Maulana Abul Kalam Azad University of Technology, West Bengal
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Semester VII [Fourth year]

CE(OE)701A	Metro System and Engineering	2L + 0T	2 Credits
Module 1	Overview of Metro Systems; Need for Metros; Routing studies; Basic Planning and Financial.		4L
Module 2	**CIVIL ENGINEERING** Overview and construction methods for: Elevated and underground Stations; Viaduct spans and bridges; Underground tunnels; Depots; Commercial and Service buildings. Initial Surveys & Investigations; Basics of Construction Planning & Management, Construction Quality & Safety Systems. Traffic integration, multimodal transfers and pedestrian facilities; Environmental and social safeguards; Track systems-permanent way. Facilities Management		12L
Module 3:	**ELECTRONICS AND COMMUNICATION ENGINEERING** Signaling systems; Automatic fare collection; Operation Control Centre (OCC and BCC); SCADA and other control systems; Platform Screen Doors.		5L
Module 4:	**MECHANICAL & TV + AC** Rolling stock, vehicle dynamics and structure; Tunnel Ventilation systems; Air conditioning for stations and buildings; Fire control systems; Lifts and Escalators		5L
Module 5:	**ELECTRICAL**: OHE, Traction Power; Substations- TSS and ASS; Power SCADA; Standby and Back-up systems; Green buildings, Carbon credits and clear air mechanics		5L

CE(OE)701B	ICT for Development	2L + 0T	2 Credits
Module 1	Introduction to ICT: New media and ICT, Different types of ICT. Use of ICT for development; e-learning; Web commerce; Mobile telephony and Development: telecom industry in India. ICT Projects implemented in India and Northeast – Problems and Prospects		7L
Module 2	Digital Revolution and Digital Communication: Basics of New media theories – Information Society; Surveillance society; Digital Divide, Knowledge society; Network society. Works of Machlup, Bell, Negroponte and Castells		6L
Module 3:	Technology and Development: ICT for Development its societal implications; Evolution of ICT in Development Endeavour; ICT and Millennium Development Goals. Democratic and decentralized processes in development. Technology and culture: community and identity; participatory culture and ICT, community informatics		8L
Module 4:	Computer Mediated Communication and development:Different types of CMC; Important theoretical framework of CMC, cyber platform and communities, Social Networking Site; Convergent media, Multimedia platforms, Scope of convergent journalism for Development; Characteristics of convergent journalism; Different types of convergent journalism: precision journalism; annotative and open-source journalism; wiki journalism; open source journalism; citizen journalism; back-pack journalism, Convergent technologies and applications; Multimedia convergence and Interactivity		10L

CE(OE)701C	Cyber Law & Ethics	2L + 0T	2 Credits
Module 1	Introduction: Basics of Law, Understanding Cyber Space, Defining Cyber Laws, Scope and Jurisprudence, Concept of Jurisdiction, Cyber Jurisdiction, Overview of Indian Legal System, Introduction to IT Act 2000, Amendments in IT Act, Cyber Laws of EU – USA – Australia - Britain, other specific Cyber laws		6L
Module 2	Computer Ethics, Privacy and Legislation: Computer ethics, moral and legal issues, descriptive and normative claims, Professional Ethics, code of ethics and professional conduct. Privacy, Computers and privacy issue, Digital Evidence Controls, Evidence Handling Procedures, Basics of Indian Evidence ACT, Legal Policies, legislative background		7L
Module 3:	Intellectual Property Rights Issues: Copyrights, Jurisdiction Issues and Copyright Infringement, Multimedia and Copyright issues, WIPO, Intellectual Property Rights, Understanding Patents, Understanding Trademarks, Trademarks in Internet, Domain name registration, Software Piracy, Legal Issues in Cyber Contracts, Authorship, Document Forgery		7L
Module 4:	Indian IT Act and Standards: Indian IT ACT, Adjudication under Indian IT ACT, IT Service Management Concept, IT Audit standards, ISO/IEC 27000 Series, COBIT, HIPPA, SOX, System audit, Information security audit, ISMS, SoA (Statement of Applicability), BCP (Business Continuity Plan), DR (Disaster		6L

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	Recovery), RA (Risk Analysis/Assessment)			
Module 5:	International Laws governing Cyber Space: Introduction to International Cyber Law, UNCITRAL, Cyber Laws: Legal Issues and Challenges in India, Net neutrality, Role of INTERPOL.			4L
Reference	Sl.	Book Name	Author	Publishing House
	1	Computer Ethics	Deborah G. Johnson	Pearsons Education
	2	Information Security and Cyber Laws	Gupta & Gupta	Khanna Publishing House
	3	Cyber Law Simplified	Vivek Sood	McGraw Hill Education
	4	Cyber frauds, cybercrimes & law in India	Pavan Duggal,	Saakshar Law Publications
	5	The Internet Law of India: Indian Law Series	Shubham Sinha	CreateSpace Independent Publishing Platform

CE(PE)701A	**Computational Hydraulics**		2L + 1T	3 Credits
Course Outcome	On successful completion of this course, student should be able to: 1. Identify the complexities involved in fluid flow problems. 2. Model the specific flow problem in terms of defining the governing equations, initial and boundary conditions and appropriate solution schemes to use. 3. Develop finite difference formulation of ordinary and partial differential equations of flow problems. 4. Develop finite volume formulation of ordinary and partial differential equations of flow problems.			
Prerequisite	Introduction to Civil Engineering CE(HS)302, Introduction to Fluid Mechanics CE(ES)401, Water Resources Engineering CE(PC)603,			
Module 1	**Introduction:** Modelling Theory - Physical modelling, analytical modelling, numerical modelling; classification of models based on i) Scale (space and time), ii) Solution (analytical and numerical); Concept of computational hydraulics; Processes involved in model development and application.			4L
Module 2	**Modelling Fluid Flow Problems:** Governing equations- Conservation of mass, conservation of momentum, conservation of energy; Mathematical classification of flow equations, solution of ordinary differential equations and partial differential equations, boundary conditions; Solution of Saint-Venant Equations - Kinematic wave solution, Diffusive wave solution and full dynamic solution; Characteristic form of Saint-Venant Equations.			8L
Module 3:	**Numerical Solution Schemes:** Discrete solution of governing equations, Space discretization - Structured grids and unstructured grids, grid generation, time discretization.			2L
	Finite Difference Method: General concept, approximation of derivatives; Finite difference formulation for ordinary differential equations - Explicit schemes, Implicit schemes, Mixed schemes and weighted average schemes; Finite difference formulation for partial differential equations - initial conditions, boundary conditions, explicit and implicit schemes; The Preissmann Scheme, The Abbott-Ionescu scheme.			8L
	Example Applications: Ordinary differential equation - Solution of linear reservoir problem; Partial differential equation - Solution of simple wave propagation, Solution of diffusion equation.			6L
Module 4:	**Finite Volume Method:** General concept, Steps in application of Finite Volume Method- Surface and volume integrals, Discretization of convective fluxes, Discretization of diffusive fluxes, evaluation of time derivative, boundary conditions.			8L
	Example Application: Solution of Advection-Diffusion Equation in 1-D.			4L
Reference	Sl.	Book Name	Author	Publishing House
	1	Computational Hydraulics	M. B. Abbott and A. W. Minns	Routledge, London, 2016
	2	Computational Hydraulics – An Introduction	C. B. Vreugdenhil,	Springer – Verlag, New York, 1989
	3	Computational Hydraulics	C. A. Brebbia and A. J. Ferrante,	Butterworth-Heinemann, 2013.
	4	Computational Methods for Fluid Dynamics,	J. H. Ferziger and M. Peric	Springer, London, 2002.

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CE(PE)701B	**Disaster Preparedness and Planning**	2L + 1T	3 Credits
Course Outcome	On completion of the course the students will be able to: 1. Define the basic concepts and terminologies disaster management 2. Understand and describe the categories of disaster 3. Realize the roles and responsibilities of a civil engineer towards society in time of a disaster 4. Analyze relationship between development and disasters 5. Apply different concepts of disaster management		
Prerequisite	Class-X level knowledge of Indian Geography and Class-XII level knowledge of Physics, Chemistry, Mathematics, Biology and Environmental Science; Undergraduate level introductory knowledge of Civil and Environmental Engineering		
Module 1	**Introduction, Basic Concepts and Definitions** Disaster, Hazard, Vulnerability, Risks, Severity, Frequency and details, Capacity, Impact, Prevention, Mitigation	3L+1T	
Module 2	**Disasters and their Classification** Natural Disasters: Floods, Draught, Cyclones, Volcanoes, Earthquakes, Tsunami, Landslides, Coastal Erosion, Soil Erosion, Forest Fires Manmade Disasters: Industrial Pollution, Artificial Flooding in Urban Areas, Nuclear Radiation, Chemical Spills, Transportation Accidents, Terrorist Strikes Hazard and vulnerability profile of India, Mountain and coastal areas, Ecological fragility	5L+3T	
Module 3:	**Disaster Impacts** Disaster Impacts: Environmental, Physical, Social, Ecological, Economic, Political Health, Psycho-social issues; Demographic aspects (gender, age, special needs); Hazard locations; Global and national disaster trends; Climate change and urban disasters.	7L+3T	
Module 4:	**Disaster Risk Reduction (DRR)** Phases of disaster management cycle; Prevention, Mitigation, Preparedness, Relief and recovery; Structural and non-structural measures; Risk analysis, Vulnerability and capacity assessment; Early warning systems, Post-disaster environmental response (water, sanitation, food safety, waste management, disease control, security, communications); Roles and responsibilities of government, community, local institutions, NGOs and other stakeholders; Policies and legislation for disaster risk reduction, DRR programmes in India and the activities of National Disaster Management Authority	7L+3T	
Module 5:	**Disasters, Environment and Development** Factors affecting vulnerability such as impact of developmental projects and environmental modifications (including of dams, land use changes, urbanization etc.), Sustainable and environmental friendly recovery; Reconstruction and development methods	6L+4T	

Reference	Sl.	Book Name	Author	Publishing House
	1	Disaster Management	S.C. Sharma	Khanna Publishing House
	2	Disaster Risk Reduction in South Asia	Pradeep Sahni	Prentice Hall
	3	Handbook of Disaster Management: Techniques & Guidelines	Singh B.K.	Rajat Publication
	4	Disaster Medical Systems Guidelines	Emergency Medical Services Authority	State of California, EMSA no.214, June 2003
	5	IASC Guidelines on Mental Health and Psychosocial Support in Emergency Settings	Inter Agency Standing Committee (IASC) (Feb. 2007).	
	6	http://ndma.gov.in/ (Home page of National Disaster Management Authority)		
	7	http://www.ndmindia.nic.in/ (National Disaster management in India, Ministry of Home Affairs)		

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CE(PE)701C	**Hydraulic Structures**	2L + 1T	3 Credits
Course Outcome	On successful completion of this course, student should be able to: 1. Identify the characteristics of various types of dams and their selection procedure. 2. Perform the reconnaissance survey and, geophysical investigations necessary for selection of suitable dam site 3. Estimate forces acting on a gravity dams and perform stability analysis. 4. Estimate the seepage loss through embankment dams and suggest necessary remedial measures. 5. Calculate the discharge through the overflow section and design the appropriate energy dissipation structures.		
Prerequisite	Introduction to Civil Engineering CE(HS)302, Water Resources Engineering CE(PC)603,		
Module 1	**Storage Structures:** Dams, Types of Dams – Embankment dams, gravity dams, various components and their functions	1L + 1T	
Module 2	**Selection of Dam Site:** Site investigations, initial study, reconnaissance survey, geophysical investigations, preliminary selection, evaluation of selected site - various types of foundation testing, field testing and borrow pit investigations, detailed investigations; assessment of foundation characteristics and suitability; selection of type of dam.	4L + 2T	
Module 3:	**Gravity Dam:** Definition, Features of some important gravity dams, Forces acting on a gravity dam, estimation of forces due to: self-weight, water pressure on upstream and downstream face, Uplift pressure, wave pressure, silt pressure, wind pressure, earthquake forces, hydrodynamic forces; Stability analysis - load combinations, codal provisions, modes of failures - overturning, sliding, tension and compression failures, factors of safeties, principal stresses; Elementary profile of a gravity dam - forces acting, minimum base width - no tension, no sliding basis, principal stresses.	8L + 4T	
	Embankment Dams: Definitions, Features of some important embankment dams; Types of embankment dams and their sectional features; Design criteria; Freeboard - necessity, estimation procedure; Seepage analysis - Laplace's flow equations, drainage blanket and rock toe, phreatic line, graphical procedure of drawing phreatic line, estimation of seepage loss; Stability analysis of embankment dams – slip circle method; Seepage Control - cut-offs, slurry trench, sheet piling, grouting, slope protection.	6L + 2T	
	Diversion headworks: Necessity and uses, different types, layout and different components; weirs on permeable foundation, Creep theories, Khosla's method; Different types of modules, Canal escapes, Silt control devices.	5L + 3T	
Module 4:	**Spillways and Energy Dissipation Structures:** Necessity, types, selection, spillway gates; High overflow ogee spillway - profile, discharge computation, flow equations, factors affecting coefficient of discharge, codal provisions. stilling basins (USBR and BIS) types	4L + 2T	
Reference	Sl.	Book Name	Author	Publishing House
	1	Hydraulic Structures	Novak, A. I. B. Moffat, C. Nalluri and R. Narayan P	E & FN Spon, UK, 2010.
	2	Hydraulic Structures	S. H. Chen	Springer Nature, USA, 2015.
	3	Irrigation Engineering and Hydraulic Structures	S. K. Sharma	S. Chand Publishing, New Delhi, 2017.
	4	Dams and Appurtenant Hydraulic Structures	A. Tanchev	CRC Press, USA, 2014.
	5	Fluid Mechanics & Hydraulic Machines	S.S. Rattna	Khanna Publishing House
	6	Fluid Mechanics and Hydraulic Machines	K. Subramanya	McGraw Hill Education (India) Private Limited, New Delhi, Chennai, 2019.

CE(PE)702A	**Prestressed Concrete**	2L + 1T	3 Credits
Course Outcome	After going through this course, the students will be able to: 1. Learn the introduction of prestressed concrete member and its deflection properties 2. Develop the design criteria of prestressed concrete section for flexure and shear properties 3. Analyze the anchorage zone stress for post-tensioned members 4. Impart knowledge regarding the methods of Analysis of Statically Indeterminate Structures. 5. Impart knowledge regarding the composite construction of Prestress and In-situ concrete. 6. Impart knowledge regarding Design of Prestressed concrete poles and sleepers and introduction of partial prestressing.		

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Prerequisite	Introduction to Solid Mechanics (CE(ES)402), Structural Analysis – I (CE(PC)503), Design of RC Structures (CE(PC)501)	
Module 1	**Introduction of Prestressed concrete:** Materials, prestressing system, analysis of prestress and bending stress, losses Shear and torsional resistance: design of shear reinforcement, design of reinforcement for torsion shear and bending. **Deflections of prestressed concrete members:** Importance, factors, short term and long term deflection	8L+4T
Module 2	**Shear and Torsional Resistance:** Design of Shear Reinforcement, Design of Reinforcement for Torsion, Shear and Bending. **Limit State Design Criteria:** Inadequacy of Elastic and Ultimate Load Method, Criteria for Limit States, Strength and Serviceability. **Design of Prestressed Concrete Section:** for Flexure & methods by Lin and Magnel	8L+4T
Module 3	**Anchorage Zone stresses in post tensioned members:** Stress distribution in end block, anchorage zone reinforcement	3L+1T
Module 4	**Statically Indeterminate Structures:** Advantages of Continuous Member, Effect of Prestressing, Methods of Achieving Continuity and Method of Analysis of Secondary Moments	4L+2T
Module 5	**Composite Construction of Prestressed and In-situ Concrete:** Types, Analysis of Stresses	3L+1T
Module 6	**Prestressed Concrete Poles and Sleepers:** Design of Sections for Compression and Bending. Introduction to Partial Prestressing.	2L+2T

IS Codes	1	IS: 1343 : 2012		
Reference	Sl.	Book Name	Author	Publishing House
	1	Prestressed Concrete	N. KrishnaRaju	TMH
	2	Prestressed Concrete	Ramamuthram	Dhanpat Rai Publishing Company
	3	Prestressed Concrete	Srikant Vanakudre	Khanna Publishing House
	4	Fundamentals of Prestressed Concrete	N.C.Sinha and S.K.Roy	S. Chand
	5	Prestressed Concrete	Karuna Moy Ghosh	PHI
	6	Design of Prestressed Structures	T.Y.Lin and N.H.Burns	

CE(PE)702B	**Repair & Rehabilitation of Structures**	**2L + 1T**	**3 Credits**
Course Outcome	By the end of this course students will have the capability/knowledge of 1. Various distress and damages to concrete and masonry structures 2. The importance of maintenance of structures, types and properties of repair materials etc 3. Assessing damage to structures and various repair techniques		
Prerequisite	Introduction to Solid Mechanics (CE(ES)402), Structural Analysis – I (CE(PC)503), Design of RC Structures (CE(PC)501), Concrete Technology (CE(PC)405).		
Module 1	**Introduction:** Overview of distress, deterioration in concrete structures, Scenario of distressed structures world over, Need for repairs and upgrading of structures, General introduction to process (Road-map) to a durable concrete repair	3L+1T	
Module 2	**Deterioration of concrete structures:** Types of deterioration – Signs, causes & symptoms, Mechanism of deterioration, contributing factors like permeability, inadequate durability & micro-structure of concrete. Physical deterioration due to moisture, temperature, shrinkage, freeze-thaw, abrasion, erosion, cavitation, crystallization of salts, Efflorescence, exposure to severe environment like marine exposure. Chemical deterioration due to corrosion of reinforcement (chloride induced, carbonation induced), Alkali-silica reaction, sulphate attack, Acid attack Deterioration due to water leakage, fire – detection & mitigation of the same. Deterioration due to ageing, inadequate maintenance, Design & construction deficiencies, overloading etc. Types of cracks, causes & characteristics of cracking in various structural components like beam, column, slab, masonry walls. Measurement of cracks, interpretation of the cause of particular type of crack.	6L+3T	
Module 3	**Conditional/damage assessment & Evaluation of structures:** Structural assessment: Conditional evaluation / Structural Appraisal of the structure – Importance, objective & stages, Conditional/damage assessment procedure, Preliminary & Detailed investigation – Scope, Objectives, Methodology & Rapid visual inspection of structures **Damage Assessment allied Tests (Destructive, Semi-destructive, Nondestructive):** Field & laboratory testing procedures for evaluating the structure for strength, corrosion activity, performance & integrity, durability.	6L+3T	

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	Interpretation of the findings of the tests		
Module 4	**Repairs, rehabilitation & Retrofitting of concrete structures:** Repair materials - Criteria for durable concrete repair, Methodology, performance requirements, repair options, selection of repair materials, Preparatory stage of repairs, Different types of repair materials & their application, types of repair techniques. **Retrofitting/Strengthening:** Need for retrofitting, Design philosophy of strengthening structures, Techniques available for strengthening including conventional and advanced techniques. **Seismic retrofit of concrete structures**: Deficiencies in structure requiring seismic retrofit, Design philosophy, Techniques to enhance the seismic resistance of structures, advanced techniques for making seismic resistant structures	9L+3T	
Module 5	**Protection & maintenance of structures** - Importance of protection & maintenance, Categories of maintenance, Building maintenance. Corrosion mitigation techniques to protect the structure from corrosion. **Long term health monitoring / Structural health monitoring (SHM)**– Definition and motivation for SHM, Basic components of SHM and its working mechanism, SHM as a tool for proactive maintenance of structures.	4L+2T	

Reference	Sl.	Book Name	Author	Publishing House
	1	Handbook on repair and rehabilitation of RCC buildings	CPWD, Government of India	
	2	Failures and repair of concrete structures	S. Champion	John Wiley and Sons
	3	Diagnosis and treatment of structures in distress	R.N.Raikar	R & D Centre of Structural Designers and Consultants Pvt.Ltd
	4	Handbook on seismic retrofit of buildings	A. Chakrabarti et.al	Narosa Publishing House
	5	Repair and protection of concrete structures	Noel P. Mailvaganam	CRC Press
	6	Concrete repair and maintenance	Peter.H.Emmons	Galgotia publications
	7	Maintanance, Repair & Rehabilitation and Minor works in Building	P.C. Varghese	PHI
	8	Concrete Structures Repair Rehabilitation and Retrofitting	J Bhattacharjee	CBS
	9	Repair & Rehabilitation of Concrete Structures	Modi and Patel	PHI

CE(PE)702C	**Finite Element Method**	**2L + 1T**	**3 Credits**
Course Outcome	After going through this course, the students will be able to: 1. Obtain an understanding of the fundamental theory of the FEA method. 2. Develop the ability to generate the governing FE equations for systems governed by partial differential equations. 3. Understand the use of the basic finite elements for structural applications using truss, beam, frame, and plane elements and		
Prerequisite	Basic Mathematics		
Module 1	**Introduction to Finite Element Analysis:** Basic Concepts of Finite Element Analysis and its necessity	2L	
Module 2	**Numerical tools for Finite Element Formulation**: Variational Principle: Ritz method, Weighted residual method: Galerkin approach, Petrov-Galerkin approach.	5L+2T	
Module 3	**Finite element Formulation:** Formulation of Euler-Bernoulli beam element and Timoshenko beam element, Imposition of boundary conditions.	7L+3T	
Module 4	**Elements and their properties:** One dimensional and Two dimensional elements (Bar element, Beam element, Plate element), Interpolation functions, Numerical integration.	7L+3T	
Module 5	**Finite element solutions:** Formulation of stiffness matrix and solution of beam, plate and truss problems, Problems on Plates with cutout. Introduction to the software SAP2000.	7L+4T	

Reference	Sl.	Book Name	Author	Publishing House
	1	An Introduction to the Finite Element Method	Reddy J.N	McGraw Hill Publication
	2	Matrix and Finite Element Analyses of Structures	Mukhopadhyay	Oxford and IBH Publishing Co. Pvt. Ltd
	3	Concepts and Applications of Finite Elements Analysis	Cook R.D, Malkus, Plesha and Witt	Wiley

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	4	Finite Element Analysis: Theory and Programming	Krishnamoorty C. S.	McGraw Hill Publication
	5	Introduction to Finite Elements in Engineering	Chandrupatla and Belegundu	PHI
	6	Finite Element Method with Applications in Engineering	Desai	Pearson
	7	Finite Element Procedures	Bathe	PHI

CE(PE)703A	Air and Noise Pollution and Control	2L + 1T	3 Credits
Course Outcome	After going through this course, the students will be able to: 1. Define the basic concepts and terminologies regarding air pollution and noise pollution 2. Describe the physics of air pollution and noise pollution 3. Apply the methods of air pollution and noise pollution measurements 4. Analyze different concepts of air and noise pollution solving mathematical problems 5. Compare air and noise quality with allowable standards and limits 6. Choose and design proper techniques for air pollution control and noise pollution control		
Prerequisite	Class-XII level knowledge of Physics, Chemistry, Mathematics, Biology and Environmental Science; Undergraduate level knowledge of Statistics and Environmental Engineering		
Module 1	**Air Pollutants** Sources; Classification; Effects on Human, Vegetation, Material Effects of Air pollution on Atmosphere: Photochemical Smog, Ozone Layer Depletion, Acid Rain, Greenhouse Effect and Global Warming	4L+2T	
Module 2	**Air Pollution Meteorology** Lapse Rate; Atmospheric Stability; Inversion; Plume Pattern	3L+1T	
Module 3	**Dispersion of Air Pollutants** Point Source Gaussian Plume Model, Stability Classes, Stability Charts, Design of Stack Height	3L+1T	
Module 4	**Air Quality** Methods of Measurement: Gaseous pollutants, Particulate pollutants Air Quality Standards and Indices: Ambient Air Quality Standard, NAAQS, Emission Standard, Air Quality Indices	4L+2T	
Module 5	**Air Pollution Control** Control of Gaseous Pollutants: Adsorption, Absorption, Condensation Control of Particulate Pollutants: Settling chambers, Cyclone separators, Wet collectors, Fabric filters, Electrostatic precipitators Control of Pollution from Automobiles	5L+3T	
Module 6	**Physics of Noise** Basics of Acoustics; Sound Pressure, Power and Intensity and their Interrelations	1L+1T	
Module 7	**Measurement of Noise** Noise Level; Interrelation between Noise, Pressure, Power and Intensity Levels; Noise Meter; Noise Networks; Frequency Band Analysis; Decibel Addition Measurement of Community Noise: L_N, L_{eq}, L_{dn}, L_{NP}	4L+2T	
Module 8	**Source and Effect of Noise** Psychoacoustics and noise criteria; effects of noise on health; annoyance rating schemes	1L+1T	
Module 9	**Noise Pollution Control** Noise Standards and Limits; Methods of Noise Pollution Control	3L+1T	

Reference	Sl.	Book Name	Author	Publishing House
	1	Air Pollution and Control	Keshav Kant, Rajni Kant	Khanna Publishing House
	2	Environmental Engineering	S.C. Sharma	Khanna Publishing House
	3	Introduction to Environmental Engineering and Science	Masters, G.M., Ela, W.P.	Prentice Hall / Pearson
	4	Environmental Engineering: A Design Approach.	Sincero, A., Sincero, G.	Prentice Hall
	5	Environmental Engineering. Volume-1 and Volume-2.	Garg, S.K.	Khanna Publishers
	6	Air Pollution	Rao, M.N., Rao, H.V.N.	Tata McGraw Hill

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CE(PE)703B	**Physico-Chemical Processes for Water and Wastewater Treatment**	2L + 1T	3 Credits
Course Outcome	On completion of the course the students will be able to: 1. Define the basic concepts and terminologies regarding physico-chemical treatment of water and wastewater 2. Describe the physics, chemistry and hydraulics of different unit operations and processes for water and wastewater treatment 3. Analyze different physico-chemical water and wastewater treatment options solving mathematical problems 4. Design different physico-chemical treatment processes to treat water and wastewater		
Prerequisite	Class-XII level knowledge of Physics, Chemistry, Mathematics, Biology and Environmental Science; Undergraduate level knowledge of Engineering Physics, Engineering Chemistry, Fluid Mechanics and Hydraulics and Environmental Engineering		
Module 1	**Introduction and Basic Concepts** Water purification in natural systems, physical processes, chemical processes and biological processes; Primary, secondary and tertiary treatment; Unit operations, unit processes	2L+2T	
Module 2	**Aeration** Aeration and Gas Transfer	2L	
Module 3	**Sedimentation** Sedimentation, different types of settling; sedimentation tank design	3L+1T	
Module 4	**Clariflocculation** Coagulation and flocculation; Coagulation processes, Stability of colloids; Destabilization of colloids; Destabilization in water and wastewater treatment; Transport of colloidal particles; Design aspects	4L+2T	
Module 5	**Filtration** Filtration processes; Hydraulics of flow through porous media; Rate control patterns and methods; Filter effluent quality parameters; Mathematical model for deep granular filters; Slow sand filtration, Rapid sand filtration, Precoat filtration; design aspects	4L+2T	
Module 6	**Disinfection** Types of disinfectants; Kinetics of disinfection; Chlorination and its theory; Design of Chlorinators	3L+1T	
Module 7	**Precipitation** Hardness removal; Iron, Manganese, and Heavy metal removal	3L+1T	
Module 8	**Adsorption** Adsorption equilibria and adsorption isotherm; Rates of adsorption; Sorption kinetics in batch reactors; Continuous reactors; Factors affecting adsorption	3L+1T	
Module 9	**Ion Exchange Processes** Materials and reactions; Methods of operation; Application; Design aspects	3L+1T	
Module 10	**Membrane Processes** Reverse osmosis, Ultrafiltration, Electrodyalisis	3L+1T	

Reference	Sl.	Book Name	Author	Publishing House
	1	Elements of Water Pollution Control Engineering	O.P. Gupta	Khanna Publishing House
	2	Environmental Engineering. Volume-1 and Volume-2.	Garg, S.K.	Khanna Publishers
	3	Environmental Engineering: A Design Approach.	Sincero, A., Sincero, G.	Prentice Hall
	4	Environmental Engineering	Peavy, H.S, Rowe, D.R, Tchobanoglous, G	Tata McGraw Hill Indian Edition
	5	Environmental Engineering	S.C. Sharma	Khanna Publishing House
	6	Manual on Water Supply and Treatment	CPHEEO	Govt. of India
	7	Manual on Sewerage and Sewage Treatment	CPHEEO	Govt. of India
	8	Manual on Municipal Solid Waste Management.	CPHEEO	Govt. of India
	9	*Water Works Engineering: Planning, Design and Operation*	Qasim, S.R., Motley, E.M., Zhu, G.	Prentice Hall
	10	*Waste Water Treatment Plants: Planning, Design and Operation*	Qasim, S.R.	CRC Press
	11	*Water Engineering: Hydraulic, Distribution and Treatment.*	Shammas, N.K., Wang, L.K.	Wiley

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	12	*Water Quality Engineering: Physical / Chemical Treatment Processes.*	Benjamin, M.M., Lawler, D.F.	Wiley

CE(PE)703C	**Water and Air Quality Modelling**	2L + 1T	3 Credits

Course Outcome	On completion of the course the students will be able to: 1. Define the basic concepts and terminologies regarding water and air quality modelling 2. Describe the background mechanisms in modeling water and air quality 3. Analyze different water and air quality models solving mathematical problems 4. Apply the concepts of air and water quality modeling in air and water pollution control and management	
Prerequisite	Class-XII level knowledge of Physics, Chemistry, Mathematics, Biology and Environmental Science; Undergraduate level knowledge of Engineering Statistics, Engineering Physics, Engineering Chemistry, Fluid Mechanics and Hydraulics and Environmental Engineering	
Module 1	**Introduction to Water Quality Models** Introduction to mathematical models; Water quality model development; Calibration and verification; Cost benefit analysis using models; Model requirements and limitations	4L+2T
Module 2	**Dissolved Oxygen Model for Streams** Sources and sinks of dissolved oxygen; Estimation of system parameters; Streeter Phelps model, oxygen 'sag' curve, Determination of deoxygenation and re-aeration coefficients; Benthal oxygen demand; Mass transport mechanisms	6L+2T
Module 3	**Models for Estuary and Lakes** Physical chemical and biological processes in estuaries and lakes	4L+2T
Module 4	**Introduction to Air Quality Models** Micrometeorological processes, Wind rose, Dispersion, coefficients and Stability classes	4L+2T
Module 5	**Dispersion Models** Point Source Gaussian Dispersion Model, Stack height computation; Line Source Models; Box Models	7L+3T
Module 6	**Air Quality Models** Regional air quality models, Source inventories and significance	4L+2T

Reference	**Sl.**	**Book Name**	**Author**	**Publishing House**
	1	Air Pollution and Control	Keshav Kant, Rajni Kant	Khanna Publishing House
	2	Elements of Water Pollution Control Engineering	O.P. Gupta	Khanna Publishing House
	3	Environmental Engineering	S.C. Sharma	Khanna Publishing House
	4	Environmental Engineering. Volume-1 and Volume-2.	Garg, S.K.	Khanna Publishers
	5	Environmental Engineering	Peavy, H.S, Rowe, D.R, Tchobanoglous, G	Tata McGraw Hill Indian Edition
	6	Introduction to Environmental Engineering and Science.	Masters, G.M., Ela, W.P.	Prentice Hall / Pearson

CE(PE)704A	**Structural Dynamics**	2L + 1T	3 Credits

Course Outcome	At the conclusion of this course, the students will have an understanding of: 1. Fundamental theory of dynamic equation of motion 2. Fundamental analysis methods for dynamic systems 3. Dynamic properties and behaviour of civil structures 4. Modelling approach of dynamic response in civil engineering applications	
Prerequisite	Introduction to Solid Mechanics (CE(ES)402), Structural Analysis – I (CE(PC)503), Structural Analysis – II (CE(PE)602B), and Engineering Mathematics (Differential Equation)	
Module 1	**Basics of Structural Dynamics:** Introduction of Structural Dynamics, Differential Equations in Civil Engineering, Types of Analysis/Static and Dynamic load, Degrees of Freedom (Ex: Generation of Stiffness matrix), Dynamic Equilibrium Equation.	3L+2T
Module 2	**Free Vibration of SDOF:** Undamped free Vibration, Natural Period/Frequency, Energy in Free Vibration, Damped Free Vibration, Types of	8L+4T

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	damping, Logarithmic decrement equation **Forced Vibration of SDOF:** Undamped Forced vibration, Amplitude & Phase Angle, Dynamic amplification factor for deflection (Rd), Damped Forced vibration, Relationship between Rd, Rv and Ra	
Module 3	**Force Transmission, Vibration Measurement**: Resonant frequency and Half power band width, Force Transmission and Isolation, Design of Vibration Measuring Instruments	3L+1T
Module 4	**Response to Arbitrary Motions:** Response to Unit Impulse, : Response to Arbitrary Force (Duhamel's Integral), Response to Step and Ramp Forces, Response to Rectangular Pulse, Half Sinusoidal wave	2L
Module 5	**Numerical Methods of Solution**: Time Stepping Methods, Central Difference Method, Newmark's Method	2L
Module 6	**Response Spectrum**: Concept of Response Spectrum, Uses of Response Spectrum, Special Cases in Spectrum, Development of Tripartite Plot, :Example: Base Shear and Base Moment, Response of Structure in Frequency Domain	3L+2T
Module 7	**Multi-Degree of Freedom Systems**: Equation of Motion for MDOF System, Solution of Equation, Natural Frequencies and mode Shapes (60), Modal Orthogonality, Approximate Method for finding Natural frequency.	2L+1T
Module 8	**Earthquake Response of MDOF Systems:** Time History Analysis, Response Spectrum Analysis, 3D Dynamic Analysis	2L
Module 9	**Dynamic Response of Continuous Systems**: Vibration of Continuous systems, Shear behaviour and bending behaviour, Generalized SDOF	2L
Module 10	**Dynamics of Rigid Blocks**: Dynamics of Rigid Blocks, Non Structural Elements, : Floor Response Spectrum	2L
Module 11	**Vibration Control**: : Introduction to Vibration Control, Active Control, Passive Control, Design of Tuned Mass Damper	2L+1T

Reference	Sl.	Book Name	Author	Publishing House
	1	Structural Dynamics (Theory and Computation)	Mario Paz.	CBS Publishers
	2	Dynamics of Structure (Theory and Application to Earthquake Engineering)	A.K.Chopra	Pearson Education
	3	Dynamics of Structures	Ashok K. Jain	Pearson Education

CE(PE)704B	Advanced Structural Analysis		2L + 1T	3 Credits
Course Outcome	After going through this course, the students will be able to: 1. Basic Knowledge of the student will increase. 2. Student will be able to apply stiffness and flexibility method using system approach. 3. Student will understand the yield conditions from their knowledge of stress-strain relations. 4. Student will be able to solve simple plate and shell problems			
Prerequisite	Introduction to Solid Mechanics (CE(ES)402), Structural Analysis – I (CE(PC)503), Structural Analysis – II (CE(PE)602B)			
Module 1	**Matrix methods of structural analysis:** Application of matrix methods to plane truss, beams, continuous frames			9L+5T
Module 2	**Finite difference and relaxation technique**-application to simple problems.			6L+3T
Module 3	**Theory of plate bending**: Navier's Sol utions. Levy's solution. Plate buckling problem. Membrane theory of domes and cylindrical shells.			7L+3T
Module 4	**Theory of Elasticity:** Three dimensional stress and strain analysis, stress strain transformation, stress invariants, equllibrium and compatibility equations. Two dimensional problems in Cartesian and polar coordinates. Plane stress, plane stain problems, St. Venant's principle			6L+1T

Reference	Sl.	Book Name	Author	Publishing House
	1	Matrix, finite element, computer and structural analysis,	Mukhopadhyay	ANE Books
	2	Intermediate Structural analysis	Wang	McGrawHill
	3	Theory of Plates and Shells	Timoshenko & Krieger	McGrawHill
	4	Structural Analysis	R Agor	Khanna Publishing House
	5	Theory of Elasticty	Timoshenko & Goodier	McGrawHill
	6	Analysis of Structures	T.S. Thandavamoorthy	Oxford University Press

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CE(PE)704C	Coastal Hydraulics and Sediment Transport	2L + 1T	3 Credits

Course Outcome	On successful completion of this course, student should be able to:
	    1. Explain and quantify coastal wave processes including wave generation, propagation, refraction, shoaling, diffraction, and breaking.
	    2. Explain and quantify coastal wave properties important to coastal engineering, including wave heights, speeds, induced water velocities, pressures, making appropriate approximations for deep and shallow waters.
	    3. Characterize and quantify basic coastal sediment transport processes and rates
	    4. Analyse coastal sites to determine design waves by utilizing historical and bathymetric data. Estimate hydrodynamic forces on coastal structures		

Prerequisite	Introduction to Civil Engineering CE(HS)302, Introduction to Fluid Mechanics CE(ES)401, Water Resources Engineering CE(PC)603,		
Module 1	**Introduction:** Basic understanding of wave mechanics including wave generation, propagation, form and assessment in the coastal zone. Statistical and spectral analysis of recorded wave data and prediction in coastal zone.	6L	
Module 2	**Tides and currents:** The equilibrium tide, Dynamic modifications of the equilibrium tide, Modification of tidal pattern, Tidal streams, Tidal bores.	6L	
Module 3:	**Waves:** The linear theory of waves, Waves of finite height, Wind waves, Waves in shoaling water, Refraction of waves, Reflection of waves, Diffraction of waves, Oscillations in a harbour, Ship waves.	8L	
Module 4:	**Sediment Transport:** Basic concepts, Transport modes, Material in suspension, Bed-Load, Turbidity and density currents, Banks and channels in river estuaries, Regime of the sea-bed; Vertical distribution of suspended sediment in waves and current over a plane bed.	8L	
Module 5:	**Littoral drift:** Definition of limit for littoral drift, The effect of grain size, The beach profile, Longshore transport of material, Coastal features.	8L	
Module 6:	**Coastal Structures:** Types and use; Effect of construction of coastal structures on stability of shoreline/ beaches, shoreline configuration.	6L	

Reference	Sl.	Book Name	Author	Publishing House
	1	Coastal hydrodynamics	J. S. Mani	Prentice-Hall of India Ltd, 2012
	2	Advances in Coastal Hydraulics	V. Panchang, J. Kaihatu	World Scientific Publishing Company, 2018
	3	Basic Coastal Engineering	R. M. Sorensen	Springer, 2010
	4	Computational Modeling in Hydraulic and Costal Engineering	C. Kouttias and P. D. Scarlatos	CRC Press, 2016.

CE(PE)705A	Railway and Airport Engineering	2L + 0T	2 Credits

Course Outcome	Students will be able to
	    6. Explain the basics in planning functional components of Railway and Airport.
	    7. Illustrate the engineering concepts of construction, operation and maintenance of Railway and Airport components.
	    8. Interpret the geometric design parameters of Railway
	    9. Decide the runway orientation of proposed runway on the basis of previous wind data analysis
	    10. Assess the basic runway length parameters.		

Prerequisite	Class-XII level knowledge of Physics, Mathematics.; Undergraduate level knowledge of Strength of Materials.		
Module 1	**Introduction to Railway Engineering: Socio-economic impact of Indian Railways; Zonal** classification of Indian Railways; Railway track gauge; Classification of Indian Railways based on Speed Criteria. **Permanent Way (P-way): Components – Rails, Rail joints, Sleepers, Ballast, Fastenings, Sub-** grade.	20L	
Module 2	**Railway Track Alignment and Engineering Survey: Basic requirement of good alignment;** **Factors in selection of good alignment; Engineering Survey; Track Stresses: Wheel loads, Dynamic effect** of wheel loads, Hammer blow, Horizontal thrust, Horizontal thrust due to nosing action, **Stresses due to** **track irregularities, Additional stresses on curves: Stresses in Sleepers;**	10L	

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	Stresses in Ballast: Pressure in the subgrade: Stress formulae.			
Module 3	Railway Geometric Design: Gradient, Speed, Degree of Curve, Super-elevation, Transition curve, Widening of gauge on curves, Shift.			
Module 4	Railway Points and Crossings; Station and Yards; Signalling and Control Systems.			
Module 5	**Airport Engineering** Airport Site Selection; Airport layout;Functions and planning of the Airfield components – runway, taxiway and Aprons, hanger, terminal building and control tower; Design of Runway and Taxiway; Runway orientation: Windrose diagrams.			
Reference	Sl.	Book Name	Author	Publishing House
	1	A Textbook of Railway Engineering	Saxena S.P. & Arora S.P	Dhanpat Rai & Sons
	2	Indian Railway Track	Agarwal M.M	Sachdeva Press
	3	Airport Planning & Design	KhannaS.K , Arora M.G & Jain S.S	Nemchand Brothers
	4	Planning & Design of Airports	Horonjeff R &Mckelvey F	Mc. Graw Hill.

CE(PE)705B	**Pavement Design**		2L + 0T	2 Credits
Course Outcome	At the end of the course, the student will be able to: 1. Differentiate between different types of pavements, both structurally and functionally. 2. Conduct Axle Load Survey and Estimate Design Traffic. 3. Analyze and design bituminous and cement concrete pavement using. 4. Understand the principles of Pavement Maintenance and identify various pavement distresses.			
Prerequisite	Transportation Engineering (CE(PC)506)			
Module 1	**Pavement Design** Flexible Pavement Design: Stresses and Deflections in homogeneous masses.; Burmister's two layer theory; Three layer and multi-layer theories; wheel load stresses, various factors in traffic wheel loads; ESWL of multiple wheels; McLeod method of design; AASTHO method of flexible pavement design. Low Volume Rigid Pavement: Criteria of Load, Scope and Specifications as per different Govt policies in India, Design Criteria.			13L
Module 2	**Pavement Construction and Management** Flexible Pavement Construction: Earthwork (Method of Alignment-wise marking using chainage), compaction of embankments, construction methods and field control checks for various types of flexible pavement materials in sub-base, base, binder and surface course layers; Construction procedure of Low Volume Rigid Pavement.			9L
Module 3	**Pavement Evaluation - Pavement Distress** Functional condition evaluation of pavements- Roughness, Skid Resistance, Serviceability Index; Structural evaluation of pavements –Benkelman beam and Falling Weight Deflectometer; Pavement strengthening; Design of bituminous and concrete overlays as per IRC			8L
Reference	Sl.	Book Name	Author	Publishing House
	1	Principles of Pavement Design	E. J. Yoder & M.W. Witzack	John Wiley and Sons
	2	Pavement Analysis and Design	Yang H. Huang	Pearson
	3	Principles of Transportation Engineering	P. Chakraborty & A. Das	PHI
	4	Highway Engineering	L.R. Kadiyali	Khanna Book Publishing (www.khannabooks.com)
	5	Highway Engineering	Khanna& Justo	Nemchand& Brothers

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	6	Relevant latest IRC Codes (IRC-37 – 2001, IRC-37 – 2012, IRC 58 – 2015, IRC 81 -1997- Indian Road Congress

CE(PE)705C	**Transportation System Planning**			**2L + 0T**	**2 Credits**
Prerequisite	Transportation Engineering (CE(PC)506)				
Module 1	**Introduction** Importance of transportation, transportation planning methodology, hierarchical levels of planning and its relation to rural, urban areas. Long range planning, Passenger and goods transportation, General concept and process of transport planning, Land-use transport interactions, Socio-economic characteristics of Land use				5L
Module 2	**Transportation System** Multi modal transportation system; Characteristics of Mass Transit systems including technical, demand operational and economic problems, fixed Track Facility, Mass Rapid Transit System Elevated, Surface and Underground construction , integrated Operating Characteristics of Terminal and Transfer facilities				10L
Module 3	**Transport planning** Studies: Urban Travel Characteristics, Private and Public Behaviour analysis, Transportation demand Surveys, Delineation of the urban area, zoning, Origin-Destination Studies, Home Interviews, trip Classification. Methodology: Study of existing network-trip generation techniques, Category analysis, multiple regression techniques, Modal split analysis, Trip distribution techniques, Growth Factor model, Gravity models, Opportunity models and multiple regression models.				15L
Reference	Sl.	**Book Name**	**Author**	**Publishing House**	
	1	Highway Engineering	L.R. Kadiyali	Khanna Book Publishing (www.khannabooks.com)	
	2	Transportation Engineering	L.R. Kadiyali	Khanna Book Publishing (www.khannabooks.com)	