

Maulana Abul Kalam Azad University of Technology, West Bengal
(Formerly West Bengal University of Technology)

Syllabus for B. Tech in Civil Engineering
(Applicable from the academic session 2018-2019)

Semester VIII [Fourth year]

CE(HS)801A	Professional Practice, law & Ethics	2L	2 Credits	
Module 1	<p>Professional Practice – Respective roles of various stakeholders: Government(constituting regulatory bodies and standardization organizations, prescribing norms to ensure safety of the citizens); Standardization Bodies (ex. BIS, IRC)(formulating standards of practice);professional bodies (ex. Institution of Engineers(India), Indian Roads Congress, IIA/COA, ECI, Local Bodies/ Planning Authorities) (certifying professionals and offering platforms for interaction);Clients/ owners (role governed by contracts); Developers (role governed by regulations such asRERA); Consultants (role governed by bodies such as CEAI); Contractors (role governed by contracts and regulatory Acts and Standards); Manufacturers/ Vendors/ Service agencies (rolegoverned by contracts and regulatory Acts and Standards)</p> <p>Professional Ethics – Definition of Ethics, Professional Ethics, Business Ethics, Corporate Ethics, Engineering Ethics, Personal Ethics; Code of Ethics as defined in the website of Institution of Engineers (India); Profession, Professionalism, Professional Responsibility, Professional Ethics; Conflict of Interest, Gift Vs Bribery, Environmental breaches, Negligence, Deficiencies in state-of-the-art; Vigil Mechanism, Whistleblowing, protected disclosures.</p>		4L	
Module 2	<p>General Principles of Contracts Management: Indian Contract Act, 1972 and amendments covering General principles of contracting; Contract Formation & Law; Privacy of contract; Various types of contract and their features; Valid & Voidable Contracts; Prime and subcontracts; Joint Ventures & Consortium; Complex contract terminology; Tenders, Request For Proposals, Bids & Proposals; Bid Evaluation; Contract Conditions & Specifications; Critical /“Red Flag” conditions; Contract award & Notice To Proceed; Variations & Changes in Contracts; Differing site conditions; Cost escalation; Delays, Suspensions & Terminations; Time extensions &Force Majeure; Delay Analysis; Liquidated damages & Penalties; Insurance & Taxation; Performance and Excusable Non-performance; Contract documentation; Contract Notices; Wrong practices in contracting (Bid shopping, Bid fixing, Cartels); Reverse auction; Case Studies; Build-Own-Operate & variations; Public- Private Partnerships; International Commercial Terms;</p>		18L	
Module 3:	<p>Arbitration, Conciliation and ADR (Alternative Dispute Resolution) system: Arbitration – meaning, scope and types – distinction between laws of 1940 and 1996; UNCITRAL model law –Arbitration and expert determination; Extent of judicial intervention; International commercial arbitration; Arbitration agreements – essential and kinds, validity, reference and interim measures by court; Arbitration tribunal – appointment, challenge, jurisdiction of arbitral tribunal, powers, grounds of challenge, procedure and court assistance; Award including Form and content, Grounds for setting aside an award, Enforcement, Appeal and Revision; Enforcement of foreign awards – New York and Geneva Convention Awards; Distinction between conciliation, negotiation, mediation and arbitration, confidentiality, resort to judicial proceedings, costs; Dispute Resolution Boards; Lok Adalats.</p>		5L	
Module 4:	<p>Engagement of Labour and Labour & other construction-related Laws: Role of Labour in Civil Engineering; Methods of engaging labour- on rolls, labour sub-contract, piece rate work; Industrial Disputes Act, 1947; Collective bargaining; Industrial Employment (Standing Orders) Act,1946; Workmen’s Compensation Act, 1923; Building & Other Construction Workers (regulation of employment and conditions of service) Act (1996) and Rules (1998); RERA Act 2017, NBC 2017</p>		2L	
Module 5:	<p>Law relating to Intellectual property: Introduction – meaning of intellectual property, main forms of IP, Copyright, Trademarks, Patents and Designs, Secrets; Law relating to Copyright in India including Historical evolution of Copy Rights Act, 1957, Meaning of copyright – computer programs, Ownership of copyrights and assignment, Criteria of infringement, Piracy in Internet – Remedies and procedures in India; Law relating to Patents under Patents Act, 1970 including Concept and historical perspective of patents law in India, Patentable inventions with special reference to biotechnology products, Patent protection for computer programs, Process of obtaining patent – application, examination, opposition and sealing of patents, Patent cooperation treaty and grounds for opposition, Rights and obligations of patentee, Duration of patents – law and policy considerations, Infringement and related remedies;</p>		1L	
Reference	Sl.	Book Name	Author	Publishing House
	1	Professional Ethics & Human Values	Premvir Kapoor	Khanna Publishing House

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	2	Legal Aspects of Building and Engineering Contracts	B.S. Patil	
	3	The National Building Code	BIS	
	4	Indian Contract Act	Dutta	Eastern Law House
	5	The Arbitration & Conciliation of Law in India with case law on UNCITRAL Model Law on Arbitration	Kwatra G.K.	Indian Council of Arbitration

CE(PE)801A	GIS & Remote Sensing		2L	2 Credits
Course Outcome	Upon completing the course, the students will be able to: 1. Define and state the scope GIS & remote sensing in civil engineering 2. Understand the basic principles of remote sensing and GIS 3. Apply the various methods of remote sensing and GIS to different geospatial datasets 4. Analyze the different results obtained from different remote sensing data sources 5. Evaluate the different results in solving real world problems. 6. Design and construct optimum solutions for real world problems that can be resolved by GIS & remote sensing			
Prerequisite	Knowledge of Class-XII level physics, computer science Knowledge of CE(PC)404 and CE(PC)494			
Module 1	Fundamentals of Remote Sensing: Energy sources and radiation principles; Electromagnetic Spectrum; Energy interactions in the atmosphere and with earth surface features; Atmospheric windows; Spectral response patterns and spectral signatures		3L	
Module 2	Digital Image Processing: Image rectification and restoration; Image enhancement; Image classification; Accuracy assessment; Digital change detection; Spatial, spectral, radiometric and temporal resolution characteristics of IRS, Landsat and Sentinel data.		6L	
Module 3:	Advanced Remote Sensing: Microwave remote sensing: Frequency and wavelengths, polarization, range and azimuth resolution, relief displacement, foreshortening, layover, shadows and speckles; Synthetic Aperture Radar (SAR); Indian microwave sensors; Working principles of LiDAR remote sensing		3L	
Module 4:	Advanced Digital Image Processing: Principal Component Analysis (PCA); Colour Space Transformation; Fourier Transformation; Image fusion; Hybrid classification system		3L	
Module 5:	GIS: Definition, components and applications of GIS; Spatial and attribute data; Raster vs. Vector GIS; Concept of topology; Non-topological data structures		3L	
Module 6	Database and Coordinate System: Concepts of Relational Data Base Management System (RDBMS) and geodatabase; Spatial and attribute query; Datum and projection; Universal Transverse Mercator (UTM) grid system; On-the-fly projection		3L	
Module 7	Spatial Data Analysis: Concepts of local, focal, zonal and global analysis; Proximity analysis; Distance measurement; Raster and vector overlay; Spatial interpolation; DEM and TIN, Cost surface analysis		6L	
Module 8	Applications of GIS & Remote Sensing: Watershed analysis; Runoff and erosion modelling, Location and allocation analysis; Atmospheric pollution monitoring; Urban growth modelling; Carbon sequestration and climate change		5L	
Reference	Sl.	Book Name	Author	Publishing House
	1	Principles of Geoinformatics	P.K. Garg	Khanna Publishing House
	2	Remote Sensing and Image Interpretation	Thomas M. Lillesand Ralph W. Kiefer Jonathan W. Chipman	Wiley India Edition
	3	Introduction to Geographic Information Systems	Kang-tsung Chang	Tata McGraw-Hill Publishing Company Limited
	4	Remote Sensing and GIS	Basudeb Bhatta	Oxford University Press
	5	Remote Sensing of Environment: An Earth Resource Perspective	J. R. Jensen	Pearson
	6	Applications of Geomatics in Civil Engineering	J. K. Ghosh I. de Silva (Eds.)	Springer
	7	Introductory Digital Image Processing: A Remote Sensing	J. R. Jensen	Pearson

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	Perspective		
8	Concepts and Techniques of Geographic Information Systems	C. P. Lo A. K. W. Yeung	Pearson

CE(PE)801B	Rock Mechanics		2L	2 Credits
Module 1	Composition of rocks, Engineering classification and Limitation of Geologic classification of rocks			4L
Module 2	Rock coming, various methods of obtaining rock cores, Engineering Properties of rock, stress -strain relations, elastic theory application to design in rock.			6L
Module 3:	Strength and failure of rocks, Uniaxial and triaxial strength of rocks, failure theories of rocks and propagation of cracks, Griffith Chack theory -Water in rock, Structural feature of mass rocks and their effects on engineering properties.			8L
Module 4:	Measurement of stresses -rock mass, various types of measuring devices, evaluation of properties of rocks in the field.			6L
Module 5:	Strain and displacement of the rock mass, rock reinforcement and support, subsidence.			6L
Reference	Sl.	Book Name	Author	Publishing House
	1	Engineering Rock Mechanics: An Introduction to the Principles	J. A. Hudson and J. P. Harrison	
	2	Rock Mechanics: For Underground Mining	Barry H.G.	
	3	Empirical Rock Failure Criteria	P.R. Sheorey, Balkema, Rotterdam	
	4	Rock Mechanics in Engineering Practice	K.G.Stagg and O.C.Zienkiewicz,	John Wiley and Sons
	5	Hand Book on Mechanical Properties of Rocks	V.S. Vutukuri and R D Lama	
	6	Rock Mechanics for Engineers	B.P Verma	
7	Engineering Behavior of Rocks	W. Farmer,	Chapman and Hall Ltd	

CE(PE)801C	Environmental Laws and Policy		2L	2 Credits
Course Outcome	Upon completing the course, the students will be able to: <ol style="list-style-type: none"> 1. To apply the relevant measures to mitigate pollution from different sources. 2. To understand the effects of the various pollutants on the environment as a whole according to the formulated guidelines 3. To be able to give recommendations for alternatives to reduce pollution 4. To formulate standards of the various parameters corresponding to their impact on the environment with changing time 			
Prerequisite	Basic Science, Biology, Environmental Sciences and Environmental Engineering (Including Air Quality Dispersion, Meteorology, Solid Waste Management, EIA)			
Module 1	Introduction: Environment, Nature, Ecosystem, Origin of Environmental laws, Concept of laws and policies, Environment and Governance			3L
Module 2	Sustainable Development and Environment: Understanding of Climate change Concept of Carbon Footprint, Carbon Credit, Carbon Offsetting Use of Hybrid Energy (Conventional +Non Conventional) Use of Clean Development Mechanism			6L
Module 3:	Environmental Laws (Indian Perspective) : Indian Environmental Laws and Policies			8L
Module 4:	Environmental Laws (International Perspective) : Fundamental Principles and Application of International Environmental Law, Introduction to Trade and Environment Right to Environment as Human Right International Humanitarian Law and Environment Environment and Conflict Management Focus on International Protocols- UNFCCC & Kyoto Protocol, Treaty on Antarctic & Polar Regions, UN Conventions of Law of the Sea and Regional Sea Convention, Law on International Water Courses			11L
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	1	Environmental Law and Policy	Aruna Venkat.	PHI Publication.
	2	Environmental Law and Policy	James Salzman & Burton H. Thompson (Jr.),	Foundation Press.
	3	Environmental Law	Gurdip Singh	Eastern Book Company
	4	Climate Change, Law, Policy and Governance	Usha Tandon	Eastern Book Company.

CE(PE)801D	Pavement Materials	2L	2 Credits	
Module 1	Introduction Basic road construction materials : Types of basic materials, Suitability of different materials depends on their availability and characteristics, Economic, Environmental, and Social issues of material usage, Life cycle analysis and its use in design		3L	
Module 2	Soil Classification; Index & Engineering properties of soil, Properties of sub-grade; Suitability of different type of soil for the construction of highway embankments and pavement layers; Field compaction and control. Introduction to Soil Stabilization: Physical and Chemical modification: Stabilization with admixtures like cement, lime, calcium chloride, fly ash and bitumen. A critical look at the different laboratory and in-situ procedures for evaluating the mechanical properties of soils viz. CBR, Plate Load test, resilient modulus, DCPT		7L	
Module 3:	Aggregate Characterization: Origin, classification, properties. Tests and specifications on road aggregates for flexible and rigid pavements. Importance of aggregate gradation problems on Rothfutch's and Critical sieve methods and Shape factor in mix design		6L	
Module 4:	Bitumen Binders Different types, properties and uses, Tests on bitumen, Rheological and pavement performance related properties, Criteria for selection of different binders. Marshall Method of mix design, Additives & Modifiers in Bituminous mixes, problems on mix design		6L	
Module 5:	Cement Requirements, design of mix for CC pavement, use of additives, IRC specifications & Tests, joint filler and sealer materials.		3L	
Module 6:	Modern trend of using Modified, Sustainable and Environment friendly materials Geo-Synthetics: Geo-synthetic clay liner – Construction details – Geo Synthetic Materials – Functions – Property characterization Modified bitumen: Crumb Rubber Modified bitumen, Natural rubber modified bitumen, polymer modified bitumen; Long term and short term ageing and its effect on bitumen performance Plastic waste: Types of polymer, applicability of polymer based waste product in different layers of pavement		4L	
Reference	Sl.	Book Name	Author	Publishing House
	1	Highway Engineering	L.R. Kadiyali	Khanna Book Publishing Co.
	2	Highway Engineering	Khanna and Justo	Nem Chand and Bros.
IS and IRC codes	1	IS 73, revised 2006, IS 2720, IS 2386, IS 1201 to 1220, IS 8887- 1995, IS 217- 1986		
	2	IRC: 51-1992, 63-1976, 74 –1979, 88-1984,		
	3	IRC SP: 53 – 2002, IRC SP: 58 – 2000,		
	4	“Guidelines for use of Geotextiles in Road Pavements and Associated works”- 2002; IRC		
	5	State of art, special report 3 – “compaction of earthwork and subgrade”- IRC, HRB, 1999		
	6	MoRTH ‘Specifications for Roads and Bridges Works’- Indian Roads Congress		

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CE(OE)801A	Human Resource Development and Organizational Behaviour		2L	2 Credits
Module 1	Organizational Behaviour: Definition, Importance, Historical Background, Fundamental Concepts of OB, Challenges and Opportunities for OB			2L
Module 2	Personality and Attitudes: Meaning of personality, Personality Determinants and Traits, Development of Personality, Types of Attitudes, Job Satisfaction			2L
Module 3:	Perception: Definition, Nature and Importance, Factors influencing Perception, Perceptual Selectivity, Link between Perception and Decision Making.			2L
Module 4:	Motivation: Definition, Theories of Motivation - Maslow's Hierarchy of Needs Theory, McGregor's Theory X & Y, Herzberg's Motivation-Hygiene Theory, Alderfer's ERG Theory, McClelland's Theory of Needs, Vroom's Expectancy Theory.			4L
Module 5	Group Behaviour: Characteristics of Group, Types of Groups, Stages of Group Development, Group Decision Making.			2L
Module 6	Communication: Communication Process, Direction of Communication, Barriers to Effective Communication			2L
Module 7:	Leadership: Definition, Importance, Theories of Leadership Styles			2L
Module 8:	Organizational Politics: Definition, Factors contributing to Political Behaviour.			2L
Module 9:	Conflict Management: Traditional vis-a-vis Modern View of Conflict, Functional and Dysfunctional Conflict, Conflict Process, Negotiation – Bargaining Strategies, Negotiation Process.			3L
Module 10:	Organizational Design: Various Organizational Structures and their Effects on Human Behaviour, Concepts of Organizational Climate and Organizational Culture.			4L
Reference	Sl.	Book Name	Author	Publishing House
	1	Organizational Behavior	Robbins, S. P. & Judge, T.A	Pearson
	2	Organizational Behavior	Luthans, Fred	McGraw Hil
	3	Understanding Organizations – Organizational Theory & Practice in India	Shukla, Madhuka	PHI
4	Principles of Organizational Behaviour	Fincham, R. & Rhodes, P	Oxford University Press	

CE(OE)801B	Bridge Engineering		2L	2 Credits
Course Outcome	After going through this course, the students will be able to: <ol style="list-style-type: none"> 1. Discuss basic definitions, types, and components of bridges. 2. Discuss sub-surface investigations required for bridge construction. 3. Understand standard specification and loads for bride design. 4. Perform design of different types bearings and joints for bridges. 5. Perform design of various reinforced concrete and steel bridges. 			
Prerequisite	Design of RC Structures (CE(PC)501), Structural Analysis – I (CE(PC)503), Design of Steel Structures (CE(PC)604),			
Module 1	Introduction: Definition and basic forms, components of a typical bridge, classification of bridges, site investigation, bridge hydrology and hydraulics. Loads: I.R.C loads, impact factors, wind loads, longitudinal forces, lateral forces and centrifugal forces. Bearings: Types of bearings, details of bearing, joints, design examples			3L
Module 2	Design of reinforced concrete solid slab bridge: Introduction, general design features, economic span, effective width method, simply supported and cantilever slab bridges, analysis and design.			7L
Module 3	Design of box culvert bridge: Introduction, design method and design example.			4L
Module 4	Design of a T beam bridge: Introduction, components, design of interior panel of slab, longitudinal and cross girders, Pigeaud's method, design example.			6L
Module 5	Design of composite bridge: General aspects, method of construction, analysis of composite section, shear connectors, design of composite beam.			4L

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Module 6	Design of steel bridges: General features, types of stress, design of railway truss bridge and plate girder bridge		6L
Module 7	Design of cable stayed bridge: General features, Philosophy of design.		2L
IS Codes	1	All relevant IRC and IS codes	
Reference	Sl.	Book Name	Author
	1	Prestressed Concrete	Shrikant Vanakudre
	2	Prestressed Concrete Bridges	N. Krishnaraju
	3	Design of Bridge Structures	Jagadish and Jayaram
	4	Essential Bridge Engineering	Jhonson Victor D.
	5	Design of Bridges	N. Krishnaraju
	6	Concrete Structures	Vazirani & Ratwani
	7	Design of concrete bridges	Aswani, Vazirani & Ratwani
	8	Bridge engineering	Ponnuswamy
	9	Principle & Practice of Bridge Engineering	Bindra
			McGrawHill
			Dhanpat Rai Publishing House

CE(OE)801C	Deep Foundations		2L + 0T	2 Credits
Course Outcome	On successful completion of this course, student should be able to: 1. Explain the concept of bearing capacity for deep foundation. 2. Estimate the safe bearing capacity including settlement consideration for deep foundations. 3. Select a suitable deep foundation system for various site conditions and also analysis of that. 4. Explain in what circumstances pile is needed and how to estimate pile and pile group capacity under various soil conditions Characterize.			
Prerequisite	Introduction to Civil Engineering CE(HS)302, CE(PE)601 Foundation Engineering, Soil Mechanics – II CE(PC)504, Soil Mechanics – I CE(PC)401.			
Module 1	Piles: types - load carrying capacity of pile - static and dynamic formula - pile load test - penetration test - pile groups - Efficiency - Feld's rule –Converse Labarre formula, Settlement of piles and pile groups - Negative skin friction – under-reamed piles, pile cap		10L	
Module 2	Drilled Pier: Introduction, uses, types, bearing capacity, settlement, construction procedures.		6L	
Module 3:	Cassion foundations: Types & selections, forces & moments, depth determination.		4L	
Module 4:	Well foundations: The Types, components, design of well foundations – grip, size, steining, curb, cutting edge, top & bottom plug, well cap; stability analysis of well foundation, construction, shift & tilts.		8L	
Reference	Sl.	Book Name	Author	Publishing House
	1	Principles of Foundation Engineering	Braja M. Das	Thomson Asia Pvt. Ltd., Singapore, 2005.
	2	Geotechnical Engineering, Principles and Practices,	Donald P. Coduto, Man-Chu Ronald Yeung and William A. Kitch,	PHI Learning Private limited, 2011.
	3	Soil Mechanics and Foundation Engineering	P. Purushothama Raj	Pearson publication

CE(OE)801D	Groundwater Contamination		2L + 0T	2 Credits
Course Outcome	On successful completion of this course, student should be able to: 1. To be able to understand the principles and theories regarding groundwater contamination with 2. To be able to formulate the various remedial measures for groundwater contamination			
Prerequisite	Basic Sciences, Hydrology, Meteorology and Groundwater Hydrology			
Module 1	Introduction: Definition of groundwater, hydrological properties of various water bearing strata, vertical distribution of subsurface water, groundwater in hydrologic cycle		2L	
Module 2	Groundwater Hydraulics: Darcy's Law, Dupuit's assumption, Application of Darcy's Law for simple flow systems, Governing differential equations for confined and unconfined aquifers, steady and unsteady flow solutions for fully penetrating wells, partially		7L	

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	penetrating wells, Interference of wells, Test pumping analysis with steady and unsteady flows, Delayed yield, method of images		
Module 3:	Groundwater quality: Indian & International standards		3L
Module 4:	Groundwater pollution: Sources, Remedial and preventive measures		3L
Module 5:	Groundwater conservation: Groundwater budget, seepage from surface water, artificial recharge with reclamation		3L
Module 6:	Models for Groundwater flow: Sampling & Monitoring methods, transport mechanisms, modeling (advective and dispersive transport), (adsorption and chemical reaction), biodegradation kinetics, numerical flow and transport modeling, waste site characterization/investigation, groundwater remediation, legal issues in groundwater contamination		10L
Reference	Sl.	Book Name	Author
	1	Elements of Hydrology and Groundwater	R.N. Saxena & D.C. Gupta
	2	Groundwater Contamination, Performance, Limitations and Impacts	Anna L Powell
	3	Groundwater Contamination and Remediation	Edited by Timothy D. Scheibe & David C. Mays
			Publishing House
			PHI
			Nova Science Publishers
			MDPI

CE(OE)802A	Soft Skills and Personality Development		2L	2 Credits
Module 1	Self-Growth i) Self Growth- Maslow's Hierarchy of Needs Theory ii) Anger, Stress & Time Management- Theories and application iii) SWOT Analysis		6L	
Module 2	Stepping Up i) Growth & Environment ii) Competitive Spirit iii) Responsibility Factor		7L	
Module 3:	Professional Communication i) Impression Management- theory on social psychology ii) Employability Quotient iii) Cross-cultural communication		6L	
Module 4:	Leadership & Team Playing i) Leadership & Team Playing: Theories, Styles, Stages ii) Motivation, Negotiation Skills, Conflict Management iii) Planning & Envisioning: Initiative and Innovation in the Work Environment- De Bono's Six Thinking Hats		6L	
Reference	Sl.	Book Name	Author	Publishing House
	1	Personality Development and Soft Skills	Barun K. Mitra	Oxford University
	2	Soft Skills: An Integrated Approach to Maximize Personality	Gajendra Singh Chauhan and Sangeeta Sharma	Wiley
	3	The Ace of Soft Skills: Attitude, Communication and Etiquette for Success	Gopaldaswamy Ramesh and Mahadevan Ramesh	Pearson

CE(OE)802B	Earthquake Engineering	2L	2 Credits
Course Outcome	After going through this course, the students will be able to: 1.To provide a coherent development to the students for the courses in sector of earthquake engineering. 2.To present the foundations of many basic engineering concepts related earthquake Engineering 3.To give an experience in the implementation of engineering concepts which are applied in field of earthquake engineering 4.To involve the application of scientific and technological principles of planning, analysis, design of buildings according to earthquake design philosophy.		
Prerequisite	Introduction to Solid Mechanics (CE(ES)402), Structural Analysis – I (CE(PC)503), Structural Analysis – II (CE(PE)602B), Design of RC Structures (CE(PC)501), Structural Dynamics (CE(PE)704A).		
Module 1	Seismology: Earth's Interior and Plate Tectonics; Causes of Earthquakes and Seismic Waves; Measurement of Earthquakes and Measurement parameters;	4L	

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	Modification of Earthquake due to the Nature of Soil; Seismic Hazard Analysis	
Module 2	Earthquake Inputs: Time History Records and Frequency Contents of Ground Motion; Power Spectral Density Function of Ground Motion; Concept of Response Spectrums of Earthquake; Combined D ² V ² A Spectrum and Construction of Design Spectrum; Site Specific, Probabilistic and Uniform Hazard Spectrums; Predictive Relationships for earthquake parameters;	4L
Module 3	Dynamics for Earthquake Analysis: Equations of Motion for SDOF and MDOF Systems; Undamped Free Vibration of SDOF and MDOF Systems; Mode Shapes and Frequencies of MDOF System; Rayleigh Damping Matrix; Direct Time Domain Analysis of MDOF System; Direct Frequency Domain Analysis of MDOF System; Modal Analysis in Time and Frequency Domain	4L
Module 4	Response Analysis for Specific Ground Motion: Equations of Motion for Single and Multi ² Support Excitations and Solutions; Equations of Motion in State Space and Solutions; Computational Steps for the Solutions using MATLAB; Time History Analysis of 3D Tall Buildings.	4L
Module 5	Response Spectrum Method of Analysis: Concept of Equivalent Lateral Force for Earthquake; Modal Combination Rules; Response Spectrum Method of Analysis of Structures and Codal Provisions; Response Spectrum Method of Analysis for Torsionally Coupled Systems; Response Spectrum Method of Analysis for Non ² Classically Damped Systems;	4L
Module 6	Seismic Soil - Structure Interaction: Fundamentals of Seismic Soil ² Structure Interaction; Direct Method of Analysis of Soil ² Structure 6 Interaction using FEM and Use of ABAQUS, Substructuring Method of Analysis of Soil ² Structure Interaction Problem	4L
Module 7	Inelastic Response of Structures for Earthquake Forces: Fundamental Concepts of Inelastic Response Analysis for Earthquake Forces; Solutions of Incremental Equations of Motions for SDOF Systems; Solutions of Incremental Equations of Motions for MDOF Systems; Push over Analysis; Concepts of Ductility and Inelastic Spectrum;	5L
Module 8	Base isolation for earthquake resistant design of structures: Base isolation concept, isolation systems and their modelling; linear theory of base isolation; stability of elastomeric bearings; codal provisions for seismic isolation, practical applications.	5L
IS Codes	1 IS1893: Part I (2016), 2 IS 13920: 2016 3 IS 4326	
Reference	Sl. Book Name Author Publishing House	
	1 Earthquake resistant design of Structures Agarwal and Shrikhande PHI	
	2 Earthquake-resistant design of structures S.K. Duggal, Oxford University Press.	
	3 Elements of Earthquake Engineering Jai Krishna, A. R. Chandrashekhar and Brijesh Chandra South Asian Publishers	
	4 Earthquake Resistant Design D. J. Dowrick John Willey & Sons	

CE(OE)802C	Urban Transport Planning	2L	2 Credits
Module 1	Introduction Urban morphology - Urbanization and travel demand – Urban activity systems and travel patterns – Systems approach – Trip based and Activity based approach		4L
Module 2	Urban Transportation Planning Goals, Objectives and Constraints - Inventory, Model building, Forecasting and Evaluation - Study area delineation – Zoning - UTP survey. Trip generation models – Trip classification - productions and attractions – Trip rate analysis - Multiple regression models - Category analysis. Trip distribution models – Growth factor models, Gravity model and Opportunity modes. Modal split models – Mode choice behavior – Trip end and trip interchange models - Probabilistic models – Utility functions - Logit models - Two stage model. Traffic assignment – Transportation networks – Minimum Path Algorithms - Assignment methods – All or Nothing assignment, Capacity restrained assignment and Multi path assignment - Route-choice behavior.		21L
Module 3	Scope of UTP in present scenario		5L

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	Financing of Project – urban development planning policy - Case studies.		
Reference	Sl.	Book Name	Author
	1	Transportation Engineering	L.R. Kadiyali
	2	Traffic Engineering and Transport Planning	L R Kadiyali
	3	Urban Transportation: Planning, Operation and Management	S Ponnuswamy and Johnson Victor
4	Transportation Planning: Principles, Practices and Policies	Pradeep Kumar Sarkar and Vinay Maitri	

CE(OE)802D	Environmental Impact Assessment and Life Cycle Analyses	2L	2 Credits	
Course Outcome	After going through this course, the students will be able to: <ol style="list-style-type: none"> To understand and evaluate the impact of any activity (large or small scale) on the surrounding environment To be able to formulate mitigation strategies to protect the environment leading to sustainability To be able to understand the intricacies of Life Cycle Analysis and apply basic knowledge for coherent existence 			
Prerequisite	Basic Sciences, Biology, Environmental Science and Environmental Engineering			
Module 1	Introduction Definition, Objective with legal aspect of Environmental Impact Assessment (EIA)		2L	
Module 2	Methodology for EIA with Base Line Studies, Screening , Scoping and Public Consultation		4L	
Module 3	EIA Analysis Data Collection & Environmental Impact Analysis, preparation of EIA report		5L	
Module 4	EIA Mitigation and Audit- Mitigation and Impact Management with various case studies, Environmental Audit		5L	
Module 5	Introduction to Life Cycle Analysis (LCA): History, Definition, Standards and structure of LCA Goal and Scope of LCA: System of a product with boundary, unit process and functional unit		2L	
Module 6	Life Cycle Interpretation and Inventory: Limitation of LCA, Identification of significant issues, Evaluation, Reporting, Critical Review. Inventory: Data Collection, Data Bases, Allocation, Validation		3L	
Module 7	LCA Impact Assessment and Practice: Categories, Classification, Normalization, LCA Management, Life Cycle thinking, Sustainability		4L	
Module 8	Introduction: Definition, Objective with legal aspect of Environmental Impact Assessment (EIA)		2L	
Reference	Sl.	Book Name	Author	Publishing House
	1	Environmental Impact Assessment	R. R. Barthwal,	New Age International Publication
	2	Environmental Impact Assessment	Canter	McGraw Hill Publications
	3	Environmental Impact Assessment: Theory and Practice	M. Anji Reddy	B. S. Publication
	4	Environmental Impact Assessment: Theory and Practice	Peter Wathern	CRC Press
	5	Life Cycle Assessment (LCA): A Guide to Best Practice	Walter Klöpffer , Birgit Grahl	Wiley Publishers
	6	Environmental Life Cycle Assessment	Olivier Jolliet, Myriam Saade-Sbeih, Shanna Shaked, Alexandre Jolliet, Pierre Crettaz,	CRC Press
7	Life Cycle Student Handbook	Mary Ann Curran,	Scrivener Publishing, Wiley	