



LINGAYA'S VIDYAPEETH

Detailed Syllabus

SESSION: 2017-19

Semester First

Detailed Contents

Course Code	Course Name	L-T-P	Cr	Theory	Internal Assessment	Total	Duration
CEC-501	Quantitative Methods in Construction Management	3-1-0	4	60	40	100	3 hr

Introduction and concepts of probability and statistics, Linear programming, Transportation and assignment problems. Dynamic programming, Queuing theory, Decision theory, Games theory. Simulations applied to construction, Modifications and improvement on CPM/PERT techniques.

Suggested Reading;

1. Operational Research by D.S. Heera

Course Code	Course Name	L-T-P	Cr	Theory	Internal Assessment	Total	Duration
CE-501-T	Highway Planning and Geometric Design	3-1-0	4	60	40	100	3 hr

UNIT –I

Planning: Description of urban and regional transportation systems, Definition of a system; System analysis: scope and limitations, Transportation planning based upon system Analysis, Survey and analysis of existing conditions.

Highway Alignment: Requirements. Factors controlling alignment. Obligatory points. Engineering Surveys for highway location. Route selection. Steps in new project. Highway classifications.

UNIT –II

Cross Sectional Element: Pavement surface characteristics. Factors affecting skid resistance.

Pavement unevenness. Camber. Providing camber in the field. Width of carriageway. Design Vehicle, Medians, kerbs, road margins, right of way and typical cross-sections of roads.

UNIT -III

Sight Distances: Introduction. Stopping sight distance. Reaction time. Analysis of stopping distance. Overtaking sight distance. Analysis of overtaking sight distance. Effect of grade on sight distances. Overtaking zone. Intermediate sight distance. Sight distance at intersections.

Super elevation: Requirement of super elevation. Limits and attainment of super elevation in the field.

UNIT –IV

Highway Alignment: General. Design speed. Horizontal curves. Super elevation. Analysis of super elevation. Super elevation design. Attainment of super elevation. Widening of pavement on horizontal curves. Methods of introducing extra widening. Horizontal Transition curves.

Different types of transition curves. Length of transition curve. Setting out of transition curve. Set-back distance on horizontal curves. Curve resistance.

UNIT –V

Vertical Alignment: General. Gradients. Compensation in gradient on horizontal curves. Vertical curves. Summit curve. Length of summit curve. Valley Curve. Length of valley curve and profile. Relevant IRC standards for urban and rural roads.

Suggested Reading;

1. L.R. Kadiyalli, Traffic Engineering and Transport Planning, Khanna Publishers, 7th Edition, 2008
2. C. S. Papacostas, P. D. Prevedouros, Transportation Engineering and Planning, PHI Publication, 3rd edition, 2002
3. Principles of Transportation Engineering by Chakroborty & Das, Prentice Hall, India.
4. Highway Engg. by S.K. Khanna & C.E.G. Justo, New Chand Bros., Roorkee.
5. Principles and Practice of Highway Engg. by L.R. Kadiyali, Khanna Publishers, Delhi.
6. Principles of Transportation and Highway Engineering by G.V. Rao, Tata McGraw-Hill Publishing Co. Ltd. N. Delhi.
7. MORTH Specifications for Road and Bridge Works, IRC Publication.

Semester First

Subject Code	Subject Name	L-T-P	Cr	Theory	Sessional	Total	Duration
CES-501	Advanced Structural Analysis	3-1-0	4	60	40	100	3 hours

1. **Stiffness Method (Systems Approach):** Basis of stiffness method, Degrees of freedom, Force-displacement relationships, Nodal stiffness.
2. **Flexibility Method (Systems Approach):** Flexibility coefficients, Basis of the method, Application to various types of structures.
3. **Introduction to Element Approach:** Member stiffness matrix, Local or Member co-ordinate system, Global or Structural co-ordinate system, Rotation of axes etc, Structure stiffness matrix.
4. **Structural Stability Analysis:** Elastic Instability, Introduction to stability problem, Energy methods, buckling of axially loaded members for different end conditions, Concept of effective length, approximate techniques, Stability analysis of beam-column and frames.
5. **Plastic Analysis:** Concept of Limit load analysis, Upper and lower bounds, Plastic analysis of beams and multi-storey frames using mechanism method.
6. **Non Linear Analysis:** Introduction to geometric and material non-linearity.

Books recommended:

1. Przemieniecki, J.S., 'Theory of Matrix Structure Analysis', Tata McGraw Hill Book Co.
2. Martin, H.C. 'Introduction to Matrix Methods of Structural Analysis' McGraw Hill Book Co.

Subject Code	Subject Name	L-T-P	Cr	Theory	Sessional	Total	Duration
CES-503	Advanced RCC Design	3-1-0	4	60	40	100	3 hours

- 1. Yield Line Theory:** Assumptions, location of yield lines, methods of analysis, analysis of one way and two way slabs.
- 2. Flat slab:** Limitations of Direct Design Method, shear in flat slabs, equivalent frame method, opening in flat slabs.
- 3. Redistribution of moments in beam:** conditions for moment redistribution, single span beams, multi-span beams and design of sections.
- 4. Deep Beam:** minimum thickness, design by IS-456. Design as per British and American practice, beam with holes.
- 5. Shear walls:** classification of shear wall, classification according to behavior and design of rectangular and flanged shear wall.
- 6. Cast-in-situ Beam-column joint,** Force acting on joints, strength requirement of column, anchorage, confinement of core, shear strength of joint, corner joint and procedure for design.
- 7. Computation of deflection and crack-width:** short term and long term deflection of beam and slab, calculation of deflection as per IS-456, Factors effecting crack width in beams, calculation of crack width in beams, calculation of crack width as per IS-456, shrinkage and thermal cracking.

Books recommended:

1. Varghese, P.C. (2001), 'Advanced Reinforced Concrete Design', Prentice Hall of India, New Delhi.
2. Jain, A.K. (1999), 'Reinforced Concrete Limit State Design' Nem Chand & Bros, Roorkee.
3. Krishna Raju (1986), 'Advanced Reinforced Concrete Design', C.B.S. Publication, New Delhi.
4. Ferguson P.M., Breen J.E. and Jirsa J.O. (1988), 'Reinforced Concrete Fundamentals', Johan wiley & sons, New York.

Subject Code	Subject Name	L-T-P	Cr	Theory	Sessional	Total	Duration
CEE-505	Advanced Water Supply & Wastewater Management	3-1-0	4	60	40	100	3 hours

1 Wastewater Characteristics and Effluent Standards: Physical, chemical and biological parameters of water pollution; Solids (volatile and non-volatile solids; suspended, dissolved and colloidal solids); Biodegradable and non-biodegradable organic matter (DO, COD, BOD and BOD kinetics); Nutrients (TKN, total nitrogen, and total and ortho-phosphorus); Sulfides, phenols, cyanides, heavy metals and recalcitrant/toxic organic compounds; Effluent standards.

2. Overview of Wastewater Treatment Technologies: Preliminary, primary, secondary and tertiary treatment technologies; Overview of biological treatment technologies; Biological treatment technologies for the tertiary treatment.

3. Preliminary Treatment: Screens; Grit removal facilities – grit channels, vortex degritters and cyclonic degritters, aerated grit chambers; Effluent sumps and pumps; Equalization tanks – flow and strength equalization, and online and offline equalization tanks.

4. Primary Treatment: Neutralization and precipitation; Primary and secondary sedimentation tanks; Membrane filtration processes; Roughing filters.

5. Biological Treatment: Activated sludge process and its modifications including SBR; Trickling filters and RBC units; SAF, FAB and MBBR technologies; UASB reactors and its modifications including anaerobic baffled reactor and anaerobic moving bed reactor; Waste stabilization pond systems and its modifications including vegetated ponds and constructed wetlands. **Other**

Treatment Technologies: Advanced oxidation processes; Biological nutrient removal; Filtration and chlorination; Membrane processes for TDS reduction; Wet oxidation process.

Recommended Books

1. Metcalf, Eddy, Tchobanoglous, G., Burton, F.L., Stensel, H.D., *Wastewater Engineering – Treatment, Disposal and Reuse*, Tata McGraw Hill (2002) 4th ed.
2. Eckenfelder WW Jr., *Industrial Water Pollution Control*, McGraw Hill (2003) 3rd ed.
3. *Biological Wastewater Treatment, Edited Volume Series*, IWA (2008).

Subject Code	Subject Name	L-T-P	Cr	Internal Assessment	Practical	Total	Duration
CES-521	Advanced Material Testing Lab	0-0-4	2	30	20	50	3 hours

List of experiments/assignments

1. Concrete Mix Design as per IS-10262 for various grades of concrete mixes.
2. Special concretes.
3. Durability studies on concrete.
4. Effect of super plasticizer on properties of concrete in fresh and hardened stages.
5. Measurement of air content of concrete.
6. Fineness of cement by Air Permeability method.
7. Non Destructive Testing of Concrete.
8. To determine the modulus of elasticity of concrete.
9. Effect of replacement of fly ash on properties of concrete.
10. Testing of structural steel reinforcement and steel sections.

Semester Second

Subject Code	Subject Name	L-T-P	Cr	Theory	Internal Assessment	Total	Duration
CE-502-T	Highway & Airport Pavement Materials	3-1-0	4	60	40	100	3 hours

UNIT – I Subgrade: Significance of subgrade soil. Characteristics of soil. Desirable properties. Index properties of Soil. Soil classification based on grain size. Soil classification system. Evaluation of soil strength. Aggregates: Introduction. Desirable properties of road aggregates. Tests for road aggregates.

UNIT – II Bituminous Materials: Introduction. Types of bituminous materials. Tests on bitumen. Cutback and emulsions. Bituminous Paving Mixes: Design of bituminous mix. Marshal method of bituminous mix design. Road making aggregates – Classification, Properties of aggregates, design of aggregate gradation, texture, polishing and skid resistance.

UNIT – III Bituminous road binders – Straight- run bitumen, emulsions, Cutback and modified binders. Rheology of bituminous binders, modified binders – adhesion and stripping, penetration index, viscosity, temperature susceptibility of viscosity. Additives and their suitability, Fillers.

UNIT – IV Construction Methods: Bituminous and concrete pavements. Relevant IS and IRC codes.

UNIT – V Polymer and Rubber Modified Binders: Physical and chemical properties. Fly ash and its characterization. Performance based mix design Approaches. Visco elastic properties of bitumen and bituminous mixture.

Suggested Readings:

- Principles of Transportation Engineering by Chakroborty & Das, Prentice Hall, India.
- Highway Engg by S.K.Khanna & C.E.G. Justo, New Chand Bros., Roorkee.
- Principles and Practice of Highway Engg. By L.R.Kadiyali, Khanna Publishers, Delhi.
- Atkins & Harold, Highway Materials, Soils, and Concretes, Prentice Hall
- Relevant IRC, ASTM, AASHTO and other Codes, Manuals and Specifications
- P.G. Lavin, Asphalt Pavements, Taylor and Francis, 1st Ed. 2007.

Subject Code	Subject Name	L-T-P	Cr	Theory	Internal Assessment	Total	Duration
CEC-504	Construction Practices & Equipment	3-1-0	4	60	40	100	3 hours

Form work design and scaffolding, slipform and other moving forms, Shoring, Reshoring, and Backshoring in multistoreyed Building construction. Prestressing, Steel and composites construction methods: Fabrication and erection of structures including heavy structures, Prefab construction, Industrialized construction, Modular coordination. Special construction methods: High rise construction, Bridge construction including segmental construction, incremental construction and push launching techniques. Factors affecting selection of equipment - technical and economic, Analysis of production outputs and costs, Characteristics and performances of equipment for major civil engineering activities such as Earth moving, erection, material transport, pile driving, Dewatering, and Concreting.

Suggested Readings:

1.

Subject Code	Subject Name	L-T-P	Cr	Internal Assessment	Practical	Total	Duration
CE-552-T	Transportation Engineering Lab	0-0-2	2	30	20	50	3 hours

- Penetration Ratio and Penetration Viscosity Number of Bituminous binders
- 10% Fines Test for aggregates
- Moisture sensitivity test for bitumen adhesion
- Viscosity-Temperature relationships for bituminous binders
- Rheological properties of bituminous binders
- Design of Bituminous mixes

Departmental Elective – I

Subject Code	Subject Name	L-T-P	Cr	Theory	Internal Assessment	Total	Duration
CE-506-T	Mass Transit System	3-1-0	4	60	40	100	3 hours

Unit-1 Transportation System Management: Travel Demand management, Traffic Management, The problems caused by turning traffic, Advantage and dis-advantage of one way street working, Tidal flow operation, Closing side streets advantages & dis-advantages, BRT (Bus Rapid Transit)

Unit-2 Trip Interchanges: Graded-separated intersections with or without interchange, Three leg interchange, Four leg interchange, Multi-leg interchange, Trumpet interchange, Diamond interchange, Clover leaf interchange, Rotary interchange, Interchange ramp, Loop, outer connection, Direct connection, Design speed for ramps.

Unit-3 Transport Planning Process: Scope, Interdependence of land use and Traffic, Stages in Transport planning, Survey and analysis of existing conditions, Fore-cast analysis of future condition, Evaluation, Program adoption and implementation, Continuing study, Trip Distribution, Opportunity Model

Unit-4 Urban Transportation Problem: Growth of Towns, Growth of Traffic, Nature of present difficulties in urban traffic conditions, Measures to meet the problems, New Transportation study, Traffic restraint measures, Promotion of public transport, Pedestrianisation, Staggering of office Hours, Promotion of Bi-cycle traffic, Role of Public transport, Fare and subsidies.

Unit-5 Intermediate Public Transport (IPT) vehicles: Types of IPT, Characteristics of IPT modes, Traffic & Environment: Introduction, Detrimental effects of Traffic on Environment, Safety, Noise, Air pollution, Visual Intrusion, Severance. Factors affecting Fuel consumption of Motor vehicles: vehicle, Drive, Road, Fuel characteristics and environmental conditions, Measures for economy of fuel in road transport. Public-private partnership in Transport Projects: Benefits from privatization, Forms of privatization, BOT, Annuity Project, Special Purpose Vehicle (SPV), Design Build finance & Operate (DBFO)

Suggested Readings;

1. L.R.Kadiyali, Transport Engineering and Transport Planning, Eighth Edition 2013.
2. C.S. Papacostas, P.D.Prevedouros, Transport Engineering and Planning, PHI Publication, #rd Edition 2002

Subject Code	Subject Name	L-T-P	Cr	Theory	Internal Assessment	Total	Duration
CEE-506	Solid Waste Management	3-1-0	4	60	40	100	3 hours

1 Solid and Hazardous Wastes: Definition, sources and characteristics; Sampling and analysis techniques; Inventorying wastes; Strategies for waste minimization.

2 Municipal Solid Waste Management: Segregation and recycling and reuse of wastes; Collection, transportation and storage of municipal solid waste; Resource recovery from wastes; waste exchanges; Composting and vermi-composting of wastes; Disposal – siting and design.

3. Hazardous Waste Treatment and Disposal: Biological and chemical treatment of hazardous wastes; Solidification and stabilization of wastes; Incineration for the treatment and disposal of hazardous wastes; Landfill disposal of hazardous waste; Bioremediation of hazardous waste disposal sites.

4. Special Waste Management: Biomedical wastes, E-waste.

5. Legal Requirements: Municipal solid waste rules; Hazardous waste rules; Biomedical waste rules; E-waste rules; Rules related to recycled plastics, used batteries, flyash, etc.

Recommended Books

1. Pichtel J, *Waste Management Practices: Municipal, Industrial and Hazardous*, CRC Press (2005)
2. Kreith F and Tchobanoglous G, *Handbook of Solid Waste Management*, McGraw Hill (2002)
3. LaGrega M, Buckingham P and Evans J, *Hazardous Waste Management*, McGraw Hill (1994)
4. Freeman H, *Standard Handbook for Hazardous Waste Management*, McGraw Hill (1989)
5. *Pollution Control Acts, Rules and Notifications Issued There under: Pollution Control Law Series*, Central Pollution Control Board, New Delhi (1986)

Subject Code	Subject Name	L-T-P	Cr	Theory	Internal Assessment	Total	Duration
CEC-506	Advanced Concrete Technology	3-1-0	4	60	40	100	3 hours

Hydration of cements and microstructural development, Mineral additives, Chemical admixtures, Rheology of concrete, Creep and relaxation, Shrinkage, cracking and volume stability, deterioration processes, special concretes, Advanced characterisation techniques, sustainability issues in concreting, Modelling properties of concrete.

Suggested Readings;

1. **Concrete Technology by Nebille**

Subject Code	Subject Name	L-T-P	Cr	Theory	Sessional	Total	Duration
CES-506	Finite Elements Method in Structural Engineering	3-1-0	4	60	40	100	3 hours

Introduction to Finite Elements: Introduction, Direct formulation of finite element characteristics, Energy approach, Convergence criteria, Displacement functions with discontinuity between elements, Solution bounds, Extension of variational approach.

Plane Stress and Plane Strain: Introduction, Element characteristics, Assessment of accuracy, Some practical applications.

Axis-Symmetric Stress Analysis: Introduction, Element characteristics, Practical applications, Non-symmetrical loading.

Some Improved Elements in 2-D Problems: Introduction, Quadrilateral element, Characteristics derived from triangular elements, Conforming shape functions for a rectangle, Conforming shape functions for an arbitrary quadrilateral, Triangular element with size nodes.

Nodes Dimensional Stress Analysis: Introduction, Tetrahedral element characteristics, Composite elements with eight nodes, Improved displacement functions an element with eight arbitrary nodes, Tetrahedral element with ten nodes, Introduction to rectangular elements, Quadrilateral elements, Conforming functions for quadrilateral elements, Plate-bending elements, Introduction to non-linear Analysis-Material non-linearity and Performance non-linearity.

Books recommended:

1. Bhavikati S. S., "Finite Element Analysis" New Age International Publishers, New Delhi (2005)
2. Desai C. S. and Abel J. F.; Introduction To The Finite Element Method : A Numerical Method For Engineering Analysis, CBS Publisher (2005)
3. O.C. Zienkiewicz & R.L. Taylor, "The Finite element method", Butterworth Heinemann (Vol I and Vol II), (2000).
4. J. N. Reddy, An introduction to the finite element method, McGraw Hill Inc. (1993).
5. C.S. Krishnamoorthy, "Finite Element Analysis, Theory and programming", Tata McGraw Hill, (1994).

Departmental Elective – II

Subject Code	Subject Name	L-T-P	Cr	Theory	Internal Assessment	Total	Duration
CE-508-T	Transportation & Environment	3-1-0	4	60	40	100	3 hours

Unit :1 Functioning of Governing Bodies e.g. Ministry of Environment & Forest, Central Pollution Control Board, State Pollution Control Board in coordination with Public & Private Sectors (Industrial Units). Planning and Decision making, Setting of industries and Concept of Zoning Atlas, Different Norms & Pollution Standards for disposal of Pollutants.

Unit:2 Industrial Pollution & Abatement, Water/Sewage Treatment, Planning and laying of Sewers for Domestic & Industrial Effluent, Rainwater. Collection of Sewage, Systems of sewerage, separate, combined and partially separate. Construction, testing and maintenance of sewer lines. Water Distribution Network, analysis of distribution network, leakage detection, Maintenance.

Unit:3 Environmental & Atmospheric Conditions, Different sources (i.e. Natural, Domestic, Industrial and Transport related Activities) of Air Pollution and its effects on surroundings. Dispersion of Air Pollutants in the atmosphere, Vehicular Pollution, analysis and measurement of vehicular emissions.Noise Pollution Different Sources, Standards and Preventing Practices.

Unit:4 Natural Resources (e.g. soil, rocks, minerals surface water and ground water etc.) and its effect on Environment, Utilization and disposal of waste materials (e.g. Fly ash, wastewater etc) for conservation of natural resources.

Unit:5 Environmental Management, Solid Waste Management, Study of Environmental Hazard, Multidisciplinary environmental strategies, Environmental Audit (EA), Risk Assessment (RA), Mass Balance related to Production and Generation of waste.Environmental Impact Assessment (Industrial as well as different mode of Transportation e.g. Highways, Railways and Airports etc), Conceptual information and methodologies for assessment of Environmental Hazard, Collection of baseline data, initial environmental examination (IEE), Environmental Impact Assessment (EIA) Planning and Execution of Projects, Resettlement Plans (Short Term & Permanent Resettlement) during and after site selection for Roads, Railways and Airports. Activities related to Planning and Implications.

Suggested Readings;

1. R.K. Sapru., "Environment Management in India", APH Publishing Corporations, 1990.
2. Garg, S.K., "Sewage and Sewage Treatment", Khanna Publishers, New Delhi, 1994.
3. B.C. Punmia., Ashok, Jain & Arun, Jain., "Water Supply Engineering", Laxmi Publication, New Delhi , 1995
4. Environmental Protection Act 1986 (Air, Water, Wastewater, Noise, Soil and Industrial Effluent)
5. Bindu, N. Lohani., "Environmental Quality Management", Publisher South Asian, 1984.
6. R.B. Singh., "Studies in Environment and Development" Commonwealth Publishers, 1988.
7. Larry W. Canter, Environmental Impact Assessment by Larry W. Canter.
8. Saxena, K.D., "Environmental Planning Policies and Programmes in India," Shipra Publication,1993.
9. Sharma, P. D., "Ecology and Environment", Rastogi Publication, 2009.
10. Manual on Sewerage and Sewage Treatment: Ministry of Urban Dev., New Delhi.
11. Manual on Water Supply and Treatment: Ministry of Urban Dev., New Delhi.
12. E.W. Steel., "Water Supply and Sewerage", McGraw Hill, New Delhi.

CEE-508: ENVIRONMENTAL SAFETY AND MANAGEMENT

Subject Code	Subject Name	L-T-P	Cr	Theory	Internal Assessment	Total	Duration
CEE-508	Environmental Safety and Management	3-1-0	4	60	40	100	3 hours

1. **Hazardous Materials:** Definition and classification; Material safety data sheets; Handling of hazardous materials.
2. **Regulations:** Rules and regulations pertaining to the management and handling of hazardous chemicals; Hazardous wastes; Biomedical wastes; Hazardous microorganisms; Genetically engineered organisms or cells; Municipal solid wastes; E-wastes; Batteries and plastics.
3. **Hazard Identification:** Assessment of risk; Risk management; OSHAS 18001 and Occupational health and safety management systems.
4. **Principles of Accident Prevention:** Accident recording; Analysis; Investigation and reporting; On-site and off-site emergency preparedness and response plans; Rules and regulations dealing with chemical accidents.
5. **Protection from Hazardous Materials:** Personal protective equipment and clothing; Fire safety; Noise and vibrations; Principles of noise control. **Safety Management:** Notification of sites; Safety reports; safety audits.

Subject Code	Subject Name	L-T-P	Cr	Theory	Internal Assessment	Total	Duration
CEC-511	Composite Materials	3-1-0	4	60	40	100	3 hours

1. Fibre Reinforced Concrete: Properties of Constituent Materials, Mix Proportions, Mixing and Casting Procedures, Properties of Freshly mixed FRC, Mechanics and properties of Fibre reinforced concrete, Composite Material approach, Application of fibre reinforced concrete.

2. Fly Ash Concrete: Classification of Indian Flyashes, Properties of Flyash, Reaction Mechanism, Proportioning of Flyash concretes, Properties of Flyash concrete in fresh and hardened state, Durability of flyash concrete.

3. Polymer Concrete: Terminology used in polymer concrete, Properties of constituent materials, Polymer impregnated concrete, Polymer modified concrete, Properties and applications of polymer concrete and polymer impregnated concrete.

4. Ferro Cement: Constituent materials and their properties, Mechanical properties of ferro cement, Construction techniques and application of ferro cement.

5. High Performance Concrete: Materials for high performance concrete, Supplementary cementing materials, Properties and durability of high performance concrete, Introduction to silica fume concrete, Properties and applications of silica fume concrete.

6. Sulphur Concrete And Sulphur Infiltrated Concrete: Process technology, Mechanical properties, Durability and applications of sulphur concrete, Sulphur infiltrated concrete, Infiltration techniques, Mechanical properties, Durability and applications of sulphur infiltrated concrete.

7. Light Weight Concrete: Properties of light weight concretes, Pumice concrete, Aerated cement mortars, No fines concrete, Design and applications of light weight concrete.

Books recommended:

1. Concrete Technology-A.M. Neville
2. Concrete Technology-M.L. Gambhir.

Subject Code	Subject Name	L-T-P	Cr	Theory	Internal Assessment	Total	Duration
CES-508	Bridge Engineering	3-1-0	4	60	40	100	3 hours

UNIT - I

Types of Bridges: Consideration of loads and stresses in bridges, bridge loading as per IRC and IRS specifications, traffic lanes, footway, kerbs, railing and parapet loading, impact, wind load, longitudinal forces, temp effects, secondary stresses, erection stresses, earth pressure, effect of live load on back fill and on the abutment.

UNIT – II

Design of RC Bridges: Slab culvert, box culvert, pipe culvert, T-beam bridge, super structure, design examples, brief introduction to rigid frame, arch and bow string girder bridges. Design of pre-stressed concrete bridges, pre-tensioned and post tensioned concrete bridges, analysis and design of multi-lane prestressed concrete T-beam bridge super structure.

UNIT – III

Steel Bridges: Types, economical span, loads, permissible stresses, fluctuation of stresses, secondary stresses, plate girder bridges, general arrangement, bridge floors, plate girder railway bridges, deck type plate girder bridges, design example. Truss bridges, types, wind force on lattice Girder Bridge, bracings, truss bridge for railway – through type truss bridge. Pier, abutment and wing walls, types of piers, forces on piers, stability, abutments, bridge code provisions for abutments, wing walls, design examples.

UNIT – IV

Bearings: Functions, bearings for steel and concrete bridges, bearings for continuous span bridges, IRC provisions for bearings, fixed bearings, expansion bearings, materials and specifications, permissible stresses, design considerations for rocker and roller cum rocker bearings, sliding bearings.

UNIT- V

Foundations, types, general design criterion, design of well and pile foundations for piers and Abutments.

Suggested Readings:

- (i) Victor DJ, Essentials of Bridge Engineering, Oxford & IBH Pubb Co.
- (ii) Rowe RE, Concrete ridge Design

Departmental Elective – III

Subject Code	Subject Name	L-T-P	Cr	Theory	Internal Assessment	Total	Duration
CE-510-T	Advanced Engineering Geology	3-1-0	4	60	40	100	3 hours

Unit I

Geology vs. Engineering, Role of geology in planning, design and construction of major man-made structural features. Engineering properties of rocks.

Unit II

Site investigation and characterization. Geological consideration for evaluation of dams and reservoirs sites; dam foundation problems; reservoir problems.

Unit III

Geological conditions for tunnelling. Soft and hard rock tunnelling. Importance of lithology, structure and water in tunnelling. Foundation treatment; Grouting, Rock Bolting and other support mechanisms.

Unit IV

Landslides; Causes, Factors and corrective/Preventive measures.

Unit V

Earthquakes; Causes, Factors and corrective/Preventive measures; seismic zones of India; seismic design of building.

SUGGESTED READINGS:

1. Krynin, D.P. and Judd W.R. 1957. Principles of Engineering Geology and Geotechnique, McGraw Hill (CBS Publ).
2. Johnson, R.B. and De Graf, J.V. 1988. Principles of Engineering Geology, John Wiley.
3. Goodman, R.E., 1993. Engineering Geology: Rock in Engineering constructions. John Wiley & Sons, N.Y.
4. Waltham, T., 2009. Foundations of Engineering Geology (3rd Edn.) Taylor & Francis.
5. Bell: F.G-, 2006. Basic Environmental and Engineering Geology Whittles Publishing.
6. Bell, .F.G, 2007. Engineering Geology, Butterworth-Heineman

Subject Code	Subject Name	L-T-P	Cr	Theory	Internal Assessment	Total	Duration
CEE-510	HAZARDOUS WASTE MANAGEMENT	3-1-0	4	60	40	100	3 hours

1.Solid and Hazardous Wastes: Definition, sources and characteristics; Sampling and analysis techniques; Inventorying wastes; Strategies for waste minimization.

2. Municipal Solid Waste Management: Segregation and recycling and reuse of wastes; Collection, transportation and storage of municipal solid waste; Resource recovery from wastes; waste exchanges; Composting and vermi-composting of wastes; Municipal solid waste management programs; Disposal – siting and design.

3. Hazardous Waste Treatment and Disposal: Biological and chemical treatment of hazardous wastes; Solidification and stabilization of wastes; Incineration for the treatment and disposal of hazardous wastes;

4. Land farming; Landfill disposal of hazardous waste;

5. Bioremediation of hazardous waste disposal sites.

Recommended Books

1. Pichtel J, Waste Management Practices: Municipal, Industrial and Hazardous, CRC Press (2005)
2. Kreith F and Tchobanoglous G, Handbook of Solid Waste Management, McGraw Hill (2002)
3. LaGrega M, Buckingham P and Evans J, Hazardous Waste Management, McGraw Hill (1994)
4. Freeman H, Standard Handbook for Hazardous Waste Management, McGraw Hill (1989)
5. Pollution Control Acts, Rules and Notifications Issued There under: Pollution Control Law Series, Central Pollution Control Board, New Delhi (1986)

Subject Code	Subject Name	L-T-P	Cr	Theory	Internal Assessment	Total	Duration
CEC-510	Construction Contract Management	3-1-0	4	60	40	100	3 hours

Professional Ethics, Duties and Responsibilities of Parties. Owner's and contractor's estimate, Bidding Models and Bidding Strategies, Qualification of Bidders. Tendering and Contractual procedures, Indian Contract Act 1872, Definition of Contract and its Applicability, Types of Contracts, Clauses in Domestic and International Contracts - CPWD, MES, FIDIC, AIA, NEC, JCT, etc. Contract Administration, Delay Protocol, Change Orders Analysis, Claim Management and Compensation, Disputes and Resolution Techniques, Arbitration and Conciliation Act 1996, Arbitration Case Studies.

Suggested Readings:

Subject Code	Subject Name	L-T-P	Cr	Theory	Sessional	Total	Duration
CES-510	Advanced Design of Steel Structures	3-1-0	4	60	40	100	3 hours

- 1. Introduction to Limit States:** Introduction, standardization, allowable stress design limit state design, partial safety factors, concept of section classification: Plastic, compact, semi-compact & slender.
- 2. Columns:** Basic concepts, strength curve for an ideal strut, strength of column member in practice, effect of eccentricity of applied loading, effect of residual stresses, concept of effective lengths, no sway & sway columns, torsional and torsional flexural buckling of column, Robertson design curve, modification to Robertson approach, design of column using Robertson approach.
- 3. Laterally restrained beams:** Flexural & shear behavior, web buckling & web crippling, effect of local buckling in laterally restrained plastic or compact beam combined bending & shear, unsymmetrical bending.
- 4. Unrestrained beam:** Similarity of column buckling & lateral buckling of beams lateral torsional buckling of symmetric section, factor affecting lateral stability, buckling of real beam, design of cantilever beams, continuous beam.
- 5. Beam columns:** Short & long beam column, effect of slenderness ratio and axial force on modes of failure, beam column under biaxial bending, strength of beam column, local section failure & overall member failure.
- 6. Beam subjected to torsion and bending:** Introduction, pure torsion and warping, combined bending and torsion, capacity check, buckling check, design method for lateral torsional buckling.
- 7. Connection design:** Complexities of steel connections, type of connection, connection design philosophies, welded and bolted connection: truss connection, portal frame connection, beam & column splices, beam to beam and beam to column connections.

Books recommended:

- 1 Teaching resource for Structural Steel Design Vol. 1 to 3, Institute for steel development & growth (INSDAG), Calcutta.
- 2 Morsis L.J., Plum, D.R "Structural Steel Work Design".
- 3 Yu, W.W., "Cold Formed Steel Structures Design".
- 4 Arya A.S. and Ajmani, J.L., "Design of Steel Structures".
- 5 Sihna D.A. "Design of Steel Structures".

Open Elective

Subject Code	Subject Name	L-T-P	Cr	Theory	Internal Assessment	Total	Duration
CE-603-T	Advanced Railway Engineering	3-1-0	4	60	40	100	3 hours

Unit 1. Railway Transportation and its development, Long-term operative plans for Indian Railways. Classification of Railway lines and their track standards, Railway terminology, Traction and tractive

Unit 2. Resistance, Hauling capacity and tractive effort of locomotives, different Types of Traction.

Unit 3. Permanent Way: Alignment Surveys, Requirement, gauges, track section, Coning of wheels, Stresses in railway track, high-speed track. Geometric design of railway track, Gauge, Gradient, speed, super elevation, cant deficiency, Negative super elevation, curves, length of transition curves, grade compensations.

Unit 4. Railway track components: Important features, Railway curves, Super elevation, Gradients and grade compensation, Points and crossing and their design approaches. ; Construction and maintenance of railway track, Control of train movements; Signals and interlocking,

Unit 5. Modernisation of railways and future trends; Track standards and track rehabilitation.

Suggested Readings:

1. J.S. Mundrey, Railway Track Engineering, Tata McGraw Hill Co. Ltd., 3rd Edition, 2000.

2. M.M. Agarwal, Railway Track Engineering, Standard Publishers, 1st Ed. 2005.

Supplementary Reading: 1. S. Chandra and Aqarwal, Railway Engineering, Oxford University Press, 1st Ed. Feb 2008. 2. A.D. Kerr, Fundamentals of Railway Track Engineering, Simmons Boardman Pub Co (December 30, 2003).

Subject Code	Subject Name	L-T-P	Cr	Theory	Internal Assessment	Total	Duration
CEE-603	ENVIRONMENTAL IMPACT ASSESSMENT	3-1-0	4	60	40	100	3 hours

- 1. Introduction:** The Need for EIA, Indian Policies Requiring EIA , The EIA Cycle and Procedures, Screening, Scoping, Baseline Data, Impact Prediction, Assessment of Alternatives, Delineation of Mitigation Measure and EIA Report, Public Hearing, Decision Making, Monitoring the Clearance Conditions, Components of EIA, Roles in the EIA Process. Government of India Ministry of Environment and Forest Notification (2000), List of projects requiring Environmental clearance, Application form, Composition of Expert Committee, Ecological sensitive places, International agreements.
- 2. Identifying The Key Issues:** Key Elements of an Initial Project Description and Scoping, Project Location(s), Land Use Impacts, Consideration of Alternatives, Process selection: Construction Phase, Input Requirements, Wastes and Emissions, Air Emissions, Liquid Effluents, Solid Wastes, Risks to Environment and Human, Health, Socio-Economic Impacts, Ecological Impacts, Global Environmental Issues.
- 3. EIA Methodologies:** Criteria for the selection of EIA methodology, impact identification, impact measurement, impact interpretation & Evaluation, impact communication, Methods-Adhoc methods, Checklists methods, Matrices methods, Networks methods, Overlays methods, Environmental index using factor analysis, Cost/benefit analysis, Predictive or Simulation methods. Rapid assessment of Pollution sources method, predictive models for impact assessment, Applications for RS and GIS.
- 4. Reviewing The EIA Report:** Scope, Baseline Conditions, Site and Process alternatives, Public hearing. Construction Stage Impacts, Project Resource Requirements and Related Impacts, Prediction of Environmental Media Quality,
- 5. Socio-economic Impacts, Ecological Impacts, Occupational Health Impact, Major Hazard/ Risk Assessment, Impact on Transport System, Integrated Impact**

Course Code	Course Name	L-T-P	Cr	Theory	Internal Assessment	Total	Duration
CEC-603	Quantitative Methods in Construction Management	3-1-0	4	60	40	100	3 hr

Introduction and concepts of probability and statistics, Linear programming, Transportation and assignment problems. Dynamic programming, Queuing theory, Decision theory, Games theory. Simulations applied to construction, Modifications and improvement on CPM/PERT techniques.

Suggested Reading;

1. Operational Research by D.S. Heera

Subject Code	Subject Name	L-T-P	Cr	Theory	Sessional	Total	Duration
CES-603	Rehabilitation of Structures	3-1-0	4	60	40	100	3 hours

- 1. Maintenance and repair strategies:** Maintenance, repair and rehabilitation, Facets of Maintenance, importance of Maintenance various aspects of Inspection, Assessment procedure for evaluating a damaged structure, causes of distress and deterioration of concrete- Evaluation of existing buildings through field investigations, Seismic evaluation of existing buildings
- 2. Serviceability and durability of concrete:** Quality assurance for concrete construction concrete properties - strength, permeability, thermal properties and cracking. - Effects due to climate, temperature, chemicals, corrosion - design and construction errors - Effects of cover thickness and cracking.
- 3. Materials and techniques for repair:** Special concretes and mortar, concrete chemicals, special elements for accelerated strength gain, Expansive cement, polymer concrete, sulphur infiltrated concrete, ferro cement, Fibre reinforced concrete. Rust eliminators and polymers coating for rebars during repair, foamed concrete, mortar and dry pack, vacuum concrete, Guniting and Shotcrete, Epoxy injection, Mortar repair for cracks, shoring and underpinning - Methods of corrosion protection, corrosion inhibitors, corrosion resistant steels, coating and cathodic protection.
- 4. Repairs, rehabilitation and retrofitting of structures:** Repairs to overcome low member strength, Deflection, Cracking, Chemical disruption, weathering corrosion, wear, fire, leakage and marine exposure - Special techniques for structural Retrofitting (Bracing, Shear walls, Base isolation etc).
- 5. Demolition techniques:** Engineered demolition techniques for Dilapidated structures - case studies - Case Studies on Restoration of fire damaged buildings, Case study on repairs and strengthening corrosion damaged buildings; Case study on use of composite fibre wraps for strengthening of building components.

Audit Course 1 & 2

Subject Code	Subject Name	L-T-P	Cr	Theory	Internal Assessment	Total	Duration
AC-512-T	Airport, Docks & Harbour	3-1-0	4	60	40	100	3 hours

Unit 1: Classification of Airports Development of Air Transportation in India, Airport site election. Modern aircraft's.

Unit 2: Airport obstructions: Zoning Laws, Imaginary surfaces, Approach and Turning zone, clear zone, vert. Clearance for Highway & Railway.

Unit: 3 Runway and taxiway design: Windrose, cross wind component, Runway Orientation and configuration. Basic runway length and corrections, runway geometric design standards. Taxiway Layout and geometric design standards. Taxiway and other areas.

Unit: 4 Air traffic control: Need, Network, control aids, Instrumental landing systems Ports and

Unit: 5 Harbours: Importance of ports and harbours. Impact on Indian trade and economy, Plan of harbour, various components, jetty, dolphins, bollards, their design and functions.

Suggested Readings:

1. Airport Planning & Design, Goyal & Praveen Kumar, Galgotia Publication
2. Harbour, Dock And Tunnel Engineering, R. Srinivasan, Charoter publishing house.

Subject Code	Subject Name	L-T-P	Cr	Theory	Internal Assessment	Total	Duration
ACE-512	CLIMATE CHANGE AND SUSTAINABLE DEVELOPMENT	3-1-0	4	60	40	100	3 hours

1. **Earth's Climate System:** Introduction-Climate in the spotlight - The Earth's Climate Machine – Climate Classification - Global Wind Systems – Trade Winds and the Hadley Cell – The Westerlies - Cloud Formation and Monsoon Rains – Storms and Hurricanes – The Hydrological Cycle – Global Ocean Circulation – El Nino and its Effect - Solar Radiation –The Earth's Natural Green House Effect – Green House Gases and Global Warming – Carbon Cycle.
2. **Observed Changes** And Its Causes: Observation of Climate Change – Changes in patterns of temperature, precipitation and sea level rise – Observed effects of Climate Changes – Patterns of Large Scale Variability – Drivers of Climate Change – Climate Sensitivity and Feedbacks – The Montreal Protocol – UNFCCC – IPCC –Evidences of Changes in Climate and Environment – on a Global Scale and in India – climate change modeling.
3. **Impacts Of Climate Change:** Impacts of Climate Change on various sectors – Agriculture, Forestry and Ecosystem – Water Resources – Human Health – Industry, Settlement and Society – Methods and Scenarios – Projected Impacts for Different Regions– Uncertainties in the Projected Impacts of Climate Change – Risk of Irreversible Changes.
4. **Climate Change Adaptation** And Mitigation Measures: Adaptation Strategy/Options in various sectors – Water – Agriculture – Infrastructure and Settlement including coastal zones – Human Health – Tourism – Transport – Energy – Key Mitigation Technologies and Practices – Energy Supply – Transport – Buildings – Industry – Agriculture – Forestry –
5. **Carbon sequestration** – Carbon capture and storage (CCS)- Waste (MSW & Bio waste, Biomedical, Industrial waste – International and Regional cooperation.

Recommended Books:

1. Anil Markandya , Climate Change and Sustainable Development: Prospects for Developing Countries, Routledge, 2002
2. Heal, G. M., Interpreting Sustainability, in Sustainability: Dynamics and Uncertainty, Kluwer Academic Publ., 1998
3. Jepma, C.J., and Munasinghe, M., Climate Change Policy – Facts, Issues and Analysis, Cambridge University Press, 1998
4. Munasinghe, M., Sustainable Energy Development: Issues and Policy in Energy, Environment and Economy: Asian Perspective, Kleindorfer P. R. et. al (ed.), Edward Elgar, 1996
5. Dash Sushil Kumar, "Climate Change – An Indian Perspective", Cambridge University Press India Pvt. Ltd, 2007

Subject Code	Subject Name	L-T-P	Cr	Theory	Internal Assessment	Total	Duration
ACC-611	Departmental Elective III (Construction & Maintenance Management)	3-1-0	4	60	40	100	3 hours

1. Services in Residential, Commercial and Medical buildings

- (A) Sanitation, water supply, electric wiring, rain water disposal, lighting & illumination, calculation methods for these services.
- (B) Air Conditioning & Ventilation: Natural ventilation, control cooling systems, modern systems of air conditioning, ducting systems, different mechanical means of air conditioning.
- (C) CCD-CS: General principles of transmission and passage of sound reverberation, absorption, reflection, acoustic materials and their coefficient, principles of good acoustic design.
- (D) Thermal Insulation: Behavior of various building materials & thermal conductivity. Thermal insulation for air conditioned interior spaces, working out air conditioning loads for different spaces.
- (E) Fire Safety Dye.

2. Architectural controls and building byelaws: Role of building byelaws in a city, local byelaws and architectural controls, façade control and zoning plans.

3. Regional planning: Understanding of physical, social and economical parameters for regional planning.

4. Landscaping: Forces of man and nature, their relationship and effect on shaping landscape, site analysis, site and.

Books Recommended:

1. Building Repair and Maintenance Management by P. S. Gahlot
2. Maintenance of Buildings by A C Panchdhari.

Subject Code	Subject Name	L-T-P	Cr	Theory	Sessional	Total	Duration
ACS-611	Design of Pre-Stressed Concrete Structures	3-1-0	4	60	40	100	3 hours

1. **Prestressing System and Losses of Prestress:** Introduction, various systems of prestressing, types of losses and their analysis.
2. **Working Stress Design of Simple Beams:** Critical load conditions; allowable stresses; Flexural design criteria; axially prestressed members; design of prestressing cable for a given cross-section; design procedure based on flexure, design by load balancing method and multiple stage prestressing.
3. **Continuous Beams:** Analysis of two span beam, analysis of two span beam with eccentricities at outer supports; continuous beams with variable section; design of continuous beam.
4. **Limit State Design of Beams:** Limit state of strength in flexure, shear and torsion; permissible stresses, Limit state of serviceability against deflection, cracking and durability; Design of simply supported and continuous beams. Limit State Design of partially pre-stressed Beams, Moment Capacity of rectangular and flanged section; design for shear and serviceability.
5. **Bond and Anchorage of prestressing cables:** bond in pre-tensioned and post-tensioned construction, prestressing cable at centroidal axis; symmetric multiple cables causing axial thrust; cable eccentricity; inclined prestressing cable, spalling stresses, end zone reinforcement.

Books recommended:

1. N. Krishna Raju, Prestressed Concrete, Tata-McGraw Hill. Delhi.
2. P. Dayaratram, prestressed Concrete Structures, Oxford & IBH Co.. Delhi.
3. Jain & Jai Krishna, Plain & Reinforced Concrete, Vol-II. Nem Chand & Co., Roorkee.
4. IS 1343-1980 code of Practice for Prestressed Concrete, Bureau of standards. New Delhi.

LINGAYA'S VIDYAPEETH

SCHEME OF STUDIES

SESSION: 2017-19

School: Engineering and Technology								Batch:2017-2019					
Department: Civil Engineering								Year: 1 st					
Course: M.Tech								Semester: 1 st					
S N	Cate - gory	Course Code	Course Name	Periods			Credit s	Evaluation Scheme					Subjec t Total Marks
				L	T	P		Theory			Practical		
								AB Q	MS E	ES E	IP	EX P	
1	PCC	CEC-501	Quantitative Methods in Construction Management	3	1	0	4	15	25	60	-	-	100
2	PCC	CE-501-T	Highway Planning and Geometric Design	3	1	0	4	15	25	60	-	-	100
3	PCC	CES-501	Advanced Structural Engineering	3	0	0	3	15	25	60	-	-	100
4	PCC	CES-503	Advanced RCC Design	3	1	0	4	15	25	60	-	-	100
5	PCC	CEE-505	Advance Water Supply & Wastewater Management	3	0	0	3	15	25	60	-	-	100
6	PCC	CES-521	Advanced Material Testing Lab	0	0	2	2	-	-	-	60	40	100
			Total---->				20						

Abbreviations:

PCC: Programme Core Courses
 PEC: Programme Elective Courses
 PROJ : Project
 PDP: Personality Development Programme
 L: Lecture
 T: Tutorial
 P: Practical

ABQ: Assignment Based Quiz
 MSE: Mid Semester Examination
 ESE: End Semester Examination
 IP: Internal Practical
 EXP: External Practical



LINGAYA'S VIDYAPEETH

SCHEME OF STUDIES

SESSION: 2017-19

School: Engineering and Technology								Batch:2017-2019					
Department: Civil Engineering								Year: 1 st					
Course: M.Tech								Semester: 2 nd					
S N	Cate - gory	Course Code	Course Name	Periods			Credit s	Evaluation Scheme					Subjec t Total Marks
				L	T	P		Theory			Practical		
								AB Q	MS E	ES E	IP	EX P	
1	PCC	CE-502-T	Highway & Airport Pavement Materials	3	1	0	4	15	25	60	-	-	100
2	PCC	CEC-504	Construction Practices & Equipment	3	1	0	4	15	25	60	-	-	100
3	PEC	CE-506(T/E/C/S)	Departmental Elective – I	3	1	0	3	15	25	60	-	-	100
4	PEC	CE-508(T/E/C/S)	Departmental Elective – II	3	0	0	4	15	25	60	-	-	100
5	PEC	CE-510(T/E/C/S)	Departmental Elective – III	3	0	0	3	15	25	60	-	-	100
6	PEC	CEE-552	Advanced Soil Mechanics Lab	0	0	2	2	-	-	-	60	40	100
7	PEC	AC-512 (T/E)	Audit Course -I	2	0	0	0	-	-	-	-	-	-
			Total---->				20						

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LINGAYA'S VIDYAPEETH

SCHEME OF STUDIES

SESSION: 2017-19

School: Engineering and Technology								Batch:2017-2019					
Department: Civil Engineering								Year: 2 nd					
Course: M.Tech								Semester: 3 rd					
S N	Cate - gory	Course Code	Course Name	Periods			Credit s	Evaluation Scheme					Subjec t Total Marks
				L	T	P		Theory			Practical		
								AB Q	MS E	ES E	IP	EX P	
1	PCC	CES-601	Earthquake Analysis & Design of Structures	4	0	0	4	15	25	60	-	-	100
2	PEC	CE-603(T/E/C/S)	Open Elective	3	0	0	3	15	25	60	-	-	100
3	PCC	CES-651	FEM Software base Lab study	0	0	4	2	-	-	-	60	40	100
4	PCC	CE-661	Dissertation-I	0	0	20	10	-	-	-	60	40	100
5	PEC	AC-611(C/S)	Audit Course -II	2	0	0	0	-	-	-	-	-	-
			Total---->				19						

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 L: Lecture
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 ESE: End Semester Examination
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LINGAYA'S VIDYAPEETH

SCHEME OF STUDIES

SESSION: 2017-19

School: Engineering and Technology									Batch:2017-2019				
Department: Civil Engineering									Year: 2 nd				
Course: M.Tech									Semester: 4 th				
S N	Cate - gory	Course Code	Course Name	Periods			Credit s	Evaluation Scheme					Subjec t Total Marks
				L	T	P		Theory			Practical		
								AB Q	MS E	ES E	IP	EX P	
1	PCC	CE-602(T/E/ C/S)	Seminar	0	0	2	1	-	-	-	60	40	100
2	PCC	CE-662(T/E/ C/S)	Dissertation-II	0	0	3 6	18	-	-	-	60	40	100
			Total---->				19						

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 PROJ : Project
 PDP: Personality Development Programme
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 P: Practical

ABQ: Assignment Based Quiz
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 ESE: End Semester Examination
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List of Departmental Electives

Departmental Elective – I

1	CE-506-T	Mass Transit System
2	CEE-506	Solid Waste Management
3	CEC-506	Advanced Concrete Technology
4	CES-506	Finite Elements Method in Structural Engineering

Departmental Elective – II

1	CE-508-T	Transportation & Environment
2	CEE-508	Environmental Safety and Management
3	CEC-508	Composite Materials
4	CES-508	Bridge Engineering

Departmental Elective – III

1	CE-510-T	Advanced Engineering Geology
2	CEE-510	Hazardous Waste Management
3	CEC-510	Construction Contract Management
4	CES-510	Advanced Design of Steel Structures

Open Elective

1	CE-603-T	Advanced Railway Engineering
2	CEE-603	Environmental Impact Assessment
3	CEC-603	Quantitative Methods in Construction Management
4	CES-603	Rehabilitation of Structures

Audit Course 1 & 2

1	AC-512-T	Airport, Docks & Harbour
2	ACE-512	Climate change and Sustainable Development
3	ACC-611	Construction and Maintenance Management
4	ACS-611	Design of Pre-Stressed Concrete Structures