIRONMENTAL STANDARDS; CRITERIA FOR STANDARDS SETTING						9
Environment (Protection) act, 1986, Environment (Protection) rules, 1986, Hazardous wastes (Management and Handling) rules, 1989, Basel convention, Manufacture, storage and import of hazardous chemical rules, 1989. Scheme of labeling of environment friendly products (ECO – Marks).						
UNIT 4 - HAZARDOUS SUBSTANCES AND ACTIVITIES						8

Legal framework: EPA and rules made thereunder; Public liability insurance act, 1991, Public Liability insurance rules, 1991, Municipal solid waste act/ rule 2000, Biomedical waste act/ rule-2004.														
UNIT 5 - RECENT RULES AND NOTIFICATIONS														9
National Green tribunals – recent environmental rules and notifications - e-waste Management construction and demolition waste management, etc.														
TOTAL: 45 PERIODS														
COURSE OUTCOMES: At the end of the course, the student will be able to														
CO1:	Fundamental knowledge of environmental policy and legislation.													
CO2:	Knowledge of legal aspects relating to water and air act													
CO3:	Learn decision-making process for the development of environmental standards													
CO4:	Aim and objectives of the Public Liability Insurance Act providing immediate relief to the persons affected by accident occurring													
CO5:	An insight into the Environmental Protection Act and the associated Rules knowledge on the Institutional setup for Environmental management and pollution control.													
CO-PO MAPPING														
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	1	3	2	1	1	2	2	1
CO2	2	2	-	-	-	-	1	3	2	-	1	3	2	1
CO3	2	2	-	-	-	-	1	3	2	-	1	3	2	1
CO4	2	2	-	-	-	-	1	2	2	-	1	2	2	2
CO5	2	2	-	-	-	-	1	2	2	-	1	2	2	2
1- low, 2 - medium, 3 - high, '-' no correlation														
TEXT BOOKS:														
1. Environmental legislation in india, ulla roiha, finpro, region asia														
2. Environmental Law of India, S.K. Choudhuri, Oxford & IBH Publishers														
REFERENCE BOOKS:														
1. Pollution control acts, rules and notifications issued thereunder, CPCB-India														
2. Handbook of Environmental laws, Acts, Guidelines, Compliances & Standards Policy,Trivedy, BS Publishers														
3. Pollution Control Acts, rules and notifications issued by CPCB [Ministry of and Environment and forest, Goverment of India], Paryavaran Bhawan, CGO Complex, New Delhi-110003.														
WEB RESOURCES:														
1. https://nptel.ac.in/courses/129106002														
2. https://onlinecourses.swayam2.ac.in/cec20_ge12/preview														

CE606307 - GROUND WATER HYDROLOGY AND MANAGEMENT (NPTEL)						
Course Category: Program Elective	Course Type: Theory		L	T	P	C
			3	0	0	3
COURSE OBJECTIVES:						
<ul style="list-style-type: none">To equip the students with capabilities required to explain groundwater occurrences, aquifer classification and aquifer properties in the many different geological environments.Carrying out comprehensive hydrological flow systems analyses in groundwater systems. Performing detailed groundwater balances, interpreting and working with the concepts of groundwater recharge, storage, and discharge.Knowledge of the steady-state and transient groundwater flow processes and their physical descriptionApplication of analytical solutions to solve the groundwater management problemsTo demonstrate and derive the basic equations used in Groundwater development and management and the corresponding equations						
UNIT 1 - INTRODUCTION						9
Ground water hydrologic cycle, origin of ground water, rock properties effecting ground water, Vertical distribution of ground water, zone of aeration and zone of saturation, geologic formation as aquifers, types of aquifers, porosity, specific yield and specific retention. Ground Water Movement- Permeability, Darcy’s law, storage coefficient, Transmissivity, Differential equation governing ground water flow in three dimensions derivation, ground water flow equation in polar coordinate system, ground water flow contours and their applications.						
UNIT 2 - ANALYSIS OF PUMPING TEST DATA-I						9
Steady flow ground water flow towards a well in confined and unconfined aquifers-Dupit’s and Theism’s equations, assumptions, formation constants, yield of an open well interface and well tests.						
UNIT 3 - ANALYSIS OF PUMPING TEST DATA-II						9
Unsteady flow towards well-non-equilibrium equations, thesis solution, jacob and chow’s simplifications, leak aquifers						
UNIT 4 - SURFACE AND SUB-SURFACE INVESTIGATION						9
surface methods of exploration-Electrical resistivity method and Seismic refraction methods. Subsurface methods geophysical logging and resistivity logging. Concept of artificial recharge of ground water, recharge methods, Applications of GIS and RS in artificial recharge of ground water along with case studies.						

UNIT 5 - GROUND WATER HYDROLOGY & MANAGEMENT													9	
Saline water intrusion in aquifer Occurrence of saline water intrusion, Ghyben-Herzberg relation, Shape of interface, control of water intrusion. Ground water basin management- Case studies of Groundwater in India Management of Groundwater: concepts of basin management, conjunctive use, mathematical modelling, artificial groundwater recharge: concepts, recharge methods, recharge mounds, induced recharge. Saline water intrusion in aquifers														
TOTAL: 45 PERIODS														
COURSE OUTCOMES: At the end of the course, the student will be able to														
CO1:	Understand aquifer properties and its dynamics groundwater occurrences, aquifer classification													
CO2:	Identify different fundamental equations and concepts as applied in the Groundwater studies													
CO3:	Discuss and derive differential equation governing groundwater flow in three dimensions													
CO4:	To solve groundwater mathematical equations and analyze pumping tests in steady and non-steady flow cases													
CO5:	Distinguish and understand the saline water intrusion problem in costal aquifers													
CO-PO MAPPING														
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2	2	3	1	1	-	1	2	1	2	3	2
CO2	3	2	3	2	3	1	1	-	2	1	1	2	2	3
CO3	1	2	3	3	2	1	2	-	1	1	3	2	2	2
CO4	2	2	3	-	2	3	1	-	1	1	2	2	1	1
CO5	3	3	3	2	2	1	3	-	2	1	2	2	1	1
1- low, 2 - medium, 3 - high, '-' no correlation														
TEXT BOOKS:														
1. Todd D.K., Mays L.W. , Groundwater Hydrology, Wiley, (2004).														
2. Raghunath H.M., Ground Water , New Age International Publishers, (2007)														
REFERENCE BOOKS:														
1. Schwarz F., Zhang H., Fundamentals of Ground Water, Wiley, (2002).														
2. Fitts C., Groundwater Science, Academic Press, (2012).														
3. Bear J., Hydraulics of Groundwater, Dover Publications, (2007)														
WEB RESOURCES:														
1. https://archive.nptel.ac.in/courses/105/101/105101214/														
2. https://www.digimat.in/nptel/courses/video/105105042/L01.html														

CE606308- SURFACE WATER HYDROLOGY						
Course Category: Program Elective	Course Type: Theory		L	T	P	C
			3	0	0	3
COURSE OBJECTIVES:						
<ul style="list-style-type: none">To understand the relevance of various components of hydrologic cycles.To assess the variability and trends in precipitation patterns over time and space.To analyze and interpret environmental data, make informed decisions, and develop innovative solutions to environmental problems.Importance of streamflow measurement in various applications.To design and implement water conservation strategies.						
UNIT 1 - HYDROMETEOROLOGY						9
Hydrologic cycle – Global water budget – Practical applications – Hydrometeorology – Constituents of atmosphere – Vertical structure of the atmosphere – general circulation – Transitory system – Air mass – Air front – cyclones – Formation of precipitation – Types and forms of precipitation – Climate and Weather – Meteorological Observations.						
UNIT 2 - PRECIPITATION						9
Measurement of rainfall – Rain gauges – Radar Measurement of rainfall - Rainfall Hyetograph – Intensity Duration and Frequency analysis – Consistency – Missing data – Rain gauge network – Average depth of rainfall analysis – Spatial analysis using GIS – Annual rainfall of India and Tamilnadu						
UNIT 3 - ABSTRACTIONS						9
Water losses - Initial losses – Interception and depression storage – Evaporation – Evaporimeters – Estimation of Evaporation - Evapotranspiration – Field Measurement – Empirical Equations - Infiltration – Infiltrimeters – Infiltration Equations - Infiltrate						
UNIT 4 - STREAMFLOW MEASUREMENT						9
Stage and Velocity Measurement – Gauges – Current meter and Doppler flow velocity meter - Discharge measurement – Area Velocity method - Area Slope method – Discharge Measuring Structures - Dilution Technique – Stage Discharge relationship – Selection of a Stream Gauging Site.						
UNIT 5 - RUNOFF AND WATER CONSERVATION						9
Concept of catchment – Linear, Areal and Relief Aspects – Detailed study of Runoff process – Factors affecting Runoff – Hydrograph – Unit Hydrograph – Synthetic Hydrograph –Runoff estimation - Strange and SCS methods – Water Conservation – Rain water and Runoff Harvesting in Rural and						

Urban Areas - Reservoir Sedimentation														
TOTAL: 45 PERIODS														
COURSE OUTCOMES: At the end of the course, the student will be able to														
CO1:	Knowledge on hydrologic cycle, hydrometeorology and formation of precipitation													
CO2:	Apply the various methods of field measurements and empirical formulas for estimating the various losses of precipitation, stream flow and runoff													
CO3:	Describe the various process, measurement and estimation of hydrological components: evaporation, infiltration, stream flow etc.													
CO4:	Apply hydrological models to real-world problems													
CO5:	Know the various methods of rainwater and runoff harvesting. Then apply the knowledge of soil erosion and sedimentation to estimate the life of the reservoir													
CO-PO MAPPING														
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	-	-	-	1	1	-	-	1	-	2	3	2
CO2	3	2	-	-	-	1	1	-	-	1	-	2	2	3
CO3	1	2	2	-	-	1	2	-	-	1	-	2	2	2
CO4	2	2	2	-	-	3	1	-	-	1	-	2	1	1
CO5	3	3	-	-	-	1	3	-	-	1	-	2	1	1
1- low, 2 - medium, 3 - high, '-' no correlation														
TEXT BOOKS:														
1. Chow V T, Maidment D R and Mays L W, Applied hydrology, McGraw Hill (1988).														
2. McCuen R H, , Hydrologic Analysis and Design, Pearson (2012)														
REFERENCE BOOKS:														
1. Chow V.T., Maidment D.R., Mays L.W., Applied Hydrology, McGraw Hill Publications, New York, 1995.														
2. Subramanya K., Hydrology, Tata McGraw Hill Co., New Delhi, 1994.														
3. Patra.K.C, Hydrology and Water Resources Engineering, Narosa Publications, 2008, Second Edition, New Delhi.														
4. Jeya Rami Reddy.P, Hydrology, Laximi Publications, New Delhi, 2004.														
WEB RESOURCES:														
1. https://onlinecourses.nptel.ac.in/noc22ce37/preview														

CE606309 - COMPUTATIONAL HYDRAULICS (NPTEL)						
Course Category: Program Elective	Course Type: Theory	L	T	P	C	
		3	0	0	3	
COURSE OBJECTIVES:						
<ul style="list-style-type: none">• Introduce the computational aspects of hydraulics in the context of Civil Engineering problems groundwater flow, open channel flow, flow in closed conduits.• It combines classical hydraulics with new methods such as finite elements and boundary elements.• Development and application of mathematical models in the area of 1D open-channel flow.• Analyzing flow characteristics, including velocity, discharge, depth, and channel morphology, using mathematical models and hydraulic principles.• To apply principles of flow in pressurized conduits and interaction hydraulics to solve practical engineering problems.						
UNIT 1 - INTRODUCTION TO COMPUTATIONAL HYDRAULICS						9
Introduction to Computational Hydraulics: Problem Definition and Governing Equations, Classification of Problems based on Initial Condition (IC) and/or Boundary Condition (BC), Classification of Differential Equations						
UNIT 2 - NUMERICAL METHODS						9
Numerical Methods: Finite Difference Method, Finite Volume Method, Mesh-Free Method, Discretization of IVP, BVP, IBVP, Numerical Stability, Convergence Solution of Algebraic Equation (Linear and Nonlinear solvers).						
UNIT 3 - GROUND WATER HYDRAULICS						9
One-Dimensional Flow, Steady Two-Dimensional Flow , Groundwater Flow , Pipe Flow, 1D Open Channel Flow: GVF, SVF, RVF, Network						
UNIT 4 - SURFACEWATER HYDRAULICS						9
Unsteady Two-Dimensional Flow using Finite Difference Method, Steady Channel Flow : Channel Network without reverse Flow, Unsteady Flow in Pipes, surface Water and Ground Water Interaction,2D Surface Water Flow: SWE						
UNIT 5 - FLOW IN PRESSURIZED CONDUIT & INTERACTION HYDRAULICS						9
Interaction Hydraulics: Groundwater Flow, Surface Flow, Pipe Flow, Channel Flow						
TOTAL: 45 PERIODS						

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

CO1:	Understand the significance of basic principles of Computational Hydraulics
CO2:	Computation of Numerical Methods & Finite Element Method
CO3:	Apply The Principles Surface water Hydraulics
CO4:	Development and application of mathematical models in the area of 1D open-channel flow
CO5:	Understand The Working Principle Of Flow In Pressurized Conduit & Interaction Hydraulics

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	3	2	-	1	-	-	-	-	-	2	2	3
CO2	2	3	3	3	-	1	-	-	-	-	-	2	2	2
CO3	2	3	3	3	-	2	-	-	-	-	-	2	2	2
CO4	2	3	3	3	-	2	-	-	-	-	-	2	2	2
CO5	2	3	3	3	-	2	-	-	-	-	-	2	2	2

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Computational Modeling in Hydraulic and Coastal Engineering” by C. G. Koutitas and P. D. Scarlatos, CRC Press.
2. Computational Fluid Dynamics” by Tapan Sengupta, Universities Press

REFERENCE BOOKS:

1. Computational River Dynamics” by Weiming Wu, Taylor and Francis.
2. An Introduction to Computational Fluid Dynamics: The Finite Volume Method” by H. Versteeg, PEARSON.
3. Mesh Free Methods: Moving Beyond the Finite Element Method” by G. R. Liu, CRC Press

WEB RESOURCES:

1. <https://nptel.ac.in/courses/105108125>
2. <https://archive.nptel.ac.in/noc/courses/noc17/SEM2/noc17-ce07/>

CE606310 - RURAL WATER RESOURCES MANAGEMENT (NPTEL)						
Course Category: Program Elective	Course Type: Theory		L	T	P	C
			3	0	0	3
COURSE OBJECTIVES:						
<ul style="list-style-type: none">To analyze hydrological data and models to assess water availability in different regions.To analyze groundwater flow patterns, and develop sustainable groundwater management strategies.To apply surface water hydrology principles to solve practical problems.Importance of integrating water management with other rural development initiatives.To develop holistic solutions to rural water management issues.						
UNIT 1 - INTRODUCTION						9
Importance of water resource management, & Hydrological Cycle and representations, Key Hydrological Parameters, analysis of hydrological water availability in India, projected water demand different use.						
UNIT 2 - INTRODUCTION TO GROUNDWATER HYDROLOGY						9
Groundwater components-precipitation ,evaporation ,runoff/ discharge, water storage ,soil moisture,- precipitation importance, types, formation ,measurement, ground water assessment, GW data issues, GW model, changes in ground water flow ,base flow hydrograph, ground water recharge						
UNIT 3 - SURFACE WATER HYDROLOGY						9
Need of surface water storage structure –constructional aspects of rural lake tank – uses of lake at ecosystem services-lift irrigation from a check dam- types of surface water irrigation-community management of irrigation-issues of rural/urban conversion of lake –,Water Mass Balance Equation						
UNIT 4 - RURAL WATER MANAGEMENT						9
Issues, Data Challenges And Observation-Rural Water Management Water Security, Water Conservation Under Mg ,Lake of Ownership By Agencies-Public Participatory By NGOs-Convergence Of Funds- Rural Water Resource Management Infrastructure (Engineered), Rural Water Resource Management Infrastructure (Nature Based)						
UNIT 5 - CASE STUDIES						9
Solving Case Studies In Rural Water Resource Management stage agencies - Rural hydrological databases for India, Remote Sensing data bases for Rural water resources						
TOTAL: 45 PERIODS						

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

CO1:	The complete knowledge on hydrologic cycle and hydro meteorological measurements
CO2:	Knowledge of the various methods of field measurements and estimation of precipitation, abstraction and runoff process which they apply to carry out the assessment of water balance and runoff potential
CO3:	Apply their knowledge on surface water hydrology
CO4:	Apply the knowledge of overall concepts of Rural Water Management
CO5:	Potential of remote sensing and GIS is solving problems in water resources through case studies.

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	-	-	-	2	2	-	-	-	-	2	1	2
CO2	2	3	-	-	-	2	3	-	-	-	1	2	2	2
CO3	3	3	-	-	-	2	3	-	-	-	1	2	2	2
CO4	3	3	-	-	-	2	3	-	-	1	2	2	2	2
CO5	2	3	-	-	-	2	2	2	-	1	2	2	1	2

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Dingman, S.L. and Dingman, S.L. 2015. Physical hydrology (Vol. 575). Upper Saddle River, NJ: Prentice Hall.
2. Viessman, W., Lewis, G.L. and Knapp, J.W. 2003. Introduction to hydrology (No. GB 661.2. V53 1972.). Upper Saddle River, NJ: Prentice Hall.

REFERENCE BOOKS:

1. Patra.K.C, Hydrology and Water Resources Engineering, Narosa Publications, 2008, 2nd Edition, New Delhi
2. Field notes from instructor 8) Raghunath H.M. 2006. Hydrology: principles, analysis and design
3. Brady, Nyle C., and Harry Oliver Buckman. The nature and properties of soils. No. 631.4 B7295n Ej. 6 008553. Macmillan, 2013.
4. Jeya Rami Reddy.P, Hydrology, Laximi Publications, New Delhi, 2004.

WEB RESOURCES:

1. <https://www.digimat.in/nptel/courses/video/105101215/L41.html>

VERTICALS 4

CE606401 – HYDROGRAPHIC SURVEYING						
Course Category: Program Elective	Course Type: Theory	L	T	P	C	
		3	0	0	3	
COURSE OBJECTIVES:						
<ul style="list-style-type: none">To provide the necessary knowledge and practical instrument operational and data processing skills.To analyze, interpret, and utilize depth data and acoustic signals effectively.To understand the factors influencing navigation accuracy and reliability.To solve practical problems in navigation, mapping, surveying, and spatial analysis.To explore case studies highlighting the diverse roles of hydrographic surveyors in different marine projects.						
UNIT 1 - INTRODUCTION, TIDES AND DATUMS						9
Overview of hydrographic surveying concepts- bathymetric and nautical charts- Basic tidal theory tidal observations and predictions - common types of recording tide gauges -different vertical datums - Indian tides.						
UNIT 2 - SOUNDINGS						9
Overview of depth data types- Working principle of echo sounders - characteristics and nature of underwater acoustic signals – transducers - error sources and calibrations- Advanced instrumentation.						
UNIT 3 - NAVIGATION AND POSITION FIXING						9
Horizontal positioning methods and requirements - concept of line and surface of position - positioning and navigation using satellite positioning systems - differential GPS and Real- time kinematic (RTK)						
UNIT 4 - PLANNING AND DATA PROCESSING						9
General considerations for planning of an inshore hydrographic survey - ground and track control - practical soundings in inshore and coastal surveys - data processing and chart compilation - hydrographic software packages for data collection - processing and plotting.						
UNIT 5 - MARINE ENVIRONMENTAL MEASUREMENTS						9
Methods of measuring and recording of currents - composition of the sea bed - and solids in suspension - Case Studies (The role of the hydrographic surveyor on different marine projects)						
TOTAL: 45 PERIODS						

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

CO1:	Learn the fundamentals of hydrographic surveying.
CO2:	Identify the appropriate techniques for different types of survey.
CO3:	Understand the various options available during the Navigation
CO4:	Analyze the data collected from a survey and assess its quality against the project requirements
CO5:	Discuss the different roles for a hydrographic surveyor on marine projects

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	1	-	-	-	-	-	2	2	2	3	1	1
CO2	3	-	1	-	-	3	-	-	1	1	-	3	2	2
CO3	3	2	2	3	-	3	-	-	1	2	-	3	1	1
CO4	3	3	2	3	3	3	-	2	-	2	1	3	1	1
CO5	3	2	3	3	3	3	3	3	-	3	3	3	2	2

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.

U.S. Army Corps of Engineers, (2002), Hydrographic Surveying, Document No. EM 1110-2-1003.

2.

Ingham, A. E. (1992), Hydrography for the Surveyor and Engineer, 3rd Edition revisedby Abbott V. J., Blackwell Science.

REFERENCE BOOKS:

1.

de Jong, C. D., Lachapelle, G., Skone, S. & Elema, I. A. (2002), Hydrography, Delft University Press, The Netherlands.

2.

Loweth, R. P. (1997), Manual of Offshore Surveying for Geoscientists and Engineers Chapman & Hall.

3.

Pugh, D. (2004), Changing Sea Levels – Effects of Tides, Weather and Climate, Cambridge University Press.

WEB RESOURCES:

1.

<https://oceanservice.noaa.gov/podcast/>

CE606402 – GEOINFORMATICS						
Course Category: Program Elective	Course Type: Theory		L	T	P	C
			3	0	0	3
COURSE OBJECTIVES:						
<ul style="list-style-type: none">• To introduce the information concepts and systems used in Geoinformatics.• To familiarize the role of Internet and Networks in Geoinformatics.• To familiarize web data services and geoinformation.• Understanding of the principles, methods, and technologies involved in accessing, processing, and utilizing data.• To communicate geospatial information effectively through maps, charts, and other visualization tools.						
UNIT 1 – COMPUTER SYSTEMS						9
C Computers - types - components - CPU - memory - Input devices-Output device- Operating Systems: Windows, Linux–fundamentals - software - system software, application software - file operations.						
UNIT 2 - DATA ACQUISITION						9
Acquisition and storage of Numeric data- Textual data - image data - Audio data - Animation and Video data - Data formats - fundamentals of image and video compression - introduction to geospatial data- remote sensing sensors, data organization						
UNIT 3 - NETWORKS AND COMMUNICATION						9
Fundamental computer network concepts - Network layers - TCP/IP model - LAN, WAN, WLAN, intranet, Internet - Applications - Essentials of internet - Ethernet - Network Routing - Switching - Data transportation through Network - protocols - Cell phone working fundamentals - Cell phone frequencies & channels - Digital cell phone components - Cell phone network technologies / architecture.						
UNIT 4 - WEB DATA AND SERVICES						9
Browser fundamentals - Client - Server - Architecture - web site essentials - Web development - Platforms - Tools - Languages - HTML PHP - client side scripting - javascript - database - Postgresql - MySQL - Web server - Application Server – Data server - Data services - Big data - cloud storage						
UNIT 5 - GEOINFORMATION						9
Information System - GIS - GPS - Information retrieval system - Geo-database - interactive applications - Multimedia applications - Earth resource platform – Google maps and Google earth -						

LBS - Introduction to Integration of Geo-database and Social networking applications														
TOTAL: 45 PERIODS														
COURSE OUTCOMES: At the end of the course, the student will be able to														
CO1:	Apply Computer systems and data formats													
CO2:	Apply basics of Geoinformation													
CO3:	Create the role of network systems that handles Geoinformation.													
CO4:	Apply data and technologies related to Geoinformation .													
CO5:	Apply data and technologies related to GPS & GIS techniques.													
CO-PO MAPPING														
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	1	2	1	-	-	-	-	-	3	2	1
CO2	3	2	-	1	1	1	-	2	2	1	-	3	2	2
CO3	3	1	-	2	2	1	-	2	-	1	-	3	3	2
CO4	3	2	1	3	1	1	-	1	-	2	2	3	3	3
CO5	3	1	1	-	1	1	3	2	1	1	-	3	2	3
1- low, 2 - medium, 3 - high, '-' no correlation														
TEXT BOOKS:														
1. Robin Nixon, "Learning PHP, MySQL, JavaScript, CSS & HTML5" Third Edition, O'Reilly, 2014.														
2. James F. Kurose, “Computer Networking: A Top-Down Approach” Sixth Edition, Pearson, 2012.														
REFERENCE BOOKS:														
1. Gottapu Sasibhushana Rao, "Mobile Cellular Communication", Pearson, 2012.														
2. Peter Norton, “Introduction to Computers” Sixth edition, Tata McGraw – Hill, 2008.														
WEB RESOURCES:														
1. https://gisresources.com/														
2. https://nptel.ac.in/courses/105108073														

CE606403 - SATELLITE IMAGE PROCESSING						
Course Category: Program Elective	Course Type: Theory		L	T	P	C
			3	0	0	3
COURSE OBJECTIVES:						
<ul style="list-style-type: none">• To solve real-world problems, and contribute to advancements in fields such as remote sensing.• To understand the importance of preprocessing techniques in enhancing the quality and usability of sensor data.• To evaluate the effectiveness of enhancement techniques using quantitative metrics and qualitative assessments.• To categorize images based on their visual content and features.• To apply advanced classifier techniques to solve complex classification problems in various domains.						
UNIT 1 – FUNDAMENTALS OF IMAGE PROCESSING						9
Introduction - Information Systems - Encoding and decoding - acquisition, storage and retrieval – data products -satellite data formats - Digital Image Processing Systems - Hardware and software design consideration Scanner, digitizer - photo write systems-Fundamental concepts of Map Info and ARCGIS Software - Function of a satellite - Satellite Component - Various band used in satellite.						
UNIT 2 - SENSORS MODEL AND PRE PROCESSING						9
Image Fundamentals – Sensor models – spectral response – Spatial response – IFOV,GIFOV& GSI – Simplified Sensor Models – Sampling & quantization concepts – Image Representation& geometry and Radiometry – Colour concepts – Sources of Image degradation and Correction procedures- Atmospheric, Radiometric, Geometric Corrections Image Geometry Restoration-interpolation methods and resampling techniques.						
UNIT 3 - IMAGE ENHANCEMENT						9
Image Characteristics - Histograms - Scattergrams – Univariate and multi variate statistics enhancement in spatial domain – global, local & colour Transformations – PC analysis, edge detections, merging - filters - convolution – LPF, HPF , HBF, directional box, cascade – Morphological and adaptive filters – Zero crossing filters – scale space transforms – power spectrum – texture analysis – frequency transformations - Fourier, wavelet and curvelet transformations.						
UNIT 4 - IMAGE CLASSIFICATION						9
Spectral discrimination - pattern recognition concepts - Baye’s approach - Signature and training sets						

– Separability test –Supervised Classification – Minimum distance to mean, Parallelepiped, MLC – Unsupervised classifiers – ISODATA,K-means-Support Vector Machine – Segmentation (Spatial, Spectral) – Tree classifiers - Accuracy assessment – Error matrix – Kappa statistics – ERGAS, RMS.

UNIT 5 - ADVANCED CLASSIFIERS

9

Fuzzy set classification – sub- pixel classifier – hybrid classifiers, Texture based classification – Object based classifiers – Artificial Neural nets – Hebbian leaning – Expert system, types and examples – Knowledge systems.

TOTAL: 45 PERIODS

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

CO1:	Understand about Remote sensing and Image processing systems
CO2:	Acquire knowledge about the source of error in satellite image and also to remove the error from satellite image.
CO3:	Select appropriate image Enhancement techniques based on image characteristics
CO4:	Classify the satellite image using various methods and also evaluate the accuracy of classification.
CO5:	Apply the advanced image classification methods and conduct lifelong research in the field of image processing.

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	2	1	1	2	1	2	-	-	1	2	2	1
CO2	2	2	1	-	1	1	2	3	-	-	1	2	3	1
CO3	3	3	2	-	1	1	2	2	-	-	1	1	2	2
CO4	2	-	1	-	-	3	1	2	1	1	-	2	3	1
CO5	1	-	1	1	-	2	-	1	2	1	2	-	1	-

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. John, R. Jensen, Introductory Digital Image Processing, Prentice Hall, New Jersey, 4th Edition, 2015.
2. Robert, A. Schowengerdt, Techniques for Image Processing and classification in Remote Sensing, Academic Press, 2012

REFERENCE BOOKS:

1. Robert, G. Reeves, - Manual of Remote Sensing Vol. I & II - American Society of Photogrammetry, Falls, Church, USA, 1983.
2. Richards, Remote sensing digital Image Analysis - An Introduction 5th Edition , 2012, Springer -Verlag 1993.

- | |
|---|
| <ol style="list-style-type: none">3. Digital Image Processing by Rafael C. Gonzalez, Richard Eugene Woods- Pearson/Prentice Hall, 20084. Fundamentals of Digital Image Processing by Annadurai Pearson Education (2006)5. Digital Image Processing: PIKS Scientific Inside by William K. Pratt 4th Edition, Wiley Interscience, 2007. |
|---|

WEB RESOURCES:

- | |
|---|
| <ol style="list-style-type: none">1. https://www.geeksforgeeks.org/satellite-image-processing/2. https://onlinecourses.nptel.ac.in/noc19_ce38/preview |
|---|

CE606404 - CARTOGRAPHY						
Course Category: Program Elective	Course Type: Theory		L	T	P	C
			3	0	0	3
COURSE OBJECTIVES:						
<ul style="list-style-type: none">To introduce concepts of Cartography.To expose the process of map making and projections.Understanding the elements of a map, principles of map layout, and fundamentals of map design.To understand the principles, techniques, and considerations involved in these aspects of cartographic design and production.Utilizing spatial data models to analyze and solve spatial problems in GIS applications.						
UNIT 1 – ELEMENTS OF CARTOGRAPHY						9
Definition of Cartography – Maps – Functions – Uses and Types of Maps – Map Scales and Contents – Map Projections – Shape, Distance, Area and Direction Properties						
UNIT 2 - MAP PROJECTION						9
Perspective and mathematical Projections – Indian Maps and Projections – Map Co-ordinate System – UTM and UPS References						
UNIT 3 - MAP DESIGN						9
Elements of a Map – Map Layout Principles – Map Design Fundamentals – Symbols and Conventional Signs – Graded and Ungraded Symbols – Color Theory – Colours and Patterns in Symbolization						
UNIT 4 - MAP PRODUCTION						9
Map Lettering – Map Production – Map Printing – Colours and Visualization – Map Reproduction – Map Generalization – Geometric Transformations – Bilinear and Affine Transformations.						
UNIT 5 - DATA QUALITY						9
Introduction to data quality – Types of data – Spatial, Attribute data – types of attributes – scales/levels of measurements – spatial data models – Raster Data Structures – Raster Data Compression – Vector Data Structures – Raster Vs Vector Models – TIN and GRID data models.						
TOTAL: 45 PERIODS						

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

CO1:	Be familiar about the concept about the basics of cartography.
CO2:	Be familiar the concepts of Map projection
CO3:	Be familiar the concepts of Map Design
CO4:	Create the concepts of Map Production and its utility.
CO5:	Create the concepts of spatial data quality and data standard

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	1	2	1	-	-	2	2	-	-	1	1	1
CO2	2	1	2	2	1	-	3	1	2	-	-	1	1	2
CO3	3	1	3	1	2	3	2	2	3	2	1	1	2	2
CO4	1	2	3	2	2	2	1	1	3	2	2	2	1	2
CO5	1	1	3	1	1	1	3	1	1	3	3	3	1	1

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Arthur H. Robinson et al, "Elements of Cartography", 7th Edition, Wiley, 2002.
2. Kang – Tsung Chang, "Introduction to Geographic Information Systems", McGraw Hill Publishing, Fourth Edition, 2017.
3. Ian Heywood, Sarah Cornelius, Steve Carver, Srinivasa Raju, "An Introduction to Geographical Information Systems, Pearson Education, Fourth Edition, 2011.

REFERENCE BOOKS:

1. John Campbell, "Introductory Cartography", Wm. C.BrownPublishers,3rd Edition,2004
2. Chor Pang LO, Albert K. W. Yeung, "Concepts and Techniques of Geographic Information Systems", Pearson Education, 2nd Edition, November 2016. ISBN: 9789332581883

WEB RESOURCES:

1. <https://alg.manifoldapp.org/read/introduction-to-cartography/section/31abbc19-43ec-4795-9b08-4d735d4b7e4b>
2. <https://archive.nptel.ac.in/courses/105/102/105102015/>

CE606405 – CADASTRAL SURVEYING							
Course Category: Program Elective	Course Type: Theory		L	T	P	C	
			3	0	0	3	
COURSE OBJECTIVES:							
<ul style="list-style-type: none">To know the concepts of cadastral surveying and its features, importance and applications.To know the advancements in surveying.Understanding of the principles, concepts, and measurements associated with aerial photography.To utilize photogrammetric products and outputs for decision-making, planning, and engineering applications.To understand the role of satellite imagery in enhancing boundary fixing and cadastral surveying processes.							
UNIT 1 – CADASTRAL SURVEY METHOD							9
Steps in survey of a village – Instruments used for cadastral survey and mapping – Orthogonal, Polar survey methods – Boundary survey – Rectangulation – Calculation of area of Land- GPS and Total Station in Cadastral survey.							
UNIT 2 - PRINCIPLES AND PROPERTIES OF PHOTOGRAPHY							9
History - Definition, Applications – Types of Photographs, Classification – Photographic overlaps – Camera: metric vs. non-metric, Digital Aerial cameras – Multiple frame and Line cameras – Linear array scanner – Flight Planning – Crab & Drift– Computation of flight plan - Photogrammetric project Planning.							
UNIT 3 - GEOMETRIC PROPERTIES OF AERIAL PHOTOGRAPHS							9
Photo coordinate measurement – Vertical photographs -geometry, scale, Coordinate system, Relief displacement – Stereoscopes – Stereoscopic parallax – parallax equations -Geometry, Scale, Coordinate system – Relief displacement — Photo Interpretation.							
UNIT 4 - PHOTOGRAMMETRIC METHODS							9
Photogrammetry for cadastral surveying and mapping – Orthophoto map – Quality control measures – Organisation of cadastral offices – international scenario.							
UNIT 5 - MAINTENANCE AND MEASUREMENTS							9
Cadastral survey maintenance – Resurveys – Measurement of sub-division – Measurement of obstructed lines – Survey of urban areas – Control requirement for Urban survey use of Satellite Imagery in							

boundary fixing.

TOTAL: 45 PERIODS

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

CO1:	Gain the knowledge about cadastral survey.
CO2:	Understand the methods of cadastral survey.
CO3:	Get the knowledge about photogrammetric methods.
CO4:	Understand Land Record System and computational procedure for modernization of the same.
CO5:	The students will be in position to understand the Government procedure in Land Record Management

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	2	2	3	-	2	1	-	2	2	1	2	1
CO2	2	2	1	1	2	1	2	1	2	1	1	2	2	1
CO3	1	2	2	2	-	2	1	2	1	3	1	1	1	3
CO4	1	1	2	1	-	2	-	2	1	1	2	1	1	2
CO5	2	1	1	1	-	1	-	1	2	2	1	1	1	1

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Paul. R Wolf., Bon A. DeWitt, Elements of Photogrammetry with Application in GIS McGraw Hill International Book Co., 4th Edition, 2014
2. R.Subramanian, Surveying and Levelling, Oxford University Press, Second Edition, 2012.

REFERENCE BOOKS:

1. Karl Kraus, Photogrammetry: Geometry from Images and Laser Scans, Walter de Gruyter GmbH and Co. 2nd Edition, 2007.
2. E. M. Mikhail, J. S. Bethel, J. C. McGlone, Introduction to Modern Photogrammetry, Wiley Publisher, 2001.
3. James, M. Anderson and Edward N. Mikhail, Introduction to Surveying, McGraw Hill Book Co, 1985.

WEB RESOURCES:

1. <https://www.land.vic.gov.au/surveying/cadastral-survey>
2. <https://www.youtube.com/watch?v=l85hzXUKGBs>

CE606406 – HIGHER SURVEYING						
Course Category: Program Elective	Course Type: Theory		L	T	P	C
			3	0	0	3
COURSE OBJECTIVES:						
<ul style="list-style-type: none">To know the techniques of time consuming for topographic mapping.To know about the fundamental concepts, data acquisition, data processing, and applicationsTo apply photogrammetry effectively in various fields, including mapping, remote sensing and geospatial analysis.To understand the principles, methods, and applications of LiDAR and RADAR remote sensing in geoscience and related fields.To understand the principles, methods, and technologies used in hydrographic surveying for mapping and charting bodies of water.						
UNIT 1 - INTRODUCTION						9
Introduction to Higher Surveying - Understanding reference system, reference frame, and coordinate system for Earth- Coordinate and datum transformations -Projected coordinate system - Fundamentals of astronomy- Applications of concepts of astronomy						
UNIT 2 - ASTRONOMY AND TIME						9
Time - Application of concepts of astronomy and time - Fundamental concepts of error, accuracy, and error propagation - Applications of error propagation - Observation Equation Method of adjustments - Condition Equation Method and Combined Method of adjustments - Analysis of adjustments and reporting of errors						
UNIT 3 - PHOTOGRAMMETRY						9
Introduction to Photogrammetry - Vertical photogrammetry -Stereo photogrammetry – Analytical photogrammetry-I - Analtical photogrammetry-II - Photogrammetric products – Image matching - Close range photogrammetry						
UNIT 4 - LIDAR AND RADAR						9
Fundamentals of LiDAR - LiDAR data acquisition - Geolocation and errors of LiDAR data - Information extraction from LiDAR data - RADAR fundamenetals -I - RADAR fundamentals-II – Radargrammetry - Imaging RADAR Interferometry - Geoscience perspective for RADAR applications						
UNIT 5 - HYDROGRAPHIC SURVEY						9
Fundamental concepts of hydrographic survey -Field procedures for hydrographic Surveying - Modern						

techniques for hydrographic Survey - Navigation														
TOTAL: 45 PERIODS														
COURSE OUTCOMES: At the end of the course, the student will be able to														
CO1:	Justify the concept of higher surveying.													
CO2:	Justify the concept of Astronomy and time.													
CO3:	Know the concept of Photogrammetry.													
CO4:	Know the advanced concepts of LIDAR and RADAR													
CO5:	Know the concepts of hydrographic survey													
CO-PO MAPPING														
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	3	2	-	-	2	1	-	2	-	2	2	1	1
CO2	2	2	3	-	-	1	1	-	1	-	1	2	1	1
CO3	1	1	2	1	-	-	1	-	1	-	1	2	2	2
CO4	1	1	2	2	2	-	2	1	2	1	1	1	1	1
CO5	3	2	1	1	1	1	1	2	1	2	-	1	1	1
1- low, 2 - medium, 3 - high, '-' no correlation														
TEXT BOOKS:														
1. Elements of Photogrammetry with Application in GIS, by Paul R Wolf, Bon A DeWitt, and Benjamin E Wilkinson, 4th ed, McGraw-Hill Education, 2014.														
2. Introduction to Modern Photogrammetry, by E M Mekhail, 1st ed, Wiley, 2001. Adjustment Computations: Spatial Data Analysis, by Charles D Ghilani, 5th ed, Wiley, 2010.														
3. Electronic Surveying in Practice, by S H Laurila, John Wiley & Sons, 1983.														
REFERENCE BOOKS:														
1. Topographic Laser Ranging and Scanning – Principles and Processing, by J Shan and C K Toth(editors), CRC Press, 2009.														
2. Hydrographic Surveying - Methods, Tables and Forms of Notes, by S H Lea, and J Gloag, Forgotten Books, 2017.														
WEB RESOURCES:														
1. https://nptel.ac.in/courses/105103176														

CE606407 – GEOGRAPHIC INFORMATION SYSTEM (NPTEL)						
Course Category: Program Elective	Course Type: Theory	L	T	P	C	
		3	0	0	3	
COURSE OBJECTIVES:						
<ul style="list-style-type: none">To know the fundamental concepts about GIS its map projection data and concepts spatial analysis, its importance and application.To implement the conceptual data of map and types of structure in different stratum.To understand the fundamentals of GIS and their applications in various domains.To develop skills in raster data input using scanners and various raster data file formats.To understand the principles, methods, and standards used to evaluate the quality of spatial data in GIS.						
UNIT 1 - INTRODUCTION						9
Overview, History and concepts of GIS - Scope and application areas of GIS - Purpose and benefits of GIS - Functional components of GIS - Importance of GPS and remote sensing data in GIS						
UNIT 2 - MAP DESIGN AND PRODUCTION						9
Elements of a Map – Map Layout Principles – Map Design Fundamentals – Symbols and Conventional Signs – Graded and Ungraded Symbols – Color Theory – Colours and Patterns in Symbolization – Map Lettering – Map Production – Map Printing – Colours and Visualization – Map Reproduction – Map Generalization – Geometric Transformations – Bilinear and Affine Transformations.						
UNIT 3 - FUNDAMENTALS OF GIS						9
Introduction to GIS – Definitions – History of GIS – Components of a GIS – Hardware, Software, Data, People, Methods – Introduction to data quality – Types of data – Spatial, Attribute data – types of attributes – scales/levels of measurements – spatial data models – Raster Data Structures – Raster Data Compression – Vector Data Structures – Raster Vs Vector Models – TIN and GRID data models.						
UNIT 4 - DATA INPUT AND TOPOLOGY						9
Scanner – Raster Data Input – Raster Data File Formats – Georeferencing– Vector Data Input – Digitizer– Datum Projection and Reprojection – Coordinate Transformation – Topology - Adjacency, Connectivity and containment – Topological Consistency – Non topological file formats – Attribute Data Linking – Linking External Databases – GPS Data Integration – Raster to Vector and Vector to Raster Conversion.						
UNIT 5 - DATA QUALITY AND OUTPUT						9
Assessment of Data Quality - Basic Aspects - Completeness, Logical Consistency, Positional						

Accuracy, Temporal Accuracy, Thematic Accuracy and Lineage – Metadata – GIS Standards – Interoperability – OGC - Spatial Data Infrastructure – Data Output – Map Compilation – Chart / Graphs.

TOTAL: 45 PERIODS

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

CO1:	Be familiar with appropriate map projection and co-ordinate system for production of Maps and shall able to compile and design maps for their required purpose.
CO2:	Be familiar with co-ordinate and Datum transformations
CO3:	Understand the basic concepts and components of GIS, the techniques used for storage of spatial data and data compression
CO4:	Understand the concepts of spatial data quality and data standard
CO5:	Understand the concept of spatial data inputs

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	2	-	2	-	2	3	2	-	-	3	1	1
CO2	3	1	1	1	1	-	1	2	1	2	2	3	1	-
CO3	3	1	2	2	3	-	1	1	2	1	1	2	2	-
CO4	3	1	1	1	1	1	2	2	1	2	1	2	1	1
CO5	1	3	3	1	1	2	1	1	1	1	1	1	1	2

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Arthur H. Robinson et al, "Elements of Cartography", 7th Edition, Wiley, 2002.
2. Kang – Tsung Chang, "Introduction to Geographic Information Systems", McGraw Hill Publishing, Fourth Edition, 2017.
3. Ian Heywood, Sarah Cornelius, Steve Carver, Srinivasa Raju, "An Introduction to Geographical Information Systems, Pearson Education, Fourth Edition, 2011.
4. R.Subramanian, Surveying and Levelling, Oxford University Press, Second Edition, 2012.

REFERENCE BOOKS:

1. John Campbell, "Introductory Cartography", Wm. C.Brown Publishers, 3rd Edition, 2004
2. Chor Pang LO, Albert K. W. Yeung, "Concepts and Techniques of Geographic Information Systems", Pearson Education, 2nd Edition, November 2016. ISBN: 9789332581883

WEB RESOURCES:

1. <https://nptel.ac.in/courses/105107155>

CE606408 – MODERN SURVEYING TECHNIQUES						
Course Category: Program Elective	Course Type: Theory		L	T	P	C
			3	0	0	3
COURSE OBJECTIVES:						
<ul style="list-style-type: none">To know the concepts of modern survey its features, techniques, importance and applications.To understand the basic principles of satellite positioning.To apply aerial photography techniques effectively in various disciplines.To process remote sensing data using specialized software tools.To understand the data structures used in GIS.						
UNIT 1 - MODERN SURVEYING EQUIPMENTS						9
Introduction – electronic distance measuring instrument – Electronic theodolite and total station – its working principle and application.						
UNIT 2 - GPS						9
Basic – Positioning using satellites – principles – GPS receivers – GPS Errors and Accuracy – Errors sources- satellite geometry and accuracy measures – measurement techniques – navigational solutions						
UNIT 3 - PHOTOGRAMMETRY						9
Introduction – Geometry of vertical and tilted photograph – stereoscopy and parallax – Flight planning – development in photogrammetry.						
UNIT 4 - REMOTE SENSING						9
Introduction – Physical basis of remote sensing – EMR, EMR interaction on atmosphere, ground surface, Water & Snow, Soil, Radiometry. – Interpretation – image processing techniques – image enhancement – information extraction.						
UNIT 5 - GIS						9
Introduction – data structure for GIS – manipulation – analysis – modeling – errors – corrections.						
TOTAL: 45 PERIODS						
COURSE OUTCOMES: At the end of the course, the student will be able to						
CO1:	Be familiar with the concept of modern surveying equipments.					
CO2:	Be familiar with the basic concepts about GPS.					
CO3:	Be familiar with the basic concepts about Photogrammetry.					
CO4:	Be familiar with the basic concepts about Remote Sensing.					
CO5:	Be familiar with the basic concepts about GIS.					

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	2	1	3	-	1	-	1	1	-	1	1	2
CO2	2	1	1	1	2	-	-	1	2	1	-	1	1	2
CO3	1	2	1	1	1	-	1	2	1	-	1	1	2	1
CO4	1	1	2	2	-	1	2	2	1	2	1	2	1	-
CO5	2	2	1	1	-	1	1	3	1	2	2	-	1	-

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Arthur H. Robinson et al, "Elements of Cartography", 7th Edition, Wiley, 2002.
2. Kang – Tsung Chang, "Introduction to Geographic Information Systems", McGraw Hill Publishing, Fourth Edition, 2017.
3. Ian Heywood, Sarah Cornelius, Steve Carver, Srinivasa Raju, "An Introduction to Geographical Information Systems, Pearson Education, Fourth Edition, 2011.

REFERENCE BOOKS:

1. John Campbell, "Introductory Cartography", Wm. C.BrownPublishers,3rd Edition,2004
2. Chor Pang LO, Albert K. W. Yeung, "Concepts and Techniques of Geographic Information Systems", Pearson Education, 2nd Edition, November 2016. ISBN: 9789332581883

WEB RESOURCES:

1. <https://archive.nptel.ac.in/courses/105/104/105104100/>

CE606409 – GPS SURVEYING (NPTEL)						
Course Category: Program Elective	Course Type: Theory		L	T	P	C
			3	0	0	3
COURSE OBJECTIVES:						
<ul style="list-style-type: none">To know the fundamental concepts of GPS surveying its conceptual techniques, importance, ideas and applications.To effectively use GPS positioning techniques for accurate spatial data acquisition in various applications.To understand the importance of proper field surveying techniques.Learn about the components of laser systems.To understand the limitations and challenges of ALS technology.						
UNIT 1 - INTRODUCTION						9
GPS Surveying and applications- GPS System – GPS Signal – GPS Receiver – GPS Software						
UNIT 2 - FIELD DEMONSTRATION METHODS						9
GPS Positioning – principles and methods – Field demonstration methods – GPS observables its types errors and Quality – Systematic errors.						
UNIT 3 - DATA PROCESSING						9
GPS data pre-processing – GPS data processing – Quality assessment of GPS Surveying – Procedure of GPS surveying – GPS field surveying						
UNIT 4 - LIDAR ALTIMETER						9
Principle and Properties of LASER- Production of Laser – Components of LASER – LiDAR – Types of LiDAR:Range Finder, DIAL and Doppler LiDAR - Platforms: Terrestrial, Airborne and Space borne LiDAR – Space Borne LiDAR Missions						
UNIT 5 - SPACE BORNE RADAR						9
Space Borne Radar Altimeter for mapping Sea Surface Topography , Moon Topography - Merits of ALS in comparison to Leveling, echo sounding						
TOTAL: 45 PERIODS						

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

CO1:	Know the concept of GPS and its software
CO2:	Evaluate the demonstration methods of GPS
CO3:	Create the procedure of GPS surveying and its application
CO4:	Know the concept of LIDAR ALTIMETER and its uses
CO5:	Know the concept of SPACE BORNE RADAR and its uses

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	2	1	3	1	1	-	1	1	-	1	1	2
CO2	2	1	1	1	2	-	-	1	2	1	-	1	1	2
CO3	1	2	1	1	1	-	1	2	1	-	1	1	2	1
CO4	1	1	2	2	-	1	2	2	1	2	1	2	1	-
CO5	2	2	1	1	3	1	1	3	1	2	2	-	1	-

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. R.Subramanian, Surveying and Levelling, Oxford University Press, Second Edition, 2012.
2. Electronic Surveying in Practice, by S H Laurila, John Wiley & Sons, 1983.

REFERENCE BOOKS:

1. Chor Pang LO, Albert K. W. Yeung, "Concepts and Techniques of Geographic Information Systems", Pearson Education, 2nd Edition, November 2016. ISBN:9789332581883

WEB RESOURCES:

1. <https://nptel.ac.in/courses/105107158>

CE606410 – DIGITAL LAND SURVEYING AND MAPPING (NPTEL)						
Course Category: Program Elective	Course Type: Theory	L	T	P	C	
		3	0	0	3	
COURSE OBJECTIVES:						
<ul style="list-style-type: none">To know the importance of land surveying and mapping through digitalization with the help of advanced techniques in surveying.To adjust GPS measurements and compute precise positions and uncertainties.Learn about the components of Total Stations.To gain practical experience in measuring vertical angles and heights using Total Stations.To understand the principles of vertical representation, contouring mapping, automated mapping and control point establishment.						
UNIT 1 - INTRODUCTION						9
Introduction & Applications - Fundamentals & Operations - Overview of Digital Land Surveying - Introduction of GPS - GPS Signal (Civilian Perspective) - GPS User Segment - GPS Positioning of Control Point						
UNIT 2 - LAND SURVEY THROUGH GPS						9
Demonstration of GPS Receivers, Software and Positioning of Control Point - GPS Position Principle of GPS Positioning & GPS Observables - Errors in GPS Observables -GPS Data Preprocessing: Differencing, Point Positioning, Baseline Processing - GPS Data Processing - Network Adjustment Quality Assessment of GPS Surveying						
UNIT 3 - LAND SURVEY THROUGH TS						9
Introduction to Total Station - Parts of Total Station - Accessories of Total Station - Handling & Setting of Total Station Measurement of Distance						
UNIT 4 - MEASUREMENT OF TS						9
Measurement of Distance Using TS - Measurement of Horizontal Angle Using TS - Measurement of Vertical Angle and Height Using TS - Errors in Total Station Other Errors in Total Station - Errors and Quality of Surveying Measurements - Error Propagation and Survey Specifications						
UNIT 5 - DIGITAL MAP MAKING						9
Basics of Vertical Representation - Contouring Mapping Fundamentals - Mapping Basics - Mapping Software - Automated Mapping - Working Steps Establishment of Control Point - Detailing of Digital Land Surveying - Demonstration of Digital Land Survey Detailing – Data Preparation and Map Making						

TOTAL: 45 PERIODS

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

CO1:	Know the basic concepts of land survey techniques
CO2:	Evaluate the methods using GPS application
CO3:	Know the basic ideas about TS
CO4:	Evaluate the methods and application using TS application
CO5:	Create the basic ideas about map making

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	2	1	3	1	2	-	1	1	-	1	1	2
CO2	2	1	1	1	2	-	-	1	2	1	-	2	1	2
CO3	1	2	1	1	1	-	1	2	1	-	1	1	2	1
CO4	1	1	2	2	-	1	2	2	1	2	1	2	1	-
CO5	2	2	1	1	3	1	1	3	1	2	2	-	1	-

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Digital Land Surveying and Mapping Hardcover – 1 August 2021 by P. K. Garg, New Age international private limited.

REFERENCE BOOKS:

1. R.Subramanian, Surveying and Levelling, Oxford University Press, Second Edition, 2012.
2. Electronic Surveying in Practice, by S H Laurila, John Wiley & Sons, 1983.

WEB RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc21_ce08/preview

VERTICALS 5

CE606501 – SOIL DYNAMICS						
Course Category: Program Elective	Course Type: Theory	L	T	P	C	
		3	0	0	3	
COURSE OBJECTIVES:						
<ul style="list-style-type: none">To understand the principles of vibration analysis, measurement, and control, enabling them to design and maintain mechanical systems.Understanding the dynamic stress-strain characteristics of soils, including their behavior under dynamic loading conditions.Learn about the specific requirements and considerations for each type of foundation.To analysis and design principles for block-type and framed-type machine foundations.To understand the importance of conducting thorough site assessments.						
UNIT 1 - THEORY OF VIBRATION						9
Introduction – Nature of dynamic loads – Basic definitions – Simple harmonic motion – Fundamentals of vibration – Single degree and multi degree of freedom systems – Free vibrations of spring – Mass systems – Forced vibrations – Resonance – Viscous damping – Principles of vibrations measuring systems – Effect of transient and pulsating loads.						
UNIT 2 - DYNAMIC SOIL PROPERTIES						9
Dynamic stress-strain characteristics – Principles of measuring dynamic properties – Laboratory techniques – Field tests – Block vibration test – Factors affecting dynamic properties – Typical values. Mechanism of liquefaction – Influencing factors – Evaluation of liquefaction potential – Analysis from SPT test – Dynamic bearing capacity – Dynamic earth pressure.						
UNIT 3 - MACHINE FOUNDATIONS						9
Introduction – Types of machine foundations – General requirements for design of machine foundations – Design approach for machine foundation – Vibration analysis – Elastic Half-Space theory – Mass-spring-dashpot model – Permissible amplitudes – Permissible bearing pressures						
UNIT 4 - DESIGN OF MACHINE FOUNDATION						9
Evaluation of design parameters – Types of Machines and foundations – General requirements –their importance – Analysis and design of block type and framed type machine foundations – Modes of vibration of a rigid foundation – Foundations for reciprocating machines, impact machines, Two – Cylinder vertical compressor, Double- acting steam hammer – Codal recommendations - Emprical approach – Barken’s method – Bulb of pressure concept – Pauw’s analogy – Vibration table studies.						

UNIT 5 - VIBRATION ISOLATION													9	
Vibration isolation – Types of isolation – Transmissibility – Passive and active isolation – Methods of isolation – Use of springs and damping materials – Properties of isolating materials – Vibration control of existing machine foundation.														
TOTAL: 45 PERIODS														
COURSE OUTCOMES: At the end of the course, the student will be able to														
CO1:	Acquire knowledge to apply theories of vibration to solve dynamic soil problems.													
CO2:	Evaluate the dynamic properties of soil using laboratory and field tests.													
CO3:	Acquire basic knowledge about machine foundations and design various types of machine foundation.													
CO4:	To know and capable of selecting the types of vibration isolation materials.													
CO5:	To apply vibration isolation techniques for various field problems.													
CO-PO MAPPING														
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	3	-	2	1	1	2	1	1	2	2	1	-	1
CO2	1	2	-	1	2	1	1	1	-	1	1	1	-	1
CO3	2	1	-	1	1	1	3	2	-	1	1	2	1	2
CO4	1	1	2	-	2	2	3	2	1	-	2	3	2	1
CO5	1	1	1	-	2	-	1	1	2	1	1	1	1	1
1- low, 2 - medium, 3 - high, '-' no correlation														
TEXT BOOKS:														
1. KameswaraRao, N.S.V., Dynamics soil tests and applications, Wheeler Publishing, New Delhi, 2000.														
2. Prakash, S and Puri, V.K., Foundations for machines, McGraw Hill, 1987.														
3. Moore, P.J., Analysis and Design of Foundations for Vibrations, Oxford and IBH, 1985.														
REFERENCE BOOKS:														
1. Major, A., Vibration Analysis and Design of Foundations for Machines and Turbines, Vol. I. II and III Budapest, 1964.														
2. Barkan, D.D., Dynamics of Basis of Foundation, McGraw Hill, 1974.														
3. Swami Saran, Soil Dynamics and Machine Foundation, Galgotia publications Pvt. Ltd. New Delhi 2010.														
WEB RESOURCES:														
1. https://www.geoengineer.org/education/soil-dynamics														

CE606502 – ADVANCED FOUNDATION ENGINEERING						
Course Category: Program Elective	Course Type: Theory		L	T	P	C
			3	0	0	3
COURSE OBJECTIVES:						
<ul style="list-style-type: none">To create knowledge about advancement in foundation technologies and its methodology.To understand the principles of raft foundation design, selection of appropriate types of rafts.To understand the characteristics and applications of various types of pile foundations.To understand the principles of vibration analysis, machine foundation design.Interpret earth pressure diagrams and analyze forces acting on retaining structures, including forces in struts.						
UNIT 1 – FOUNDATION DESIGN BASICS						9
Criteria for choice of foundation, bearing capacity, total and differential settlements, tolerance for various types of structures, Interpretation of soil profile from design parameters like modulus of compressibility, Modulus of sub grade reaction, Poisson’s ratio, etc.						
UNIT 2 - RAFT FOUNDATIONS						9
Raft foundations for building and tower structures, including effects of soil-structure interaction and nonlinearity, different types of rafts						
UNIT 3 - DEEP FOUNDATIONS						9
Pile foundation-types, methods of installation, codal practices for permissible load under vertical and lateral loads, stresses during pile driving, load carrying capacity of pile groups, negative skin friction, under-reamed piles, Foundation for heavy structures, well foundations, caisson foundations, equipment used for construction of these foundation systems.						
UNIT 4 - MACHINE FOUNDATIONS						9
Theory of vibrations, free and forced vibrations with and without damping for a single degree freedom system, types of machine foundations, their design criteria, permissible amplitudes and bearing pressure.						
UNIT 5 - CANTILEVER SHEET PILES AND ANCHORED BULKHEADS						9
Earth pressure diagram, determination of depth of embedment in sands and clays, timbering of trenches, Earth pressure diagrams, forces in struts. Cofferdams: Stability, bearing capacity, settlements (qualitative treatment only, no designs).						
TOTAL: 45 PERIODS						

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

CO1:	Identify a suitable foundation system for a structure.
CO2:	Evaluate the importance of raft foundation and principles of design for buildings and tower structures.
CO3:	Analyse and design pile foundations.
CO4:	Examine and discuss various machine foundations.
CO5:	Analyse and design Sheet piles and cofferdams.

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	-	1	1	-	1	3	1	-	1	1	-	-
CO2	1	1	-	2	3	-	2	2	1	-	2	1	-	2
CO3	2	1	1	2	2	-	-	2	1	-	3	2	1	1
CO4	3	2	2	1	1	1	-	1	2	2	1	1	2	1
CO5	2	3	1	1	1	2	-	1	1	1	1	-	1	1

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Das, B.M., "Principles of Foundation Engineering", 4th Edition, PWS Publishing, Singapore, 1999
2. Bowles, J.E., "Foundation Analysis and Design", 5th Edition, McGraw- Hill International, 2000
3. Shamsheer Prakash, "Soil Dynamics", 3rd Edition, John Wiley publications, 2000

REFERENCE BOOKS:

1. Murthy, V.N.S., "Soil Mechanics and Foundation Engineering", 4th Edition, Sai Krupa
2. Technical Consultants, 2000.
3. Venkataramah, C., "Geotechnical Engineering", 5th Edition, New Age International Pvt. Ltd., 2009.
4. Swami Saran, "Analysis and Design of Substructures", 2nd Edition, Oxford & IBH Publishing Company Pvt. Ltd., 2009.

WEB RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc22_ce32/preview

CE606503 – GROUND IMPROVEMENT TECHNIQUES						
Course Category: Program Elective	Course Type: Theory	L	T	P	C	
		3	0	0	3	
COURSE OBJECTIVES:						
<ul style="list-style-type: none">• Learn about drainage techniques for ground water lowering, including the use of well points, deep wells, vacuum methods, and electro-osmotic methods.• Explore the concept and design principles of sand piles, considering factors influencing compaction.• To understand the importance of site investigation, soil testing, and analysis in the selection and design of ground improvement techniques.• To develop skills in grout monitoring and quality control to ensure proper installation and performance.						
UNIT 1 – DEWATERING						9
Introduction – Scope and necessity of ground improvement in Geotechnical engineering basic concepts. Drainage – Ground Water lowering by well points, deep wells, vacuum and electro- osmotic methods. Stabilization by thermal and freezing techniques - Applications.						
UNIT 2 - COMPACTION AND SAND DRAINS						9
Insitu compaction of granular and cohesive soils, Shallow and Deep compaction methods – Sand piles – Concept, design, factors influencing compaction. Blasting and dynamic consolidation – Preloading with sand drains, fabric drains, wick drains etc. – Theories of sand drain – design and relative merits of various methods – Case studies.						
UNIT 3 - STONE COLUMN, LIME PILES AND SOIL NAILING						9
Stone column with and without encased, lime piles – Functions – Methods of installation – design, estimation of load carrying capacity and settlement. Root piles and soil nailing – methods of installation – Design and Applications - Soil liquefaction mitigation methods - case studies.						
UNIT 4 - GEOSYNTHETICS AND ITS APPLICATIONS						9
Reinforcement – Principles and basic mechanism of reinforced earth, simple design: Synthetic and natural fiber based Geotextiles and their applications. Filtration, drainage, separation, erosion control – case studies.						
UNIT 5 – GROUTING						9
Grouting – Types of grout – Suspension and solution grouts – Basic requirements of grout. Grouting equipment – injection methods – jet grouting – grout monitoring – Electro – Chemical Stabilization –						

Stabilization with cement, lime - Stabilization of expansive clays – case studies.														
TOTAL: 45 PERIODS														
COURSE OUTCOMES: At the end of the course, the student will be able to														
CO1:	Evaluate the ideas about dewatering and its techniques.													
CO2:	Create the basic knowledge about compaction and sand drains.													
CO3:	Evaluate the conceptual ideas about stone column, lime piles and soil nailing													
CO4:	Create the basic knowledge in geosynthetics and its applications													
CO5:	Know about various techniques about grouting													
CO-PO MAPPING														
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	-	2	-	2	3	-	-	1	3	1	-	2
CO2	1	3	-	1	-	1	1	-	-	2	2	1	-	1
CO3	2	3	-	1	-	1	2	1	-	1	1	2	1	1
CO4	1	3	1	3	1	-	-	1	1	1	1	1	1	2
CO5	2	1	2	1	2	2	-	2	2	3	1	1	-	1
1- low, 2 - medium, 3 - high, '-' no correlation														
TEXT BOOKS:														
1. Cox, B.R., and Griffiths S.C., Practical Recommendation for Evaluation and mitigation of Soil Liquefaction in Arkansas, (Project Report), 2010.														
2. Das, B.M., Principles of Foundation Engineering, Fourth Edition, PWS Publishing, 1999.														
3. Day, R.W., Foundation Engineering Handbook, McGraw – Hill Companies, Inc. 2006.														
REFERENCE BOOKS:														
1. Han,J., Principles and Practice of Ground Improvement, John Wiley and Sons, NewJersey, Canada2015.														
2. Hehn, R.W., Practical Guide to Grouting of Underground Structures, ASCE, 1996.														
3. Jewell, R.A., Soil Reinforcement with Geotextiles, CIRIA, London, 1996.														
WEB RESOURCES:														
1. https://www.engineeringcivil.com/ground-improvement-techniques.html														

CE606504- EARTHQUAKE RESITANT DESIGN OF STRUCTURES						
Course Category: Program Elective	Course Type: Theory		L	T	P	C
			3	0	0	3
COURSE OBJECTIVES:						
<ul style="list-style-type: none">To know the concepts of earthquake resistant structures and its design over various methods.To understand the principles and methods of analysis for combined footings under earthquake loads.To understand the effect of horizontal loads and moments on shallow foundations.To understand the effect of horizontal loads and moments on pile foundations.Gain knowledge of dynamic bearing capacity under transient and earthquake-type loads, including the types of dynamic loads and their effects on foundation performance.						
UNIT 1 – INTRODUCTION						9
General requirements - Types of shallow and deep foundations and their use - Performance of various types of foundations during past earthquakes.						
UNIT 2 - SHALLOW FOUNDATION						9
Shallow Foundations - IS codes for bearing capacity and settlement of foundations - Foundation design - Modes of soil failure - Shallow Foundations- Safe bearing capacity - Differential & total settlements - Increase in permissible stress under earthquake loads - Methods of analysis- Combined footings for earthquake loads - Shallow Foundations - Raft foundation - Modulus of subgrade reaction - Winkler model						
UNIT 3 - SHALLOW UNDER ELASSTIC CONCEPT						9
Beam on elastic foundation - Dynamic Bearing Capacity under Transient & Earthquake Type Loads - Types of dynamic loads - Footing requirements to account for settlements and earthquake-induced forces - Pseudo-Static analysis of footings with eccentric & inclined loads - Effect of horizontal load and moment - Dynamic Analysis of shallow foundations for various modes of vibrations						
UNIT 4 - PILE FOUNDATION						9
Types of piles based on usage, material, construction etc. - Pile load capacity in compression Bearing capacity of piles - Group action of piles - Settlement of a pile group - Pile Foundations - Laterally loaded piles, elastic analysis - Reese and Matlock approach, fixity of pile heads, - dimensionless factors.						
UNIT 5 - PILE UNDER DYNAMIC LOADS						9
Pile with dynamic loads - Pile Foundations - Soil-pile analysis with spring-mass & FEM idealization						

- Elements for slip and separation - Soil-pile interaction - IS code of practice for the design of pile foundations - Piles through liquefiable soils

TOTAL: 45 PERIODS

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

CO1:	Create basic knowledge towards earthquake loads
CO2:	Evaluate the concepts over shallow foundation
CO3:	Evaluate the concepts over shallow foundation under elastic concept
CO4:	Evaluate the concepts over pile foundation
CO5:	Evaluate the concepts over pile foundation under dynamic loads

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	1	1	3	1	2	1	-	2	-	1	1	2
CO2	1	2	1	1	2	1	3	2	-	1	-	2	2	1
CO3	2	3	2	2	-	2	2	-	2	1	1	1	1	1
CO4	1	2	1	2	-	1	1	-	1	1	2	2	-	1
CO5	2	1	1	1	-	1	2	-	1	-	1	1	1	1

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Das, B.M., "Principles of Foundation Engineering", 4th Edition, PWS Publishing, Singapore, 1999
2. Bowles, J.E., "Foundation Analysis and Design", 5th Edition, McGraw- Hill International, 2000

REFERENCE BOOKS:

1. Murthy, V.N.S., "Soil Mechanics and Foundation Engineering", 4th Edition, Sai Krupa Technical Consultants, 2000
2. Venkataramah, C., "Geotechnical Engineering", 5th Edition, New Age International Pvt. Ltd., 2009

WEB RESOURCES:

1. <https://sjce.ac.in/wp-content/uploads/2018/01/EQ4-Earthquake-Resistant.pdf>

CE606505 – GEOTECHNIQUES FOR INFRASTRUCTURE							
Course Category: Program Elective	Course Type: Theory		L	T	P	C	
			3	0	0	3	
COURSE OBJECTIVES:							
<ul style="list-style-type: none">To understand the principles, procedures, and limitations of each field testing method.To understand the specific considerations for designing shallow foundations for railway and highway bridges, as well as port and harbor structures.To understand the axial load-bearing capacity of piles and methods for its calculation.To understand the fundamental principles of foundation engineering and their application.To evaluate the design and stability of anchored sheet pile walls.							
UNIT 1 – SITE INVESTIGATION FOR INFRASTRUCTURE PROJECTS							9
Site Investigation for Infrastructure Projects: methods of site investigation, types of soil samples and samplers- Geotechnical field testing – SPT, CPT, Plate Load Test, Pile Load Test.							
UNIT 2 - SHALLOW FOUNDATIONS FOR INFRASTRUCTURE PROJECTS							9
Shallow Foundations for Railway & Highway Bridges and Port & Harbour Structures: types of foundations, design forces, safe and allowable bearing capacity of shallow foundations, settlement computation							
UNIT 3 - PILE FOUNDATIONS FOR INFRASTRUCTURE PROJECTS							9
Pile Foundations for Railway & Highway Bridges and Port & Harbour Structures: Pile foundations – types, axial and lateral capacity of pile, pile group analysis and pile cap - Introduction to drilled piers, caissons, well foundations.							
UNIT 4 - FOUNDATIONS FOR ELECTRICAL TOWERS							9
Foundations for Transmission Line, Radar Antenna, Microwave and TV Tower and Chimneys: Introduction, foundations for towers and chimneys, design forces, behaviour of pad and chimney foundations, design of chimney and pad foundations, anchor foundations (rock anchors), design of foundations for towers and chimneys, analysis of raft on pile foundations; design and construction of shallow foundations on rocks.							
UNIT 5 - SHEET PILE FOR INFRASTRUCTURE							9
Sheet Piles – introduction, types of sheet pile walls, cantilever sheet pile wall, anchored sheet pile wall, stability analysis of anchored bulkhead by free earth support and fixed earth support method, position of anchorage. Expansive and Collapsible Soil: Difficult soils- loose granular soils, soft clays and shrinkable							

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

CO1:	Create basic site investigation for infrastructure projects.
CO2:	Evaluate basic ideas in shallow foundations.
CO3:	Evaluate basic ideas in deep foundations.
CO4:	Evaluate basic ideas in foundation for electrical towers.
CO5:	Evaluate basic ideas in sheet piles.

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	-	2	1	2	3	1	-	2	-	1	1	3
CO2	1	1	-	1	1	1	2	2	-	1	-	1	2	2
CO3	2	2	-	2	1	2	1	1	-	1	-	2	1	1
CO4	1	2	1	1	2	1	1	1	2	1	2	1	1	2
CO5	2	1	2	1	2	2	1	1	1	1	2	1	3	1

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Analysis and Design of Shallow and Deep Foundations, Lymon C Reese, William M Isenhowe and Shin-Tower Wang, John Wiley and Sons, 2005.
2. Analysis and Design of Substructures, Swami Saran, Oxford and IBH Publishing, New Delhi, 2008.
3. Design of Foundation Systems, Ninan P Kurian, Narosa Publishing House, New Delhi, 2005.

REFERENCE BOOKS:

1. Soil Mechanics and foundation engineering – P. Purushottama Raj, Pearson Education.
2. Construction of marine and offshore structures – Ben C Gerwick, jr., CRC Press, Taylor and Francis Group.
3. Pile design and construction practice – M J Tomlinson, View point Publications, Palladian Publications Limited.
4. IS: 4091 (1979) -Design and construction of foundations for transmission line towers
5. IS: 11233 (1985) – Design and construction of foundations for Radar Antenna, Microwave and TV Tower.

WEB RESOURCES:

1. <https://www.amrita.edu/course/geotechnics infrastructure/>

CE606506 – EARTH AND EARTH RETAINING STRUTURES						
Course Category: Program Elective	Course Type: Theory	L	T	P	C	
		3	0	0	3	
COURSE OBJECTIVES:						
<ul style="list-style-type: none">To understand the state of stress within retained soil masses.To develop critical thinking skills to identify potential failure modes and assess risk factors.To understand the principles of soil-structure interaction and the behavior of sheet pile walls under different loading scenarios.To understand the mechanisms of soil movement and the potential risks associated with seepage and soil liquefaction.To understand the basic principles of slurry-supported trenches and their applications.						
UNIT 1 - EARTH PRESSURE THEORIES						9
Introduction – State of stress in retained soil mass – Earth pressure theories – Classical and graphical techniques (Culmann’s method) – Active and passive cases – Earth pressure due to external loads.						
UNIT 2 - COMPACTION, DRAINAGE AND STABILITY OF RETAINING STRUCTURES						9
Retaining structure – Selection of soil parameters - Lateral pressure due to compaction, strain softening, wall flexibility, drainage arrangements and its influence. – Stability analysis of retaining structure both for regular and earthquake forces.						
UNIT 3 - SHEET PILE WALLS						9
Types of sheet piles - Analysis and design of cantilever and anchored sheet pile walls – free earth support method – fixed earth support method. Design of anchor systems - isolated and continuous.						
UNIT 4 - SUPPORTED EXCAVATIONS						9
Lateral pressure on sheeting in braced excavation, stability against piping and bottom heaving. Earth pressure around tunnel lining, shaft and silos – Soil anchors – Soil pinning –Basic design concepts.						
UNIT 5 - SLURRY SUPPORTED EXACAVATION						9
Slurry supported trenches-basic principles-slurry characteristics-specifications-diaphragm walls bored pile walls-contiguous pile wall-secant piles-stability analysis.						
TOTAL: 45 PERIODS						

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

CO1:	Analyse the earth pressure acting on retaining structures by applying classical theories considering all influencing parameters and suggest the earth pressure to be considered for the design of retaining structures.
CO2:	Apply the knowledge of engineering and earth pressure to analyse and design rigid retaining structures considering effect of compaction, wall flexibility, pore water pressure and earth quake forces.
CO3:	Apply the knowledge of engineering and earth pressure to analyse and design flexible earth retaining walls and also acquire the knowledge of design of anchors
CO4:	Apply the knowledge on lateral earth pressure behind and around excavation to analyse and design braced excavations, slurry supported excavations and underground utilities.
CO5:	To understand the role of slurry in supporting excavations and to perform stability analysis by considering the actual shape of slurry support

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	1	2	3	1	2	2	1	3	1	1	1	-
CO2	1	2	1	2	2	-	1	3	2	2	1	1	2	-
CO3	2	3	1	1	1	-	1	3	1	2	1	1	-	-
CO4	1	2	2	1	1	1	1	2	1	1	2	2	-	1
CO5	1	1	1	3	1	2	1	1	3	1	1	1	-	2

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Clayton, C.R.I., Militisky, J. and Woods, R.I., Earth pressure and Earth-Retaining structures, Second Edition, Survey University Press, 1993.
2. Das, B.M., Principles of Geotechnical Engineering, Fourth Edition, The PWS series in Civil Engineering, 1998.
3. Militisky, J. and Woods, R., Earth and Earth retaining structures, Routledge, 1992.

REFERENCE BOOKS:

1. Winterkorn, H.F. and Fang, H.Y., Foundation Engineering Handbook, GalgotiaBooksSource, 2000.
2. Koerner, R.M. Designing with Geosynthetics, Third Edition, Prentice Hall, 1997.

WEB RESOURCES:

1. <https://www.laterlite.com/applications/geotechnical/earth-retaining-structures/>

CE606507 – SOIL STRUCTURE INTERACTION						
Course Category: Program Elective	Course Type: Theory		L	T	P	C
			3	0	0	3
COURSE OBJECTIVES:						
<ul style="list-style-type: none">To study various soil response models used in soil-foundation interaction analysis.To investigate the analysis of beams of finite length.To understand numerical methods commonly used for the analysis of finite plates.To apply theoretical concepts and analytical methods.To understand the principles of dynamic loads and their effects on ground-foundation interaction.						
UNIT 1 - SOIL-FOUNDATION INTERACTION						9
Introduction to soil-foundation interaction problems, Soil behaviour, Foundation behaviour, Interface behaviour, Scope of soil foundation interaction analysis, soil response models, Winkler, Elastic continuum, Two parameter elastic models, Elastic-plastic behaviour, Time dependent behaviour.						
UNIT 2 - BEAM ON ELASTIC FOUNDATION- SOIL MODELS						9
Infinite beam, Two-parameter models, Isotropic elastic half space model, Analysis of beams of finite length, combined footings.						
UNIT 3 - PLATES ON ELASTIC CONTINUUM						9
Thin and thick rafts, Analysis of finite plates, Numerical analysis of finite plates.						
UNIT 4 - ANALYSIS OF AXIALLY AND Laterally LOADED PILES AND PILE GROUPS						9
Elastic analysis of single pile, Theoretical solutions for settlement and load distributions, Analysis of pile group, Interaction analysis, Load distribution in groups with rigid cap, Load deflection prediction for laterally loaded piles, Subgrade reaction and elastic analysis, Interaction analysis, Pile-raft system						
UNIT 5 - GROUND-FOUNDATION- STRUCTURE INTERACTION						9
Effect of structure on ground-foundation interaction, Static and dynamic loads.						
TOTAL: 45 PERIODS						

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

CO1:	Evaluate the concepts of soil-foundation interaction.
CO2:	Create the basic concepts of beam on elastic foundation – soil models.
CO3:	Create the basic concepts of plates on elastic continuum.
CO4:	Evaluate the analysis of axially and laterally loaded piles and pile groups.
CO5:	Evaluate the basic concepts of ground –foundation-structure interaction.

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	3	-	2	1	2	1	2	3	1	3	-	1	2
CO2	1	2	-	-	2	1	2	1	1	1	2	3	2	1
CO3	2	1	1	-	1	1	1	2	2	2	1	1	1	1
CO4	1	1	1	1	-	3	3	2	1	2	3	1	1	2
CO5	2	2	2	1	-	1	1	2	1	2	3	2	2	1

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Rolando P. Orense, Nawawi Chouw & Michael J. Pender – Soil-Foundation-Structure Interaction, CRC Press, 2010 Taylor & Francis Group, London, UK.
2. Selvadurai, A. P. S. – Elastic Analysis of Soil-Foundation Interaction, 1979

REFERENCE BOOKS:

1. Soil Structure Interaction – The real behaviour of structures, the institution of structural engineers, London, March 1989.
2. Poulos, H. G., and Davis, E. H. – Pile Foundation Analysis and Design, 1980

WEB RESOURCES:

1. <https://nptel.ac.in/courses/105105200>

CE606508 – GEOTECHNICAL EARTHQUAKE ENGINEERING (NPTEL)						
Course Category: Program Elective	Course Type: Theory	L	T	P	C	
		3	0	0	3	
COURSE OBJECTIVES:						
<ul style="list-style-type: none">To understand the principles and concepts of geotechnical earthquake engineering.To understand the uses and applications of strong ground motion and wave propagation data in earthquake engineering.To understand the methods for measuring and estimating dynamic soil properties.To develop proficiency in conducting seismic hazard analysis and site response analysis.To explore the principles of seismic design for geotechnical structures.						
UNIT 1 - INTRODUCTION						9
Introduction to Geotechnical Earthquake Engineering - Basics of Vibration Theory - Engineering Seismology						
UNIT 2 - GROUND MOTION						9
Strong Ground Motion - Wave Propagation – its uses and applications						
UNIT 3 - DYNAMIC SOIL PROPERTIES						9
Dynamic Soil Properties – its types, applications and uses						
UNIT 4 - HAZARD ANALYSIS						9
Seismic Hazard Analysis - Site Response Analysis – various types						
UNIT 5 - ANALYSIS AND DESIGN ON GEOTECHNICAL STRUCTURES						9
Seismic Analysis and Design of Various Geotechnical Structures and its types						
TOTAL: 45 PERIODS						
COURSE OUTCOMES: At the end of the course, the student will be able to						
CO1:	Understand the basic concepts of geotechnical earthquake engineering.					
CO2:	Know about the ground motion.					
CO3:	Create the basic concepts of dynamic soil properties.					
CO4:	Understand the basic ideas about hazard analysis and response analysis.					
CO5:	Evaluate the basic ideas about the analysis and design on geotechnical structures.					
CO-PO MAPPING						

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	1	2	3	1	2	2	-	2	2	1	-	2
CO2	1	3	2	1	2	2	1	3	-	1	1	3	-	1
CO3	2	2	2	1	1	1	1	3	1	-	1	2	-	1
CO4	1	1	3	2	1	1	1	1	2	-	-	1	-	2
CO5	3	2	1	3	1	3	1	1	1	-	1	1	1	1
1- low, 2 - medium, 3 - high, '-' no correlation														
TEXT BOOKS:														
1. Murthy, V.N.S., “Soil Mechanics and Foundation Engineering”, CBS Publishers Distribution Ltd., New Delhi. 2015 2. Gopal Ranjan and Rao, A.S.R., “Basic and Applied Soil Mechanics”, New Age Ltd. International Publisher New Delhi (India) 2006.														
REFERENCE BOOKS:														
1. Das, B.M., “Principles of Geotechnical Engineering”. Brooks / Coles / Thompson Learning Singapore, 8th Edition, 2013. 2. Punmia, B.C., “Soil Mechanics and Foundations”, Laxmi Publications Pvt. Ltd. New Delhi, 2005														
WEB RESOURCES:														
1. https://nptel.ac.in/courses/105101134														

CE606509 – UNSATURATED SOIL MECHANICS (NPTEL)						
Course Category: Program Elective	Course Type: Theory		L	T	P	C
			3	0	0	3
COURSE OBJECTIVES:						
<ul style="list-style-type: none">To understand the mechanisms governing water retention and drainage characteristics in unsaturated soils.To understand the concept of water retention in soils and its significance.To investigate laboratory testing techniques for suction-controlled direct shear tests.To understand the properties and behavior of bentonite clay.To explore the importance of unsaturated soil mechanics.						
UNIT 1 - FUNDAMENTAL PRINCIPLES AND CONSTITUTIVE RELATIONSHIPS						9
Fundamental Aspects of Unsaturated Soil Mechanics and its Basic Principles - Phases of Unsaturated Soils-I - Phases of Unsaturated Soils-II - Equilibrium between Air and Water Phases - Capillary Phenomenon in Unsaturated Soils-I - Capillary Phenomenon in Unsaturated Soils-II						
UNIT 2 - SUCTION MEASUREMENT AND CONTROL TECHNIQUES						9
Concept of Water Retention and Soil Water Characteristics - Hydraulic conductivity functions and determination of state variables - Suction Measurement/Control Techniques - HCF Determination - SWCC and HCF Models - HCF Modeling - Fitting of SWCC & HCF modeling - Pedo-transfer Functions (PTF)						
UNIT 3 - STEADY-STATE FLOW THROUGH SOILS						9
Steady-State & Transient Flow - Analytical Methods for Transient Flow - Shear Strength of Unsaturated Soils - Suction-Controlled Direct Shear Test - Suction-Controlled Triaxial Test - Extended M-C Criterion - Concept of "Suction Stress"						
UNIT 4 - SHEAR STRENGTH OF UNSATURATED SOILS						9
Estimation of Swelling Pressure in the Laboratory and Behaviour of Collapsible soil Volume Change Behaviour of Bentonite and Kaolin Clay						
UNIT 5 - VOLUME CHANGE SWELLING BEHAVIOR OF SOILS						9
Introduction to Volume Change Swelling Behavior of Soils - Demonstration of Various Experiments Related to Unsaturated Soil Mechanics						
TOTAL: 45 PERIODS						

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

CO1:	Evaluate the concepts of fundamental principle and constitutive relationships.
CO2:	Evaluate the concepts of suction measurement and control techniques.
CO3:	Create the basic concepts steady state flow through soils.
CO4:	Create the basic ideas about shear strength of unsaturated soils.
CO5:	Evaluate the conceptual ideas of swelling behavior of soil.

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	3	2	3	1	3	2	1	2	-	1	2	1	2
CO2	2	2	1	2	1	-	1	2	1	-	2	1	1	1
CO3	1	-	2	1	2	-	1	1	1	-	2	1	2	1
CO4	1	-	1	1	1	1	1	1	2	1	3	2	1	1
CO5	3	1	1	1	1	2	3	3	1	2	2	1	1	3

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Analysis and Design of Shallow and Deep Foundations, Lymon C Reese, William M Isenhowe and Shin-Tower Wang, John Wiley and Sons, 2005.
2. Analysis and Design of Substructures, Swami Saran, Oxford and IBH Publishing, New Delhi, 2008.

REFERENCE BOOKS:

1. Winterkorn, H.F. and Fang, H.Y., Foundation Engineering Handbook, Galgotia Books, 2000.

WEB RESOURCES:

1. <https://nptel.ac.in/courses/105103177>

CE606510 – GEOSYNTHETICS ENGINEERING IN THEORY AND IN PRACTICE (NPTEL)						
Course Category: Program Elective	Course Type: Theory	L	T	P	C	
		3	0	0	3	
COURSE OBJECTIVES:						
<ul style="list-style-type: none">To gain knowledge of the different types of geosynthetics.To understand the mechanisms and concepts of pavement engineering.To understand the construction procedures for geotechnical structures using various facing elements.To understand the principles and applications of geocell/geofoam systems.To understand the advantages of using the LSS model in slope stability analysis.						
UNIT 1 - INTRODUCTION						9
Background of reinforced earth, mechanism and concepts, Basis of reinforced earth wall design. - Geosynthetics classifications, functions, applications, raw materials used.- Different types of Geosynthetics, manufacturing, system, Design and sustainability. - Various properties of Geosynthetics, physical properties, mechanical properties, hydraulic properties & endurance properties, Nano material. - Mechanism of filtration and drainage functions & their applications, - Design step for erosion control and geocomposite drainage.						
UNIT 2 - MECHANISM AND CONCEPTS						9
Mechanisms and concept of pavement, design of unpaved road, Giroud and Noiray method, U.S. Forest services, airfield pavement design, reflection cracking, pavement rehabilitation and repair, Nano material.						
UNIT 3 - TYPES OF FACING ELEMENTS						9
Different types of facing elements, construction procedure, cost, design of Geosynthetics wrap around faced wall, geogrid reinforced soil walls, geocell wall, gabion wall. Model for single and multi-layer reinforced slopes, guidelines for design of reinforced slopes, software for reinforced soil slopes. Design of basal reinforced embankment, placement of Geosynthetics, construction procedure, widening of existing road embankments. Consolidation techniques, Development of design chart for prefabricated vertical drains, ground instrumentation and monitoring, Design of encased stone columns						
UNIT 4 - GEOFOAM SYSTEMS						9
geocell/geofoam systems. Bearing capacity of Geosynthetics reinforced soil system, geocell reinforced sand overlaying soft clay. Geotextile tubes, geotextile containers, geotextile bags,						

dewatering waste and contaminated sediments, installation and design of geotextile tube.

UNIT 5 - GEOFOAM PROPERTIES	9
Design of landfill liner, veneer slope stability without and with seismic analysis, run out length, settlement of landfill, advantage of LSS model. Applications, advantage, function of geofoam, physical, mechanical and thermal properties of geofoam, design of embankment using geofoam, geofoam reinforced soil walls, New light weight fill material.	
TOTAL: 45 PERIODS	
COURSE OUTCOMES: At the end of the course, the student will be able to	
CO1:	Create the basic introductory form of geosynthetics and its importance.
CO2:	Evaluate the ideas about mechanism of geosynthetics.
CO3:	Create the basic concepts and types of facing element.
CO4:	Evaluate the ideas about geoform system
CO5:	Evaluate the ideas about landfill liner.

CO-PO MAPPING														
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	-	3	1	2	2	1	3	1	-	2	-	1	2
CO2	1	1	2	2	1	-	2	2	1	-	1	1	2	1
CO3	1	3	1	1	1	-	1	3	2	-	1	2	1	1
CO4	2	3	1	1	1	1	1	2	1	1	2	1	1	1
CO5	1	1	1	2	3	2	-	2	-	2	-	1	1	-
1- low, 2 - medium, 3 - high, '-' no correlation														

TEXT BOOKS:
1. Clayton, C.R.I., Militisky, J. and Woods, R.I., Earth pressure and Earth-Retaining structures, Second Edition, Survey University Press, 1993.
2. Das, B.M., Principles of Geotechnical Engineering, Fourth Edition, The PWS series in Civil Engineering, 1998.
3. Militisky, J. and Woods, R., Earth and Earth retaining structures, Routledge,1992.

REFERENCE BOOKS:
1. Winterkorn, H.F. and Fang, H.Y., Foundation Engineering Handbook, GalgotiaBooksSource, 2000.
2. Koerner, R.M. Designing with Geosynthetics, Third Edition, Prentice Hall, 1997.

WEB RESOURCES:
1. https://nptel.ac.in/courses/105101143

VERTICALS 6

CE606601 – RAILWAY INFRASTRUCTURE PLANNING AND DESIGN						
Course Category: Program Elective	Course Type: Theory		L	T	P	C
			3	0	0	3
COURSE OBJECTIVES:						
<ul style="list-style-type: none">• To know about railway track components and function.• To assess geometric design of railway track• To study the track construction and maintenance.• To learn the crossings and safety of railway tracks.• To study the station yards of railway station.						
UNIT 1 - RAILWAY PLANNING						9
General: Development of railways in India, Permanent way and railway track components, different gauges in India, conning of wheels, Functions of various Components - Rails, Sleepers and Ballast, Rails - types of rails, rail sections, defects in rails, creep of rails, rail fixtures and fastenings, rail joints and welding of rails, sleepers – types, spacing and density, Ballast – types, advantages and disadvantages, Subgrade – Requirement, embankment.						
UNIT 2 - GEOMETRIC DESIGN OF RAILWAY TRACK						9
Gradients, grade compensation, speed of trains on curves, super elevation, cant deficiency, negative super elevation, curves, widening on curves. Track layouts, Switches, Tongue Rails, Crossings, Layout of Turnout – Double Turnout, Diamond crossing, Scissors crossing.						
UNIT 3 - TRACK CONSTRUCTION AND MAINTENANCE						9
Track laying, inspection and maintenance, maintenance tools, maintenance of rail surface, track drainage, track tolerances, mechanized method, ballast confinement and directed track maintenance, bridge maintenance, renewal, classification of renewal works, mechanized relaying, track renewal trains.						
UNIT 4 - SIGNALING, INTERLOCKING AND SAFETY						9
Objectives, classification, fixed signals, stop signals, signaling systems, mechanical signaling system, electrical signaling system, systems for controlling train movement, interlocking, modern signaling installations. Safety measures classification of level crossings, accidents at level crossings, remedial measures, maintenance of level crossings.						
UNIT 5 - RAILWAY STATION AND YARDS						9
Site selection, facilities, classification, platforms, building areas, types of yards, catch sidings, slip sidings, foot over bridges, subways, cranes, weighbridge, loading gauge, end loading ramps,						

locomotive sheds, triangles, traverser, carriage washing platforms, buffer stop, scotch block, derailling switch, sand hump, fouling mark.

TOTAL: 45 PERIODS

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

CO1:	Plan the railway network.
CO2:	Determine factors governing the design of railway infrastructure.
CO3:	Develop maintenance strategies for the railway track system
CO4:	Design the railway track system and identify a suitable signal system
CO5:	Recommend suitable measures for the safety of the railway network

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	3	2	-	1	2	3	1	1	1	2	2	1
CO2	3	3	1	2	-	3	2	1	2	1	1	2	2	1
CO3	2	3	3	2	-	1	2	3	1	1	1	2	2	1
CO4	3	3	1	2	2	3	2	1	2	1	-	2	2	2
CO5	3	2	3	3	2	-	2	-	-	1	-	2	2	1

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Saxena, S.C., and Arora, S.P A Textbook of Railway Engineering, Dhanpat Rai Publications, New Delhi, India, 2017, 8th Edition.
2. Subramanian K.P., "Highways, Railways, Airport and Harbour Engineering", Scitech Publications, 7th Edition 2010.
3. Mundrey, J.S Railway Track Engineering, Tata McGraw-Hill Education Private Limited, New Delhi, India, 2017, 5th Edition

REFERENCE BOOKS:

1. Venkatramaiah. C., Transportation Engineering-Vol.2 Railways, Airports, Docks and Harbours Bridges and Tunnels, Orient Blackswan Private Limited, Kindle Edition, 2018
2. Rangwala, S.C Railway Engineering, Charotar Publishing House Pvt. Ltd., Anand, India, 2017, 27th Edition.
3. Chandra, S., and Agarwal, M.M , Railway Engineering,, Oxford University Press, Noida, India, 2013, 2nd Edition.

WEB RESOURCES:

1. <https://rdso.indianrailways.gov.in>
2. <https://www.ircen.gov.in>

CE606602 – AIRPORT INFRASTRUCTURE PLANNING AND DESIGN						
Course Category: Program Elective	Course Type: Theory	L	T	P	C	
		3	0	0	3	
COURSE OBJECTIVES:						
<ul style="list-style-type: none">To learn the airport planning and layout.To study the runway and taxiway orientation.To find the structural airport design pavements.To study the lighting and marking systems.To find the terminal planning and area design.						
UNIT 1 – AIRPORT PLANNING						8
Air transport characteristics - airport classification – ICAO - airport planning- Site selection typical - Airport layouts, case studies, parking and circulation area.						
UNIT 2 - GEOMETRIC DESIGN OF AIRFIELD						10
Airport classification - runway configuration - runway orientation - wind rose diagram (problems) - estimating runway length - sight distance and longitudinal profile - transverse gradient - airfield separation requirements - obstacle clearance requirements. Taxiway and taxilane separation requirements - sight distance and longitudinal profile - exit taxiway geometry - location of exit taxiways - design of taxiway curves and intersections - end-around taxiways - aprons						
UNIT 3 - STRUCTURAL DESIGN OF AIRPORT PAVEMENTS						9
FAA pavement design methods - equivalent aircraft method - cumulative damage failure method - design of flexible pavements - design of rigid pavements – joints - joint spacing - continuously reinforced concrete pavements - design of pavement overlays.						
UNIT 4 - AIRPORT LIGHTING, MARKING, AND SIGNAGE						8
Requirements - approach lighting system configurations - visual approach slope aids – threshold lighting - runway lighting - taxiway lighting - runway and taxiway marking - airfield signage.						
UNIT 5 - PLANNING AND DESIGN OF TERMINAL AREA						10
Passenger terminal system - design considerations - terminal demand parameters – facility classification - level of service criteria. Terminal planning process - overall space requirements - Concept development - horizontal distribution concepts - vertical distribution concepts. Apron gate system - number of gates - ramp charts - gate size - aircraft parking type - apron layout. - Apron circulation - passenger conveyance to aircraft - apron utility requirements.						
TOTAL: 45 PERIODS						

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

CO1:	Gain an insight on the planning and site selection of airport planning.
CO2:	Determine the orientation of runways.
CO3:	Design geometrics of the airport infrastructure.
CO4:	Determine the lighting and marking systems.
CO5:	Design thickness of the runway, taxiway, and apron.

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	3	2	3	1	2	3	1	1	1	2	2	1
CO2	3	3	1	2	2	3	2	1	2	1	1	2	2	1
CO3	2	3	3	2	3	1	2	3	1	1	1	2	2	1
CO4	3	3	1	2	2	3	2	1	2	1	-	2	2	2
CO5	3	2	3	3	-	-	2		-	1	-	2	2	1

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Khanna.S.K. Arora.M.G and Jain.S.S, Airport Planning and Design, Nem Chand & Bros, 6th Edition 2022
2. Robert Honjeff and Francis X.Mckelvey, "Planning and Design of Airports, McGraw-Hill Education, 5th Edition 2010.
3. Subramanian K.P., "Highways, Railways, Airport and Harbour Engineering", Scitech Publications, 7th Edition 2010.

REFERENCE BOOKS:

1. 1. Sharma S. K, Principles, Practice and Design of Highway Engineering Including Airport Pavements, S. Chand Publishing, 2014
2. Venkatramaiah. C., Transportation Engineering-Vol.2 Railways, Airports, Docks and Harbours Bridges and Tunnels, Orient Blackswan Private Limited, Kindle Edition, 2018
3. Young, S.B., and Wells, A.T, Airport Planning and Management, McGraw-Hill Education, New York, USA, 7th Edition 2019.

WEB RESOURCES:

1. <https://archive.nptel.ac.in/courses/114/106/114106025/>
2. <https://archive.nptel.ac.in/courses/105/107/105107123/>

CE606603 – WATERWAY INFRASTRUCTURE PLANNING AND DESIGN						
Course Category: Program Elective	Course Type: Theory		L	T	P	C
			3	0	0	3
COURSE OBJECTIVES:						
<ul style="list-style-type: none">• To know about harbour planning and site investigation.• To study the construction of breakwaters and navigations.• To learn the harbour repair works and facilities.• To study the demand estimation and port facilities.• To assess the coastal production and inland transportation.						
UNIT 1 – HARBOUR PLANNING						10
Types of water transportation, water transportation in India, requirements of ports and harbors, classification of harbors, selection of site and planning of harbors, location of harbor, traffic estimation, master plan, ship characteristics, harbor design, turning basin, harbor entrances, type of docks, its location and number, Site investigations – hydrographic survey, topographic survey, soil investigations, current observations, tidal observations.						
UNIT 2 - HARBOUR WORKS						8
Design and construction of breakwaters, berthing structures - jetties, fenders, piers, wharves, dolphins, trestle, moles, navigational aids, requirements of signals, fixed navigation structures, the necessity of navigational aids, light houses, beacon lights, floating navigational aids, light ships, buoys, radar.						
UNIT 3 - DOCKS AND REPAIR FACILITIES						9
Harbor docks, use of wet docks, design of wet docks, repair docks, lift docks, dry docks, keel and bilge blocking, construction of dry docks, gates for dry docks, pumping plant, floating docks, slipways, locks, size of the lock, lock gates, types of gates						
UNIT 4 - PORT FACILITIES AND DEMAND ESTIMATION						9
Port development, port planning, port building facilities, transit sheds, warehouses, cargo handling facilities, container handling terminal facilities, shipping terminals, inland port facilities. Forecasting demand for services of a new port, Optimal handling capacity estimation, Evaluation, and management of port projects - Long-term port planning						
UNIT 5 – DREDGING AND COASTAL PROTECTION						9
Classification, types of dredgers, choice of dredger, uses of dredged materials, coastal erosion and protection, sea wall, revetment, bulkhead, coastal zone, and beach profile. Inland Navigation: Inland						

waterways, Inland water transportation in India, classification of waterways, the economics of inland waterways transportation, national waterways.

TOTAL: 45 PERIODS

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

CO1:	Plan and design harbour facilities.
CO2:	Discriminate harbour works, berthing structure.
CO3:	Design repair facilities and construction of dry docks
CO4:	Design port facilities and forecasting demand
CO5:	Design coastal protection facilities, plan navigational aids and inland navigation for safe operations

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	-	2	2	1		2	1	2	2	1
CO2	3	2	2	2	-	2	2	1	2	2	2	2	2	1
CO3	3	2	2	2	-	2	2	1	2	2	2	2	2	1
CO4	3	2	3	2	-	2	3	1	1	1	1	2	2	1
CO5	3	2	2	2	-	2	3	1	2	2	2	2	2	1

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Subramanian K.P., "Highways, Railways, Airport and Harbour Engineering", Scitech Publications, 7th Edition 2010.
2. Bindra, S.P, Docks and Harbour Engineering, Dhanpat Rai and Sons, 2012, 9th Edition.
3. Srinivasan R. and Rangwala S.C , Harbour, Dock and Tunnel Engineering,, Charotar Publishing House, 2018, 29th Edition

REFERENCE BOOKS:

1. Venkatramaiah. C., Transportation Engineering-Vol.2 Railways, Airports, Docks and Harbours Bridges and Tunnels, Orient Blackswan Private Limited, Kindle Edition, 2018
2. Seetharaman, S, Dock and Harbour Engineering, , Umesh Publications, New Delhi, India, 1999
3. Hasmukh P. Oza and Gautam H. Oza, Dock and Harbour Engineering, Charotar Publishing House Pvt. Ltd, 2012.

WEB RESOURCES:

1. <https://nptel.ac.in/courses/114/106/114106025/#>
2. <http://dredge-india.nic.in/ops-main-page.html>

CE606604 – ROAD SAFETY SYSTEM						
Course Category: Program Elective	Course Type: Theory		L	T	P	C
			3	0	0	3
COURSE OBJECTIVES:						
<ul style="list-style-type: none">• To helps in identifying the reasons for road accidents.• To learn the all safety measure in accident.• To helps in identifying the scientific Investigation of road accidents.• To provides knowledge on road safety audit.• To assess the accident cast methodology.						
UNIT 1 – INTRODUCTION						9
Accident Scenarios – Global, National , Regional and Mega City Levels - Causes of accidents – Human factors – Vehicles – Road and its condition – Environmental Factors- Conventional methods and Inadequacies- Case studies – Application of Dynamic Simulation Modeling in Accident Prediction						
UNIT 2 - ACCIDENT STUDIES						9
Accident Data Collection - Accident prevention- Types of Statistics- Accident Rates – Statistical Methods in Accident Analysis-Crash reconstruction Theories –All Safety Measures for Road Safety - Computer Record Systems –RADMS- Case studies.						
UNIT 3 - ACCIDENT ANALYSIS TECHNIQUES						9
Collision and Condition Diagram – Preparation, Spatial Analysis of Accidents – Methods and GIS in Accident Analysis - Black Spot, Black Route and Area Identification. Conventional Accident Prediction Models – Development – Empirical Bayees Approach – Before and After Evaluation – Case Studies						
UNIT 4 - ROAD SAFETY AUDIT						9
Introduction to safety- Road safety management system- Need for Road Safety Audit – Concept and Elements of Safety Audit – Safety Audit for existing roads – Legal requirements – Provisions of Motor Vehicle Act and role of NGO’s in prevention of accidents. Case Studies.						
UNIT 5 - ACCIDENT COSTING						9
Trends in cost of Road Accidents - Significance -- Conventional Methods - Application of Dynamic Modeling in Crash Costing-Economic Analysis of Road Accident Cost in India.						
TOTAL: 45 PERIODS						

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

CO1:	Apply the knowledge of science and engineering fundamentals in developing an efficient road safety system.
CO2:	Explain concepts and analysis of accident data collection and studies.
CO3:	Knowledge in accident analysis techniques with various advanced methods.
CO4:	Concepts & Significance of road safety audit and management system with case studies.
CO5:	Conduct research pertinent to road accident costing and to communicate effectively to different stakeholders as well as engage in independent life-long learning

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2	2	2	2	2	2	2	2	2	1
CO2	3	3	2	2	2	2	2	2	2	2	2	2	2	1
CO3	3	3	2	2	2	2	2	2	2	2	2	2	2	1
CO4	3	3	3	2	2	2	3	2	2	2	2	2	2	1
CO5	3	3	2	2	2	2	3	2	2	2	2	2	2	1

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Subramanian K.P., "Highways, Railways, Airport and Harbour Engineering", Scitech Publications, 7th Edition 2010.
2. Dhillon B.S, "Transportation Systems Reliability and Safety"-, CRC Press Publication, USA, 1st Edition 2011.
3. Martin Belcher, Steve Proctor and Phil Cook (2011), "Practical Road Safety Auditing"-, ICE Publication, Scotland, 3rd Edition 2011

REFERENCE BOOKS:

1. Geetam Tiwari, Dinesh Mohan, "Transport Planning and Traffic Safety: Making Cities, Roads, and Vehicles Safety"- CRC Press Publication, USA 1st Edition, 2016.
2. Ministry of Surface Transport, "Accident Investigation and Prevention Manual for Highway Engineers in India, Government of India, 2001.
3. Martin Belchar, "Practical Road Safety Auditing", Ice Publishing, 2015

WEB RESOURCES:

1. <https://ncert.nic.in/vocational/pdf/ivas104.pdf>
2. <https://roadsafety.piar.org/en/road-safety-management/safe-system-approach>

CE606605 – INTELLIGENT TRANSPORTATION SYSTEMS							
Course Category: Program Elective	Course Type: Theory		L	T	P	C	
			3	0	0	3	
COURSE OBJECTIVES:							
<ul style="list-style-type: none">To learn the fundamentals of ITS.To study the ITS functional areasTo learn the ITS traffic management.To provides knowledge on ITS planning and network operation.To have an overview of ITS implementation in developing countries							
UNIT 1 – ITS HISTORY							9
ITS Background and Telemetric systems: Definitions, features, and objectives of ITS, History of ITS and its development worldwide, telemetric concept, transport telemetric, telemetric structure, ITS taxonomy, ITS application areas, uses, and application overview.							
UNIT 2 - DATA COLLECTION THROUGH ITS							9
Sensors & its application in traffic data collection - Elements of Vehicle Location and Route Navigation and Guidance concepts; ITS Data collection techniques – vehicle Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), GIS, RFID, video data collection, Internet of Things (IOT)							
UNIT 3 - ITS IN TRAFFIC MANAGEMENT							9
ITS User Needs and Services and Functional areas –Introduction, Advanced Traffic Management systems (ATMS), Advanced Traveler Information systems (ATIS), Advanced Vehicle Control systems (AVCS), Advanced Public Transportation systems (APTS), Advanced Rural Transportation systems (ARTS)- Autonomous Vehicles- Autonomous Intersections.							
UNIT 4 - ITS IN TRANSPORTATION PLANNING							9
ITS and safety, ITS and security- Traffic and incident management systems; ITS and sustainable mobility, travel demand management, electronic toll collection, ITS and road-pricing; Transportation network operations – public transportation applications- Weight –in Motion.							
UNIT 5 - ITS APPLICATION IN LOGISTICS							9
Commercial vehicle operations and intermodal freight-Fleet Management- IT application in freight logistics-E commerce - ITS standards - development process - legal issues - financial issues- Mainstreaming ITS- integration and up-gradation - Future of ITS - case studies							

TOTAL: 45 PERIODS

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

CO1:	Identify and differentiate ITS user services and their components.
CO2:	Gain knowledge on data collection using sensors and its applications.
CO3:	Acquainted with the knowledge of ITS in Traffic Management
CO4:	Application of ITS in Transportation Planning
CO5:	Select suitable standards for effective implementation of ITS.

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	2	3	2	2	1	3	1	2	2	2	1
CO2	2	2	1	3	3	2	2	2	3	2	3	2	2	1
CO3	2	1	2	2	2	3	1	1	3	2	1	2	2	1
CO4	2	2	1	3	2	3	1	1	3	1	3	2	2	1
CO5	3	2	1	3	3	2	1	2	3	2	3	2	2	1

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Srinivasa Kumar R, "Intelligent Transportation Systems", Universities Press P Ltd, Telangana, 2022
2. Chowdhury M.A. and A. Sadek, Fundamentals of Intelligent Transportation Systems Planning, Artech House, 2010, 1st Edition.
3. Sarkar, Pradip Kumar, and Amit Kumar Jain, Intelligent Transport Systems, PHI Learning, 2018, 1st Edition.

REFERENCE BOOKS:

1. Intelligent Transport Systems: Cases and Policies, Roger Stough, Edward Elgar, 2001.
2. Henry F. Korth, and Abraham Silberschatz, Data Base System Concepts, McGraw Hill, 1992
3. Kan Paul Chen, John Miles ITS Hand Book 2000: Recommendations for World Road Association (PIARC).

WEB RESOURCES:

1. <http://digital-library.theiet.org/content/journals/iet-its>
2. https://www.its.dot.gov/research_areas/data_access.html

CE606606 – ENVIRONMENTAL IMPACTS OF TRANSPORTATION						
Course Category: Program Elective	Course Type: Theory		L	T	P	C
			3	0	0	3
COURSE OBJECTIVES:						
<ul style="list-style-type: none">To know about EIA Concepts.To learn the environmental law and regulations.To study the prediction of environmental pollutionsTo find the EIA methodologies.To assess the mitigation measures and polices of transport technologies.						
UNIT 1 - TRANSPORT AND ENVIRONMENT						9
Environment and its interaction with human activities - Environmental imbalances - Attributes, Impacts, Indicators and Measurements - Concept of Environmental Impact Assessment, Environmental Impact Statement, Objectives of EIA, Advantages and Limitations of EIA.						
UNIT 2 - ENVIRONMENTAL STANDARDS, LAWS AND REGULATIONS						9
Laws protecting the environment include environmental protection, air, noise pollution, motor vehicle acts, town and country planning, and development control regulation.						
UNIT 3 - PREDICTION OF AIR AND NOISE POLLUTION						9
Factors affecting air pollution from road traffic - vehicle characteristics - engine types - vehicle age and maintenance - driving conditions - average speed - temperature - meteorological conditions - emission inventory - dispersion of pollutants - inverse air quality models - emission and dispersion models - driving cycles - macroscopic and microscopic modeling at the Microscopic level of air pollution from road traffic - road traffic noise model (RTNM) – Calixto model - acoustical assessment.						
UNIT 4 - METHODOLOGIES						9
Methodologies Criteria - Adhoc – checklist - matrix - network- overlays - benefit-cost analysis - choosing a methodology - IRC code.						
UNIT 5 - MITIGATION MEASURES AND POLICIES						9
Cleaner fuels - vehicle technology - replacement strategies improving fuel efficiency - encouraging non-motorized and public transport - taxation on emissions - noise barriers - land use planning - resurfacing roads with low-noise materials - managing traffic flows – advanced construction methods.						
TOTAL: 45 PERIODS						

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

CO1:	Examine the effect of transportation on the environment.
CO2:	Differentiate various environmental standards
CO3:	Estimate air pollution and noise pollution due to surface transportation.
CO4:	Carryout an environmental impact assessment.
CO5:	Apply various measures to mitigate the pollution caused by transportation.

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2	2	2	1	1	1	-	2	2	1
CO2	3	2	2	2	2	2	2	1	1	1	-	2	2	1
CO3	3	2	2	2	2	2	2	1	2	1	-	2	2	1
CO4	3	2	2	2	2	2	2	2	1	1	2	2	2	1
CO5	3	2	2	2	2	2	2	2	1	1	2	2	2	1

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Louis Franklin Cohen and Gary Richard McVoy, Environmental Analysis of Transportation Systems, , John Wiley & Sons, 1982.
2. Peter Morris and Riki Therivel, Methods of Environmental Impact Assessment (Natural and Built Environment Series), Routledge, 2009, 3rd Edition.
3. Anjaneyulu Y and Valli Manickam, Environmental Impact Assessment Methodologies, BS Publications, 2nd Edition, 2007

REFERENCE BOOKS:

1. Canter, L.W., Environmental Impact Assessment, McGraw Hill Pub. Co., New York, 1997
2. Guidelines for Environmental Impact Assessment for Highway Projects, IRC: 104, Indian Roads Congress, India, 1988.
3. Transport Policy and Environment, David Banister, E&FN Spain, 1999

WEB RESOURCES:

1. <http://www.nap.edu/catalog/10354.html>
2. <https://www.digimat.in/nptel/courses/video/105107210/L15.html>

CE606607 – TRAFFIC ENGINEERING AND MANAGEMENT (NPTEL)						
Course Category: Program Elective	Course Type: Theory		L	T	P	C
			3	0	0	3
COURSE OBJECTIVES:						
<ul style="list-style-type: none">• To identifying traffic characteristics and survey.• To learn the traffic flow and design service.• To identifying the traffic management techniques.• To provides knowledge on design of road intersection.• To assess parking plan and design criteria.						
UNIT 1 - TRAFFIC SURVEYS AND ANALYSES						9
Traffic characteristics: Human, vehicular, and Pavement Characteristics, Problems- presentation of traffic volume data, Annual Average Daily Traffic, Average Daily Traffic, Design hourly traffic volume; Speed- spot speed, presentation of spot speed data, speed and delay studies, methods of conducting spot-speed studies and Speed and Delay studies; Problems Origin and Destination – methods of conducting the survey and presentation of data; parking surveys, presentation of data and analyses, determination of parking demand; Accident studies and analyses; Different problems.						
UNIT 2 - TRAFFIC FLOW AND ROADWAY CAPACITY						9
Traffic Flow Characteristics – Basic traffic manoeuvres, Traffic stream flow characteristics, SpeedFlow- Density Relations; Passenger Car Units – Mixed traffic flow and related issues – Concept of PCU value- Factors affecting PCU values- Recommended PCU values for different conditions; Capacity and Level of Service – Factors affecting practical capacity – Design Service Volumes.						
UNIT 3 - COST – EFFECTIVE TRAFFIC MANAGEMENT TECHNIQUES						9
Traffic System Management: Regulatory Techniques- one way street, Reversible Street, Reversible lane, Turning moment restrictions, closing streets; Traffic Control Devices – Traffic Signs – Road Markings, Traffic Signals, Miscellaneous traffic control devices; Traffic Segregation – Vehicle segregation, Pedestrian segregation, Traffic signals design; Bus Priority Techniques – Priority manoeuvres – With-flow bus lane and contra-flow bus lane; Self- Enforcing Techniques- Demand Management Techniques (TDM) Road pricing, parking control, Tolls, Staggering of office/educational institution hours.						
UNIT 4 - DESIGN OF ROAD INTERSECTIONS						9
Importance and Classification; Intersections at-grade – uncontrolled, channelised; Rotary intersections (problems)- Signalised intersections (problems)- Grade Separated Intersections – merits and demerits,						

types, pattern of intersections with different types of interchanges- Capacity, Concept diagrams.														
UNIT 5 - DESIGN OF PARKING AND PEDESTRIAN FACILITIES AND CYCLE TRACKS													9	
Parking: Need for parking studies and its ill effects- Parking Standards for different land uses, different types of parking - Conceptual plans for different types of parking; Pedestrians: Importance, Barriers, Behaviour, Pedestrian facilities – Principles of planning, Level of Service (LoS), Design standards.; Cycle Tracks: Principles of design, Design criteria, Design standards for Rural Expressways.														
TOTAL: 45 PERIODS														
COURSE OUTCOMES: At the end of the course, the student will be able to														
CO1:	Analyze the problems and relating it with standards													
CO2:	Apply the principles of traffic flow characteristics and their relationships													
CO3:	Determine the various traffic management measures in addressing the demand Pricing and ITS applications.													
CO4:	Designing various types of control and regulatory measures to meet an efficient t traffic network.													
CO5:	Explain the various type of facilities and plan for non motorised transport													
CO-PO MAPPING														
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	1	1	1	1	2	2	3	1	2	1
CO2	3	3	3	3	3	2	1	2	3	1	3	1	2	2
CO3	3	2	3	2	1	1	1	2	2	3	2	1	2	1
CO4	3	3	3	3	3	2	2	2	2	3	3	1	2	1
CO5	3	2	2	2	1	2	3	3	2	2	2	1	2	1
1- low, 2 - medium, 3 - high, '-' no correlation														
TEXT BOOKS:														
1. Kadiyali. L.R. Traffic Engineering and Transport Planning, Khanna Publishers, Delhi, 2019.														
2. Khanna .K and Justo C.E.G. and Veeraragavan, A Highway Engineering, Nem Chand Bros., Roorkee,10th Edition, 2014														
3. Papacosta.P.S and Prevedouros.P.D, “ Transportation Engineering and Planning, 3 rd Edition, 2015														

REFERENCE BOOKS:
<ol style="list-style-type: none">1. Indian Roads Congress (IRC) Specifications: Guidelines and special publications on Traffic Planning and Management.2. Salter. R.I and Hounsell N.B, Highway Traffic Analysis and design, Macmillan Press Ltd.1996.3. Roger P.Roess, William R.Mcshane and Elena S.Prassas, Traffic Engineering-2nd Edition, Prentice Hall Publishers,, Upper Saddle River, New Jersey 1998
WEB RESOURCES:
<ol style="list-style-type: none">1. https://archive.nptel.ac.in/courses/105/101/105101008/2. https://nptel.ac.in/courses/105101008

CE606608 – PAVEMENT ENGINEERING						
Course Category: Program Elective	Course Type: Theory		L	T	P	C
			3	0	0	3
COURSE OBJECTIVES:						
<ul style="list-style-type: none">• To gains knowledge on various pavement materials.• To have the knowledge on IRC guidelines for designing flexible pavement.• To have the knowledge on IRC guidelines for designing rigid pavement.• To provides knowledge on pavement construction.• To assess quality and serviceability conditions of roads						
UNIT 1 - PAVEMENT MATERIALS AND SUBGRADE ANALYSIS						8
Introduction – Pavement as layered structure – Pavement types -rigid and flexible-Subgrade analysis- Stress and deflections in pavements- Pavement Materials and Testing- Modified Binders.						
UNIT 2 - DESIGN OF FLEXIBLE PAVEMENTS						10
Flexible pavement design – Advantages and disadvantages -Factors influencing design of flexible pavement, Empirical – Mechanistic empirical and theoretical methods – Design procedure as per IRC guidelines – Design and specification of rural roads.						
UNIT 3 - DESIGN OF RIGID PAVEMENTS						9
Cement concrete pavements Factors influencing CC pavements – Modified Westergaard approach – Design procedure as per IRC guidelines – Concrete roads and their scope in India.						
UNIT 4 - PAVEMENT CONSTRUCTION, EVALUATION AND MAINTENANCE						10
Construction Techniques practice of flexible and concrete pavement Pavement Evaluation - Causes of distress in rigid and flexible pavements – Evaluation based on Surface Appearance, Cracks, Patches and Pot Holes, Undulations, Raveling, Roughness, Skid Resistance. Structural Evaluation by Deflection Measurements - Pavement Serviceability index, - Pavement maintenance (IRC Recommendations only).						
UNIT 5 - STABILIZATION OF PAVEMENTS						8
Stabilization with special reference to highway pavements – Choice of stabilizers – Testing and field control - Stabilization for rural roads in India – Use of Geosynthetics in roads						
TOTAL: 45 PERIODS						

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

CO1:	Get knowledge about types of rigid and flexible pavements
CO2:	Design of rigid pavements
CO3:	Design of flexible pavements
CO4:	Determine the causes of distress in rigid and flexible pavements.
CO5:	Understand stabilization of pavements, testing and field control

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	1	-	3	1	-	2	1	-	1	2	1
CO2	2	1	3	1	2	-	1	-	2	1	-	2	2	1
CO3	3	3	3	2	3	3	2	3	1	1	2	3	2	1
CO4	2	3	2	2	2	3	3	3	-	1	3	3	2	1
CO5	3	2	1	1	2	3	1	3	-	1	3	3	2	1

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Khanna, S.K. and Justo C.E.G. and Veeraragavan, A, "Highway Engineering", New Chand and Brothers, Revised 10th Edition, 2014.
2. Kadiyali, L.R., "Principles and Practice of Highway Engineering", Khannatech. Publications, New Delhi, 2015.
3. Subramanian K.P., "Highways, Railways, Airport and Harbour Engineering", Scitech Publications, 7th Edition 2010.

REFERENCE BOOKS:

1. Yoder, R.J. and Witchak M.W. "Principles of Pavement Design", John Wiley 2000
2. Guidelines for the Design of Flexible Pavements, IRC-37-2012, The Indian roads Congress, New Delhi
3. Guideline for the Design of Rigid Pavements for Highways, IRC 58-2018, The Indian Road Congress, New Delhi.

WEB RESOURCES:

1. <https://archive.nptel.ac.in/courses/105/107/105107219/>
2. <https://www.youtube.com/watch?v=exctAga2KXY>

CE606609 – URBAN PLANNING AND DEVELOPMENT (NPTEL)						
Course Category: Program Elective	Course Type: Theory		L	T	P	C
			3	0	0	3
COURSE OBJECTIVES:						
<ul style="list-style-type: none">• To have the knowledge on urban classification area.• To have the knowledge on planning process and theories.• To identifying the development plan and evaluation.• To provides knowledge on plan implementation and development projects.• To identifying the regulations and laws related to urban planning.						
UNIT 1 - INTRODUCTION						7
Definition of Human settlement, Urban area, Town, City, Metropolitan City, Megalopolis, Urbanisation, Urbanism, Suburbanisation, Urban sprawl, Peri-urban areas, Central Business District (CBD), Urban Agglomeration, Census definition of urban settlements, Classification of urban areas – Positive and negative impacts of urbanisation, - Atal Mission for Rejuvenation and Urban Transformation (AMRUT)						
UNIT 2 - PLANNING PROCESS AND THEORIES						10
Principles of Planning –Stages in Planning Process – Goals, Objectives, Delineation of Planning Areas, Draft Plans, Evaluation, Final Plan. Planning Theories - Garden City Concept, Geddesian Triad by Patrick Geddes, Modernism Concept by Le-Corbusier, Radbun Concept, Neighbourhoods, Theories of Ekistics, Bid-rent Theory by William Alonso, Green Belt Concept						
UNIT 3 - DEVELOPMENT PLANS, PLAN FORMULATION AND EVALUATION						10
Types of plans – Regional Plan, Master Plan, Structure Plan, Detailed Development Plan, New Town/ Satellite town- Development Plan, urban nodes, Smart City Plan -Scope and Content of Regional Plan (RP), Master Plan (MP), and the Detailed Development Plan (DDP), Methodologies for the preparation of the RP, MP, and the DDP – Case Studies.						
UNIT 4 - PLAN IMPLEMENTATION						10
Planning Standards, Project Formulation and evaluation; Project Report preparation and presentation; Legal, Financial and Institutional constraints – Problems due to multiple laws, rules and institutions; Financing of Urban Development Projects; Urban planning agencies and their functions in the plan formulation and implementation - Waste collection planning for urban area						
UNIT 5 - URBAN AND REGIONAL PLANNING LEGISLATIONS, REGULATIONS AND DESIGNS						8

Town and Country Planning, Local Bodies and Land Acquisition Acts, Development and Building Rules, Site analyses, Layouts and Buildings Design.

TOTAL: 45 PERIODS

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

CO1:	Find the basic issues and meaning of terminologies in urban planning
CO2:	Explain the different types of theories of urban planning and city development.
CO3:	Apply the different types of plan, their strategies and their preparation process.
CO4:	Comprehend the planning standards, evaluate the constraints and the financial mechanism
CO5:	Knowledge on various town and country planning acts and their functions.

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	2	1	-	3	3	1	3	1	3	1	2	1
CO2	2	1	3	2	-	3	2	2	2	1	3	2	2	1
CO3	3	1	3	1	-	2	3	1	2	2	2	1	2	1
CO4	2	1	2	2	2	1	2	2	3	1	3	2	2	1
CO5	3	2	1	2	-	3	2	2	2	2	3	2	2	1

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Goel, S.L Urban Development and Management, Deep and Deep publications, New Delhi 2002.
2. George Chadwick, A Systems view of planning, Pergamon press, Oxford 1978
3. Singh V.B, Revitalised Urban Administration in India, Kalpaz publication, Delhi, 2001

REFERENCE BOOKS:

1. Tamil Nadu Town and Country Planning Act 1971, and Rules made thereunder, Government of Tamil Nadu, Chennai
2. Thooyavan, K.R., Human Settlements – A Planning Guide to Beginners, M.A Publications, Chennai, 2005
3. Urban & Regional Development Plans Formulation & Implementation (URDPFI) Guidelines, Vol I & II, Jan 2015, Govt of India, Ministry of Urban Development

WEB RESOURCES:

1. <https://archive.nptel.ac.in/courses/124/107/124107158/>
2. https://onlinecourses.nptel.ac.in/noc23_ar07/preview

CE606610 – GIS FOR TRANSPORTATION SYSTEMS (NPTEL)						
Course Category: Program Elective	Course Type: Theory		L	T	P	C
			3	0	0	3
COURSE OBJECTIVES:						
<ul style="list-style-type: none">• To have the knowledge on GIS data models.• To have the knowledge on data mapping and capture concept.• To identifying the transport network routings.• To provides knowledge on facility location and spatial aggregation.• To identifying the transportation analysis with GIS modeling.						
UNIT 1 - GIS – TRANSPORTATION DATA MODELS						9
Data Domains and Data Modelling in GIST - Data Modelling Techniques - Data Modelling and Design Issues - Graph Theory and Network Analysis - Network representation of a Transportation System - Linear referencing methods and systems - Transportation Data Models for ITS and related Applications.						
UNIT 2 - TRANSPORTATION DATA SOURCES AND INTEGRATION						9
Basic Mapping Concepts - Transportation Data Capture and Data Products - Transportation Data Integration - Spatial Data Quality - Spatial and Network aggregation.						
UNIT 3 - SHORTEST PATHS AND ROUTING						9
Fundamental Network Properties - Fundamental Properties of Algorithms - Shortest Path Algorithms - Routing Vehicles within Networks.						
UNIT 4 - NETWORK FLOWS AND FACILITY LOCATION						9
Flow-through Uncongested Networks - Flow-through Congested Network - Facility location within Networks - Spatial Aggregation in Network Routing and location problems.						
UNIT 5 - GIS-BASED SPATIAL ANALYSIS AND MODELING						9
GIS and spatial analysis - Urban sprawl - GIS Analytical functions - Coupling Transportation Analysis and Modelling with GIS - Customizing GIS - Supporting Advanced Transportation Analysis in GIS.						
TOTAL: 45 PERIODS						

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

CO1:	Develop GIS-T Data Models
CO2:	Represent Transportation Data in GIS Environment.
CO3:	Analyze Transport Networks.
CO4:	Integrate ITS with GIS.
CO5:	Model spatial and transportation facilities in GIS

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	3	1	2	1	1	1	1	2	2	2
CO2	3	2	2	2	3	1	2	2	1	1	1	2	2	2
CO3	3	2	2	2	3	1	2	1	1	1	1	2	2	2
CO4	3	2	2	2	3	1	2	2	1	1	1	2	2	2
CO5	3	2	2	2	3	1	2	1	1	1	1	2	2	2

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Miller HJ and Shaw SL, Geographic Information Systems for Transportation (GIST): Principles and Applications, Oxford University Press, 2001
2. Henk J. Scholten and John Stillwell Geographical Information Systems for Urban and Regional Planning, Springer, 2010
3. C.P.Lo, Albert K. W.Yeung, Concepts and Techniques of Geographic Information Systems, Pearson, 2016, 2nd Edition

REFERENCE BOOKS:

1. Adaptation of Geographic Information Systems for Transportation, NCHRP Report 359, TRB, Washington, DC, 1993.
2. Geographic Information Systems Applications in Transit: A Synthesis of Transit Practice, TCRP Synthesis 55, TRB, 2004.
3. Simlowitz H.J., GIS Support Transportation System Planning, International GIS Sources Book.

WEB RESOURCES:

1. <https://archive.nptel.ac.in/courses/105/108/105108073/>
2. <https://archive.nptel.ac.in/courses/105/107/105107206/>

INSTITUTE ELECTIVES

CE607103-CLIMATE CHANGE ADAPTATION AND MITIGATION						
Course Category: Institutional Elective	Course Type: Theory		L	T	P	C
			3	0	0	3
COURSE OBJECTIVES:						
<ul style="list-style-type: none">To demonstrate a comprehensive understanding of the Earth's atmosphere and its role in shaping weather and climate patterns.To Analyzing the various elements related to climate change.To identify, assess, and articulate the multifaceted impacts of climate change on both natural and human systems.To critically evaluate the feasibility, effectiveness, and potential trade-offsTo identify, analyze, and evaluate various alternate fuels and renewable energy technologies						
UNIT 1 - INTRODUCTION						9
Atmosphere – weather and Climate - climate parameters – Temperature, Rainfall, Humidity, Wind – Global ocean circulation – El Nino and its effect - Carbon cycle						
UNIT 2 - ELEMENTS RELATED TO CLIMATE CHANGE						9
Greenhouse gases - Total carbon dioxide emissions by energy sector – industrial, commercial, transportation, residential – Impacts – air quality, hydrology, green space - Causes of global and regional climate change – Changes in patterns of temperature, precipitation and sea level rise – Greenhouse effect						
UNIT 3 - IMPACTS OF CLIMATE CHANGE						9
Effects of Climate Changes on living things – health effects, malnutrition, human migration, socioeconomic impacts- tourism, industry and business, vulnerability assessment- infrastructure, population and sector – Agriculture, forestry, human health, coastal areas						
UNIT 4 - MITIGATING CLIMATE CHANGE						9
IPCC Technical Guidelines for Assessing Climate Change Impact and Adaptation - Identifying adaption options – designing and implementing adaption measures – surface albedo environment-reflective roofing and reflective paving – enhancement of evapotranspiration - tree planting programme – green roofing strategies – energy conservation in buildings – energy efficiencies – carbon sequestration.						
UNIT 5 - ALTERNATE FUELS AND RENEWABLE ENERGY						9
Energy source – coal, natural gas – wind energy, hydropower, solar energy, nuclear energy, geothermal energy – biofuels – Energy policies for a cool future - Energy Audit.						
TOTAL: 45 PERIODS						

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

CO1:	an insight into carbon cycle, physical basis of the natural greenhouse effect, including the meaning of the term radiative forcing, climate change, global warming and measures to adapt and to mitigate the impacts of climate change
CO2:	understanding on the growing scientific consensus established through the IPCC as well as the complexities and uncertainties
CO3:	ability to plan climate change mitigation and adaptation projects including the use of alternate fuels and renewable energy
CO4:	Gain in-depth knowledge on climate models
CO5:	Post process the model outputs for climate impact assessment, know about adaptation strategies

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	3	-	-	-	-	-	-	-	1	-	2	2	2
CO2	-	-	-	-	-	2	2	-	-	-	-	-	2	2
CO3	2	3	-	2	3	-	-	-	-	-	-	-	2	2
CO4	2	-	2	2	3	-	-	-	2	-	-	-	2	2
CO5	-	3	-	-	3	-	-	-	3	2	3	2	2	2

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Ruddiman W.F, freeman W.H. and Company, "Earth"s Climate Past and Future", 2001
2. Velma. I. Grover "Global Warming and Climate" Change. Vol I an II. Science Publishers, 2005.
3. Dash Sushil Kumar, "Climate Change – An Indian Perspective", Cambridge University Press India Pvt. Ltd, 2007

REFERENCE BOOKS:

1. IPCC Fourth Assessment Report, Cambridge University Press, Cambridge, UK, 2007
2. Thomas E, Lovejoy and Lee Hannah "Climate Change and Biodiversity", TERI Publishers, 2005
3. Jan C. van Dam, Impacts of "Climate Change and Climate Variability on Hydrological Regimes", Cambridge University Press, 2003.

WEB RESOURCES:

1. https://onlinecourses.swayam2.ac.in/nou21_ge37/preview
2. <https://www.ipcc.ch/report/ar5/wg1/>

CE607104- SUSTAINABLE DEVELOPMENT						
Course Category: Institutional Elective	Course Type: Theory		L	T	P	C
			3	0	0	3
COURSE OBJECTIVES:						
<ul style="list-style-type: none">To introduce the basic concepts of sustainable development.To aware those about the role of technology towards environmental sustainability.To give a basic understanding of sustainable development framework, its pillars and application.To familiarize the concept of sustainable development goals and appreciate the interdependence of economic and social aspects of sustainability, recognize and analyze climate changes, concept of carbon credit and the challenges of environmental management.To inculcate and embrace sustainability practices and develop a broader understanding on green materials, energy cycles and analyze the role of sustainable urbanization.						
UNIT 1 - INTRODUCTION TO SUSTAINABLE DEVELOPMENT						9
Introduction to Sustainable Development: Glimpse into History and Current practices - Broad introduction to SD - its importance, need, impact and implications; definition coined; evolution of SD perspectives (MDGs AND SDGs) over the years; recent debates; 1987 Brundtland Commission and outcome; later UN summits (Rio summit, etc.) and outcome.						
UNIT 2 - ECOSYSTEM & SUSTAINABILITY						9
Fundamentals of ecology - types of ecosystems & interrelationships, factors influencing sustainability of ecosystems, ecosystem restoration - developmental needs. Introduction to sustainability & its factors, requirements for sustainability: food security and agriculture, renewable resources - water and energy, non-renewable resources, factors and trade-offs, sustainability conflicts, a conceptual framework for linking sustainability and sustainable development.						
UNIT 3 - FRAMEWORKS OF SUSTAINABILITY						9
Analytical frameworks in sustainability studies, sustainability metrics: criteria and indicators; the significance of quantitative and qualitative assessments of sustainability; current metrics and limitations; metrics for mapping and measuring sustainable development; application of the metrics in real scenarios.						
UNIT 4 - SUSTAINABILITY AND MANAGEMENT						9
Development , GDP ,Sustainability- concept, needs and challenges-economic, social and aspects of sustainability-from unsustainability to sustainability-millennium development goals, and protocols						

Sustainable Development Goals-targets, indicators and intervention areas Climate change- Global, Regional and local environmental issues and possible solutions-case studies. Concept of Carbon Credit, Carbon Footprint. Environmental management in industry-A case study.

UNIT 5 - SUSTAINABILITY PRACTICES	9
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Zero waste and R concept, Circular economy, ISO 14000 Series, Material Life cycle assessment, Environmental Impact Assessment. Sustainable habitat: Green buildings, Green materials, Energy efficiency, Sustainable transports. Sustainable energy: Non-conventional Sources, Energy Cycles carbon cycle, emission and sequestration, Green Engineering: Sustainable urbanization- Socio economic and technological change.

TOTAL: 45 PERIODS

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

CO1:	Recognize the basics about sustainable development & its Concepts.
CO2:	Understand the basic concept of Sustainable Development (SD), the environmental.
CO3:	Understand what is sustainable development framework and different governmental policies which aim for it.
CO4:	To recognize the different goals of sustainable development and apply them for suitable technological advancement and societal development.
CO5:	To demonstrate the knowledge of sustainability practices and identify green materials, energy cycles and the role of sustainable urbanization

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	2	3	-	-	-	-	2	-	-
CO2	3	2	-	-	-	2	3	-	-	-	-	2	-	-
CO3	-	-	-	-	-	2	3	-	-	-	-	2	-	-
CO4	3	2	1	1	-	2	3	-	-	-	-	1	-	-
CO5	3	2	1	1	-	2	3	-	-	-	-	1	-	-

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Sustainable Engineering: Concepts, Design and Case Studies, D.T. Allen, and D.R. Shonnard, Prentice Hall,(2011
2. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall
3. Bradley. A.S; Adebayo, A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning
4. Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition, New Age International Publishers ,2018

REFERENCE BOOKS:

1. Abdul Malik, Elisabeth Grohmann. Environment protection strategies for sustainable development by. ISBN 978-94-007-1591-2.
2. Sylvie Faucheux, Martin O' Corner Jan van der strateen. Sustainable development: concepts, rationalities, and strategies, ISBN 978-94-017-3188-1.
3. Jennifer A. Elliott. An introduction to sustainable development. ISBN-13: 978- 0415590730
4. Chopra, K., and Kadekodi, G.K. (1999), Operationalising Sustainable Development, SagePublication, New Delhi

WEB RESOURCES:

1. United Nations Sustainable Development Goals (UN SDGs) - Course (nptel.ac.in)
2. System design for sustainability - Course (nptel.ac.in)

CE607105 - WATERSHED CONSERVATION AND MANAGEMENT						
Course Category: Institutional Elective	Course Type: Theory		L	T	P	C
			3	0	0	3
COURSE OBJECTIVES:						
<ul style="list-style-type: none">To provide the technical and sociological understanding of a watershed.To demonstrate a comprehensive understanding of soil conservation measures.To assess the potential of these techniques to enhance water availability, mitigate water scarcity, and improve water quality.To utilize the Geographic Information Systems (GIS) for watershed management.To understand the watershed management principles and practices.						
UNIT 1 - WATERSHED CONCEPTS						9
Watershed – Definition, Need and Elements – Principles - Influencing Factors: Geology – Soil – Morphological Characteristics - Toposheet - Delineation – Codification – Prioritization – Watershed Atlas.						
UNIT 2 - SOIL CONSERVATION MEASURES						9
Types of Erosion – Water and Wind Erosion: Causes, Factors, Effects and Management – Soil Conservation Measures: Agronomical and Mechanical – Design of Terraces and Bunds - Estimation of Soil Loss – USLE Equation - Sedimentation.						
UNIT 3 - WATER HARVESTING AND CONSERVATION						9
Yield from a Catchment - Traditional Water Harvesting Techniques – Micro-Catchments - Design of Small Water Harvesting Structures: Farm Ponds, Percolation Tanks, Check dams, Grassed Waterways.						
UNIT 4 - GIS FOR WATERSHED MANAGEMENT						9
Applications of Remote Sensing and Geographical Information System - Role of Decision Support System – Conceptual Models and Case Studies.						
UNIT 5 - WATERSHED MANAGEMENT						9
Project Proposal Formulation - Watershed Development Plan – Entry Point Activities – Watershed Economics - Agroforestry – Grassland Management – Wasteland Management – Watershed Approach in Government Programmes – People’s Participation – Evaluation of Watershed Management Programmes – Integrated Watershed Management – Case studies.						
TOTAL: 45 PERIODS						

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

CO1:	Recognize and Interpret the morphological features of a watershed.
CO2:	State, design and sketch the soil conservation structures.
CO3:	Describe the micro catchment and apply the concepts to design the small water harvesting structures.
CO4:	Illustrate the application of modern tools and technology in the management of watershed.
CO5:	Classify the management activities and to develop an integrated watershed development plan.

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	1	1	-	1	-	3	2	-	2	2	1
CO2	3	2	2	2	1	2	2	1	1	2	1	2	2	2
CO3	3	2	2	2	1	2	2	1	1	2	1	2	2	2
CO4	-	-	-	-	3	-	-	-	3	2	2	2	2	1
CO5	-	2	2	2	-	2	2	3	3	3	2	2	2	2

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Ghanashyam Das, Hydrology and Soil Conservation Engineering, Prentice Hall of India Private Limited, New Delhi, Second Edition, 2009.
2. Suresh, R. Soil and Water Conservation Engineering, Standard Publishers and Distributors Private Limited, New Delhi, 2020.

REFERENCE BOOKS:

1. Glenn O Schwab. et al, Soil and Water Conservation engineering, Wiley India Private Limited, 2009.
2. Heathcote, I. W. Integrated Watershed Management: Principles and Practice. John Wiley and Sons, Inc., New York, Second Edition 2009.
3. John G. Lyon, GIS for Water Resources and Watershed Management, CRC Press, 2002.
4. Vijay P. Singh, Donald K. Frevert, Watershed Models, CRC Press, 2005.
5. Vir Singh, Raj, Watershed Planning and Management, Bio- Green Publisher, 2016.

WEB RESOURCES:

1. <https://nptel.ac.in/courses/105101010>
2. <https://www.nptelvideos.com/course.php?id=372>

CE607203 - ENVIRONMENTAL RISK MANAGEMENT						
Course Category: Institutional Elective	Course Type: Theory		L	T	P	C
			3	0	0	3
COURSE OBJECTIVES:						
<ul style="list-style-type: none">• To Identifying and classifying environmental hazards and risks.• To study the different hazard identification.• To lean the tools that can be used in predicting and managing risks.• To learn the risk communication and management.• To study the different case studies on development projects.						
UNIT 1 - INTRODUCTION						7
Sources of Environmental hazards – Environmental and ecological risks – Environmental risk assessment framework – Regulatory perspectives and requirements – Risk Analysis and Management and historical perspective - Social benefit Vs technological risks - Path to risk analysis - Perception of risk - Risk assessment in different disciplines.						
UNIT 2 - ELEMENS OF ENVIRONMENTAL RISK ASSESSMENT						11
Hazard identification and accounting – Fate and behaviour of toxics and persistent substances in the environment – Properties, processes and parameters that control fate and transport of contaminants – Receptor exposure to environmental contaminants – Dose Response Evaluation – Exposure Assessment – Exposure Factors, Slope Factors, Dose Response calculations and Dose Conversion Factors – Risk Characterization and consequence determination – Vulnerability assessment – Uncertainty analysis.						
UNIT 3 - TOOLS AND METHODS FOR RISK ASSESSMENT						11
HAZOP and FEMA methods – Cause failure analysis – Event tree and fault tree modeling and analysis – Multimedia and multipath way exposure modeling of contaminant migration for estimation of contaminant concentrations in air, water, soils, vegetation and animal products – Estimation of carcinogenic and non-carcinogenic risks to human health – Methods in Ecological risk assessment – Probabilistic risk assessments – radiation risk assessment – Data sources and evaluation.						
UNIT 4 - RISK MANAGEMENT						7
Risk communication and Risk Perception – comparative risks – Risk based decision making – Risk based environmental standard setting – Risk Cost Benefit optimization and tradeoffs – Emergency Preparedness Plans – Emergency planning for chemical agent release – Design of risk management programs – risk based remediation; Risk communication, adaptive management, precaution and stake						

holder involvement.

UNIT 5 - APPLICATIONS

9

Case studies on risk assessment and management for hazardous chemical storage – Chemical industries – Tanneries – Textile industries – Mineral processing and Petrochemical plants – Hazardous waste disposal facilities – nuclear power plants – contaminated site remediation – Case histories on Bhopal, Chernobyl, Seveso, Three Mile Island.

TOTAL: 45 PERIODS

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

CO1:	Identify fate and behaviour of toxics and persistent substances in the environment.
CO2:	Analyse the hazard identification of risk assessment.
CO3:	Analyse the role of different evidentiary approaches to supporting risk assessments.
CO4:	Apply and to develop the skill to prepare principle of risk management for solving environmental problems.
CO5:	Evaluate environmental impact assessment reports

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	1	-	2	1	1	1	1	1	2	2	1
CO2	3	3	3	2	-	2	2	1	1	1	1	2	2	1
CO3	3	3	3	3	3	2	2	2	1	2	2	2	2	2
CO4	3	3	3	2	-	2	1	1	1	1	2	2	2	2
CO5	3	3	3	2	2	2	2	3	2	2	3	3	2	2

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Jeanne X. Kasperson, Roger E. Kasperson, Global Environmental Risk, United Nations University Press, 2nd Edition 2013.
2. Cutter, S.L., Environmental Risk and Hazards, Prentice-Hall of India Pvt. Ltd., New Delhi, 1999
3. Raghavan K. V. and A A. Khan, "Methodologies in Hazard Identification and Risk Assessment", Manual by CLRI, 1990

REFERENCE BOOKS:

1. Sam Mannan, Lees' Loss Prevention in the Process Industries, Hazard Identification, Assessment and Control, 4th Edition, Butterworth Heineman, 2012.
2. Kolluru Rao, Bartell Steven, Pitblado R and Stricoff "Risk Assessment and Management Handbook", McGraw Hill Inc., New York, 1996.
3. Kofi Asante Duah, "Risk Assessment in Environmental management", John Wiley and sons, Singapore, 1998

WEB RESOURCES:

1. https://www.google.co.in/books/edition/Risk_Assessment_Guidance_for_Superfund/E/3wISAAAAMAAJ?hl=en&gbpv=1&dq=environmental+risk+
2. https://www.google.co.in/books/edition/Framework_for_Application_of_the_Toxicit/ojAzut6oEQEC?hl=en&gbpv=1&dq=environmental+risk+assessment+websource&pg=PA25&printsec=frontcover

CE607204- ENERGY EFFICIENCY, ACOUSTICS AND DAY LIGHTING IN BUILDING						
Course Category: Institutional Elective	Course Type: Theory	L	T	P	C	
		3	0	0	3	
COURSE OBJECTIVES:						
<ul style="list-style-type: none">• To provide good knowledge regarding building technology and building services engineering.• To contribute to a low demand for purchased energy to buildings.• To provide additional knowledge regarding building physics, ventilation technology and indoor climate.• To learn the sounds and absorptive constructions.• To study day lighting and insulation of buildings.						
UNIT 1 - INTRODUCTION						8
Climate adapted and climate rejecting buildings – Heat Transfer – Measuring Conduction – Thermal Storage – Measurement of Radiation – The Greenhouse Effect – Convection – Measuring latent and sensible heat – Psychrometry Chart – Thermal Comfort – Microclimate, Site Planning and Development – Temperature – Humidity – Wind – Optimum Site Locations – Sun Path Diagrams - Sun Protection – Types of Shading Devices – Design responses to energy conservation strategies.						
UNIT 2 - DAYLIGHTING AND ELECTRICAL LIGHTING						10
Materials, components and details – Insulation – Optical materials – Radiant Barriers – Glazing materials – Glazing Spectral Response – Day lighting – Sources and concepts - Building Design Strategies – Case Studies – Daylight apertures – Light Shelves – Codal requirements – Day lighting design – Electric Lighting – Light Distribution – Electric Lighting control for day lighted buildings - Switching controls – Coefficient of utilization – Electric Task Lighting – Electric Light Zones – Power Adjustment Factors.						
UNIT 3 - DESIGN FOR CLIMATIC ZONES						10
Energy efficiency – An Overview of Design Concepts and Architectural Interventions – Embodied Energy – Low Embodied Energy Materials – Passive Downdraft Evaporative Cooling – Design of Energy Efficient Buildings for Various Zones – Cold and cloudy – Cold and sunny – Composite – Hot and dry – Moderate – Warm and humid – Case studies of residences, office buildings and other buildings in each zones – Commonly used software packages in energy efficient building analysis and design – Energy Audit – Certification.						

UNIT 4 - ACOUSTICS													10	
Sound waves, sound field - Acoustics and physiology, basic notions, sound levels and loudness - Sound measurement, frequency band, frequency band analysis, noise report, hygienic limits - Urban acoustics, noise attenuation - Room acoustics, diffuse sound field, sound field - Absorptive constructions, membranes and oscillating plates, Helmholtz resonators. Sound insulation, rating of air-born and structure-born sound insulation - Air- born sound insulation, Watter’s method.														
UNIT 5 - DAY LIGHTING													7	
Day lighting: Lighting principles and fundamentals – Design Sky, Indian sky, daylight prediction and design of fenestration – Ceiling reflector – Floor slope – Reverberation time – Sound in enclosure – Glare index - Methods for evaluation of day lighting in buildings - day lighting and insulation for the building design.														
TOTAL: 45 PERIODS														
COURSE OUTCOMES: At the end of the course, the student will be able to														
CO1:		Demonstrate a good ability to calculate the energy balance of buildings												
CO2:		Evaluate different opportunities to save energy with measures regarding both building technology and building services engineering												
CO3:		Assess the potential conflict between energy conservation and indoor climate for different energy saving measures												
CO4:		Determination of requirements for indoor acoustic comfort and design of building protection against exterior noise.												
CO5:		Design for natural ventilation and day lighting & design of space for external and internal noise control.												
CO-PO MAPPING														
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	-	-	-	-	1	-	-	-	2	2	1
CO2	3	2	3	-	-	-	-	1	-	-	-	2	2	1
CO3	3	2	3	-	-	-	-	1	-	-	-	2	2	1
CO4	3	2	3	2	-	-	-	1	-	-	-	2	2	1
CO5	3	2	3	-	-	-	-	1	-	-	-	2	2	1
1- low, 2 - medium, 3 - high, '-' no correlation														
TEXT BOOKS:														
1. Brown, G.Z. and DeKay, M., Sun, Wind and Light – Architectural Design Strategies, John Wiley and Sons Inc,3rd Edition, 2014.														
2. Majumdar, M, Energy – Efficient Buildings in India, Tata Energy Research Institute, Ministry of Non-Conventional Energy Sources, 2009.														
3. Markus,T.A. & Morris, E.N., "Building Climate and Energy" Pitman publishing limited. 1980.														

REFERENCE BOOKS:
<ol style="list-style-type: none">1. A.K.Mittal, “Electrical and Mechanical Services in High Rise Building: Design and Estimation Manual”, CBS, 2015.2. Descottes, Herve and Cecilia E. Ramos, “Architectural Lighting: Designing with Light and Space, Princeton Architectural Press, Princeton, 2013.3. The Lighting Handbook, IES, 2011 and National Lighting Code, SP 27:2010.
WEB RESOURCES:
<ol style="list-style-type: none">1. https://archive.nptel.ac.in/courses/105/102/105102175/2. https://www.digimat.in/nptel/courses/video/105102175/L01.html

CE607303 - PLASTIC WASTE MANAGEMENT						
Course Category: Institutional Elective	Course Type: Theory		L	T	P	C
			3	0	0	3
COURSE OBJECTIVES:						
<ul style="list-style-type: none">To identify, evaluate, and characteristic sources of environmental pollutants.Understanding and implementing primary recycling techniques for plastic wastes.Understanding and implementing secondary recycling techniques for plastic wastes.Understanding and implementing tertiary recycling techniques for plastic wastes.Implementing strategies to reduce and prevent plastic waste disposal.						
UNIT 1 - SOURCES AND CHARACTERIZATION						9
Plastic and environment value additions, global policy, regulations, waste energy management. Waste treatment of various plastic plants, estimations of power requirement & efficiency of size reduction operation of plastics, environment pollution aspects. Need for recycling – Sorting and segregation of waste – Plastics identification- Plastics Production and composition – Plastics waste – Composition, quantities and disposal alternatives.						
UNIT 2 - PRIMARY RECYCLING OF PLASTIC WASTES						9
Primary recycling – Equipment’s for primary recycling. Specific recycling techniques – PE films, PP battery case – Crushing and separation – PET films.						
UNIT 3 - SECONDARY RECYCLING OF PLASTIC WASTES						9
Recycling of plastics from urban waste – rheology, density, mechanical behavior. Secondary recycling Plastics wastes containing paper – hydrolytic treatment – processing methods – processing of mixed plastics waste – household waste – industrial sector – TPO based materials.						
UNIT 4 - TERTIARY RECYCLING OF PLASTIC WASTES						9
Use of recyclable plastics in motor vehicles – recoverable materials – disposal of residuals – recyclable plastic components – virgin and recycled HDPE – Fluorinated and unfluorinated HDPE – fuel tanks. Tertiary recycling – Reactors used – Advantages – Dry method wet method - use of Recyclable plastics in automobiles.						
UNIT 5 - PLASTIC WASTE DISPOSAL REDUCTION AND PREVENTION						9
Overview of plastic waste disposal options (landfill, incineration, and ocean dumping) - Environmental and health impacts of plastic waste disposal - Regulations and policies for plastic waste disposal - Strategies for reducing plastic waste generation (reuse, redesign, and substitution) - Importance of public awareness and education for plastic waste reduction.						

TOTAL: 45 PERIODS

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

CO1:	Sources of plastics waste generation and the segregation methods for recycling the plastics.
CO2:	Learn about various equipment for recycling of plastics.
CO3:	Understand the process involved in secondary recycling of plastics.
CO4:	Comprehend the tertiary recycling of plastics.
CO5:	Learn about disposal reduction and prevention of plastics.

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	-	-	2	-	-	-	-	2	-	-
CO2	3	-	3	-	-	3	-	-	3	-	2	2	2	-
CO3	3	2	3	2	3	2	3	2	-	-	-	-	3	2
CO4	2	2	-	2	2	2	2	-	2	-	-	-	3	2
CO5	3	2	2	-	2	-	2	-	2	-	-	-	2	2

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Polymer recycling, Science, Technology and Applications, John Scheirs, John Wiley and Sons, England 1988.
2. Recycling of Plastic Materials (Ed), Francesco Paolo La Mantia, Chem Tec Publishing, 1993.
3. Plastics Waste Management (Ed), Nabil Mustafa, Marcel Dekker, New York, 1995.

REFERENCE BOOKS:

1. Degradable polymers, Recycling and Plastic Waste Management (Eds) Ann Christine Albertson and Samuel J. Huang, Marcel Dekker, New York.
2. Recycling and Plastics Waste Management, Edited by Dr.J.S.Anand, CIPET, 1997.
3. John Schiles, Polymer Recycling.

WEB RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc20_ce13/preview
2. <https://archive.nptel.ac.in/courses/105/102/105102012/>

CE607304 – WASTE TO ENERGY CONVERSION						
Course Category: Institutional Elective	Course Type: Theory		L	T	P	C
			3	0	0	3
COURSE OBJECTIVES:						
<ul style="list-style-type: none">• Develop a comprehensive understanding of waste to energy conversion technologies and their role in sustainable waste management practices• Analyze and evaluate the suitability of different waste to energy conversion technologies for different types of waste streams• Develop skills in project planning, implementation, and evaluation of waste to energy projects• Enhance critical thinking and problem-solving skills related to waste management and renewable energy• Develop communication and teamwork skills through group projects and presentations						
UNIT 1 - INTRODUCTION TO WASTE TO ENERGY CONVERSION						9
Overview of waste to energy conversion - Types of waste and their characteristics - Energy potential of different waste streams - Environmental and economic benefits and drawbacks of waste to energy conversion						
UNIT 2 - WASTE COLLECTION AND HANDLING						9
Collection methods for different types of waste - Transfer and transport of waste - Waste sorting and segregation - Pre-processing of waste for energy conversion						
UNIT 3 - THERMAL CONVERSION TECHNOLOGIES						9
Combustion-based technologies: incineration, gasification, pyrolysis - Anaerobic digestion - Emerging technologies: plasma gasification, hydrothermal carbonization - Efficiency and emissions Considerations.						
UNIT 4 - BIOLOGICAL CONVERSION TECHNOLOGIES						9
Composting – Biomethanation - Anaerobic co-digestion - Efficiency and emissions considerations- the different types of biological conversion technologies and their mechanisms - Analyze the efficiency and emissions considerations of different biological conversion technologies.						
UNIT 5 - WASTE TO ENERGY PROJECT PLANNING AND IMPLEMENTATION						9
Regulatory and permitting requirements - Site selection and design considerations - Project financing and economics - Operation and maintenance considerations - Case studies of successful waste to energy projects.						

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

CO1:	Understand the fundamentals of waste to energy conversion.
CO2:	Understand the various methods of waste collection and handling.
CO3:	Understand the principles and applications of thermal conversion technologies.
CO4:	Understand the principles and applications of biological conversion technologies.
CO5:	Understand the project planning and implementation process for waste to energy conversion projects.

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	-	-	2	-	-	-	-	2	-	-
CO2	2	-	1	-	-	1	-	-	3	-	2	2	2	-
CO3	3	2	1	2	1	2	1	2	-	-	-	-	1	2
CO4	2	2	-	2	2	2	2	-	2	-	-	-	2	2
CO5	2	2	2	-	2	-	2	-	2	-	-	-	2	2

1- low, 2 - medium, 3 - high, '-' no correlation**TEXT BOOKS:**

1. "Waste to Energy Conversion Technology" by Naomi B Klinghoffer (2019)
2. "Waste Management Practices: Municipal, Hazardous, and Industrial" by John Pichtel (2018).
3. "Anaerobic Digestion of Organic Waste: A Renewable Source of Biogas and Soil Fertilizer" by M.R. El-Fadel and L.T.M. Jijakli (2019).

REFERENCE BOOKS:

1. "Waste to Energy: Technologies and Project Implementation" by Marc J. Rogoff and Francois Screve (2011).
2. Anaerobic Digestion of Organic Waste: A Renewable Source of Biogas and Soil Fertilizer" by M.R. El-Fadel and L.T.M. Jijakli (2019).
3. "Renewable Energy Finance: Powering the Future" by Charles W. Donovan (2015).

WEB RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc20_ch16/preview
2. <https://www.perlego.com/book/1829721/waste-to-energy-conversion-technology-pdf>

CE607402 – ELECTRONIC WASTE MANAGEMENT						
Course Category: Institutional Elective	Course Type: Theory		L	T	P	C
			3	0	0	3
COURSE OBJECTIVES:						
<ul style="list-style-type: none">• Understanding and navigating the sources, classification, and regulatory framework surrounding environmental pollutants.• To demonstrate proficiency in waste characterization and implementing source reduction strategies.• To minimize environmental risks and hazards.• To evaluate the suitability of different processing technologies for various types of waste streams.• Design and implement sustainable waste disposal solutions that prioritize waste reduction, pollution prevention, and environmental protection.						
UNIT 1 - SOURCES, CLASSIFICATION AND REGULATORY FRAMEWORK						9
Types and Sources of solid and hazardous wastes - Need for solid and hazardous waste management – Elements of integrated waste management and roles of stakeholders - Salient features of Indian legislations on management and handling of municipal solid wastes, hazardous wastes, biomedical wastes, lead acid batteries, electronic wastes , plastics and fly ash – Financing waste management.						
UNIT 2 - WASTE CHARACTERIZATION AND SOURCE REDUCTION						9
Waste generation rates and variation - Composition, physical, chemical and biological properties of solid wastes – Hazardous Characteristics – TCLP tests – waste sampling and characterization plan - Source reduction of wastes						
UNIT 3 - STORAGE, COLLECTION AND TRANSPORT OF WASTES						9
Handling and segregation of wastes at source – storage and collection of municipal solid wastes – Analysis of Collection systems - Need for transfer and transport – Transfer stations Optimizing waste allocation– compatibility, storage, labelling and handling of hazardous wastes – hazardous waste manifests and transport						
UNIT 4 - WASTE PROCESSING TECHNOLOGIES						8
Objectives of waste processing – material separation and processing technologies –biological & chemical conversion technologies – methods and controls of Composting.						
UNIT 5 - WASTE DISPOSAL						10
Waste disposal options – Disposal in landfills - Landfill Classification, types and methods – site						

selection - design and operation of sanitary landfills, secure landfills and landfill bioreactors – leachate and landfill gas management – landfill closure and environmental monitoring – Rehabilitation of open dumps – landfill remediation

TOTAL: 45 PERIODS

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

CO1:	Understand the concepts of sources and classifications of waste management.
CO2:	Evaluate the conceptual ideas about the waste characterisation and waste reduction.
CO3:	Create new ideologies of storage, collection and transportation of wastes.
CO4:	Create the basic ideas about waste processing technologies and its applications.
CO5:	Understanding the concepts of waste disposal methods and uses.

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	2	-	-	-	2	-	-	-	-	2	-	-
CO2	2	1	1	-	-	1	-	-	3	-	2	2	2	-
CO3	3	2	1	2	1	2	1	2	-	-	-	2	1	2
CO4	2	2	-	2	2	2	2	-	2	-	-	2	2	2
CO5	2	2	2	-	2	-	2	-	2	-	-	2	2	2

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. George Tchobanoglous et al, ||Integrated Solid Waste Management, McGraw - Hill, 2014.
2. Manual on Municipal Solid waste Management, CPHEEO, Ministry of Urban Development, Govt.of. India, New Delhi, 2000.
3. Tchobanoglous Thiesen Ellasen; Solid Waste Engineering Principles and Management, McGraw - Hill 1997.

REFERENCE BOOKS:

1. R.E.Landrefh and P.A.Rebers,|| Municipal Solid Wastes-Problems & Solutions|| ,Lewis, 1997.
2. Blide A.D.& Sundaresan, B.B,||Solid Waste Management in DevelopingCountries, INSDOC, 1993.

WEB RESOURCES:

1. <https://archive.nptel.ac.in/courses/105/105/105105169/>

CE607403 – ENVIRONMENTAL QUALITY MONITORING & ANALYSIS						
Course Category: Institutional Elective	Course Type: Theory		L	T	P	C
			3	0	0	3
COURSE OBJECTIVES:						
<ul style="list-style-type: none">To introduce about instrumental methods of monitoring the quality.To educate techniques and applications of Spectroscopic Methods.To educate techniques and applications of Chromatographic Methods.To introduce about ecological modeling, single and multi species modeling on a brief.To educate about the modeling of CSTR and the kinetics of reaction taking place in it.						
UNIT 1 - INTRODUCTION						9
Wet Chemistry methods and their limitations - Instrumental Methods, Selection of method Precision and Accuracy, Error in measuring signals - Quality control & assurance Sample preservation, Sample preparation and analyte isolation						
UNIT 2 - SPECTROSCOPIC METHODS						9
Principles, techniques and applications of spectrophotometry, fluorimetry, nephelometry and turbidimetry, Atomic Absorption Spectrometry (Flame, graphite furnace and hydride generation), Atomic Emission Spectrometry (AES) , flame and Inducted Coupled Plasma (ICP) – TOC Analyzer						
UNIT 3 - CHROMATOGRAPHIC METHODS						9
Column, Paper and thin layer chromatography (TLC)- Principles, techniques and applications of GC, GC-MS, High performance liquid chromatography (HPLC) and Ion chromatograph (IC)- Hyphenated techniques for Environmental contaminant(trace organics) analysis						
UNIT 4 - ECOLOGICAL SYSTEM						9
Basic concepts in ecology and ecological modeling, Population Dynamics: Birth and death processes. Single species growth, Prey-predator models: Lotka-Volterra, Rosenzweig-MacArther, Kolmogorov models. Multi-species modeling - Structural analysis and stability of complex ecosystems						
UNIT 5 - CONTINUOUS-FLOW REACTOR MODELING						9
CSTR, Plug-Flow, Dispersion. A case study of a tubular reactor with axial dispersion, Parameter Calibration: Search algorithms for nonlinear dynamical models, Variance of estimated parameters. Application to Monod and Haldane kinetics						
TOTAL: 45 PERIODS						

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

CO1:	Understand the concept of various instrumentation techniques.
CO2:	Learn techniques and applications of Spectroscopic Methods.
CO3:	Learn techniques and applications of Chromatographic Methods.
CO4:	Understand the basic concept of Ecological System.
CO5:	Learn parameters of modeling of CSTR.

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	-	-	2	-	-	-	-	2	-	-
CO2	2	-	1	-	-	1	-	-	3	-	2	2	2	-
CO3	3	2	1	2	1	2	1	2	-	-	-	-	1	2
CO4	2	2	-	2	2	2	2	-	2	-	-	-	2	2
CO5	2	2	2	-	2	-	2	-	2	-	-	-	2	2

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Barceló, D.(editor), "Environmental analysis. Techniques, Applications and Quality Assurance", Elsevier, The Netherlands, 1996.
2. Deaton, M.L and Winebrake, J.J., "Dynamic Modeling of Environmental Systems", Springer-Verlag, 2000.
3. Willard H. Merritt, L. Dean, D.A. and Settle, F.A. 'Instrumental methods of analysis Edn. Words Worth, New York, 2004.

REFERENCE BOOKS:

1. Reeve, R.N., "Introduction to Environmental Analysis", Analytical Techniques in the Sciences, John Wiley & Sons, Chichester, UK, 2002.
2. Paul R. Loconto Trace Environmental Quantitative Analysis: Principles, Techniques, and Applications, Marcel Dekker; 1 edition (May 2001)
3. Orhon, D and Artan, N., "Modeling of Activated Sludge Systems, Technomic" Publ. Co., 1994.

WEB RESOURCES:

1. <https://archive.nptel.ac.in/courses/103/106/103106162/>
2. <https://www.env.go.jp/earth/coop/coop/materials/14-tbseme/14-tbseme.pdf>