

PCE101 ADVANCED STRUCTURAL ANALYSIS

L	T	P	Cr.
3	2	0	4.0

Stiffness Method (Systems Approach): Basis of stiffness method, Degrees of freedom, Force-displacement relationships, Nodal stiffness.

Flexibility Method (Systems Approach): Flexibility coefficients, Basis of the method, Application to various types of structures.

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.

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.

Plastic Analysis: Concept of Limit load analysis, Upper and lower bounds, Plastic analysis of beams and multi-storey frames using mechanism method.

Non Linear Analysis: Introduction to geometric and material non-linearity.

Recommended Books:

1. Gere, G. M. and Weaver, Jr. W., *Matrix Analysis of Framed Structures*, CBS Publishers (1987).
2. McCormac, J. C. & Nelson, J. K., *Structural Analysis: A Classical and Matrix Approach*, John Wiley and Sons (1997).
3. Pandit & Gupta, *Matrix Analysis of Structures*, Tata McGraw Hill Publications (2003).
4. Iyengar, N.G.R., *Elastic Stability of Structural Elements*, Macmillan India Ltd (1980).

PIN101 DAMS AND SPILLWAYS

L	T	P	Cr.
3	2	0	4.0

Introduction: Types, classification, factors governing the selection of a dam site

Gravity Dams: Forces acting on gravity dam, Design, Modes of failure and criteria for structural stability, principal and shear stress, methods of analysis, elementary profile of a gravity dam, high and low gravity dam, Joints in gravity dam, Galleries, foundation treatment

Earth dam: Classification, Method of construction, Causes of failure, Design criteria, seepage line and its location, Design of Filters, Seepage control, Stability of earth dams.

Arch dams: Types, forces acting on arch dam, design of arch dam

Buttress dams: Types, forces acting on buttress dam, design of buttress dam

Spillways: Location, types, design consideration, energy dissipation below spillways, design of stilling basin, spillway crest gates

Recommended Books:

1. Garg, S. K., *Irrigation Engineering and Hydraulic structures*, Khanna Publishers, New Delhi (2010).
2. Varshney, R. S., *Concrete Dams*, Oxford and IBH Publishing Company, New Delhi. (1982)
3. Novak, Pavel, Moffat, A I B, and Nalluri, C., *Hydraulic structures*, Taylor & Francis, (2001).

PCE321 FOUNDATION ENGINEERING

L	T	P	Cr.
3	2	0	4.0

Shallow foundations: Terzaghi's bearing capacity equation, General bearing capacity equation, Meyerhof's Vesic theory, Effect of water table, Special footing problems, I.S. Codes, Footing pressure for settlement on sand, Soil pressure at a depth, Boussineq's & Westergaard's methods, Computation of settlements, Inclined and Eccentric Loads.

Pile foundations: Timber, Concrete, Steel piles, Estimating pile capacity by dynamic formula, by wave equation and by static methods, Point bearing piles, Pile load tests, Negative skin friction, Modulus of sub-grade reaction for laterally loaded piles, Lateral resistance, Pile group considerations, Efficiency, Stresses on underlying strata, Settlement of pile groups, Pile caps, Batter piles, Approximate and Exact analysis of pile groups, I.S. Codes.

Well Foundations: Types (open end, closed or box, Pneumatic, Drilled), Shapes, Bearing capacity and settlements, Determination of grip length by dimensional analysis, Stability of well foundations by IRC Method, Construction, Tilts & shifts.

Machine Foundations: Types, Analysis and design by Barkans method, Determination of coefficient of uniform elastic compression, and Design of a machine foundation, I.S. Method of design.

Introduction to Geotechnical Earthquake Engineering: Ground Shaking, Liquefaction, Evaluation, Mechanism, Effects of liquefaction.

Sheet pile Structures: Types, Cantilever, Anchored sheet, Design by free earth & fixed earth method, Anchored braced sheeting, Cofferdams, Stability of cellular cofferdam, Instability due to heave of bottom.

Recommended Books:

1. Bowles, Joseph E. , *Foundation Analysis and Design*, Tata McGraw Hill (2001).
2. Coduto, Donald P., *Foundation Design: Principles and Practice*, Prentice Hall (2001).
3. Dass, B. M. , *Principles of Foundation Engineering*, Thomson Learning (2006).
4. Kramer, Steven L., *Geotechnical Earthquake Engineering*, Pearson Education (2003).
5. Murthy, V.N.S., *Advanced Foundation Engineering*, C.B.S. Publishers (2007).

L	T	P	Cr.
2	0	0	2.0

An overview of Basic Concepts Related to Infrastructure: Introduction to Infrastructure., An Overview of the Power Sector in India., An Overview of the Water Supply and Sanitation Sector in India., An overview of the Road, Rail, Air and Port Transportation Sectors in India. , An overview of the Telecommunications Sector in India. , An overview of the Urban Infrastructure in India. , An overview of the Rural Infrastructure in India. An Introduction to Special Economic Zones, Organizations and Players in the field of Infrastructure, The Stages of an Infrastructure Project Lifecycle., an Overview of Infrastructure Project Finance

Private Involvement in Infrastructure: A Historical Overview of Infrastructure Privatization. The Benefits of Infrastructure Privatization, Problems with Infrastructure Privatization, Challenges in Privatization of Water Supply: A Case Study, Challenges in Privatization of Power: Case Study., Privatization of Infrastructure in India : Case Study, Privatization of Road Transportation Infrastructure in India.

Challenges to Successful Infrastructure Planning and Implementation: Mapping and Facing the Landscape of Risks in Infrastructure Projects, Economic and Demand Risks : The Case study, Political Risks : The case study, Socio-Environmental Risks : Case study, Cultural Risks in International Infrastructure Projects, Legal and Contractual Issues in Infrastructure, Challenges in Construction and Maintenance of Infrastructure.

Strategies for Successful Infrastructure Project Implementation: Risk Management Framework for Infrastructure Projects, Shaping the Planning Phase of Infrastructure Projects to mitigate risks, Designing Sustainable Contracts, Introduction to Fair Process and Negotiation, Negotiating with multiple Stakeholders on Infrastructure Projects, Sustainable Development of Infrastructure, Information Technology and Systems for Successful Infrastructure Management, Innovative Design and Maintenance of Infrastructure Facilities, Infrastructure Modeling and Life Cycle Analysis Techniques, Capacity Building and Improving the Governments Role in Infrastructure Implementation, An Integrated Framework for Successful Infrastructure Planning and Management - Infrastructure Management Systems and Future Directions.

Recommended Books:

1. Grigg, Neil, *Infrastructure engineering and management*, Wiley, (1988).
2. Haas, Hudson, Zaniewski, *Modern Pavement Management*, Krieger, Malabar, (1994).
3. Hudson, Haas, Uddin, *Infrastructure management: integrating design, construction, maintenance, rehabilitation, and renovation*, McGraw Hill, (1997).
4. Munnell, Alicia, Editor, *Is There a Shortfall in Public Capital Investment? Proceedings of a Conference Held in June (1990)*.
5. *World Development Report 1994: Infrastructure for Development* (1994).
6. Zimmerman, K. and F. Botelho, "Pavement Management Trends in the United States," 1st European Pavement Management Systems Conference, Budapest, September (2000).

PIN201 SITE EXPLORATION AND FIELD TESTING

L	T	P	Cr
2	0	4	4.0

Need and importance of site investigations: Site exploration and phasing of site exploration programme, Spacing and depth of bore holes, significant depth

Methods of site exploration: Soundings bore holes, drilling methods and equipment wash boring, rotary boring and percussion boring in soils at stabilization of bore holes. Procuring and handling of disturbed and undisturbed samples- various types of samplers and sampling techniques, their relative merits and suitability in particular cases, lowering of water table.

Geophysical methods of soil exploration: Seismic, electrical and resistivity methods, Magnetic and gravity methods, Observation of ground water level, Different methods of ground water observation, Their merits and demerits.

Soil testing techniques: Field tests for permeability, in place density, vane shear test, plate bearing test, standard penetration test, SCPT, CPT, Pressure meter test.

Laboratory Work:

Tri-axial shear test, Drained and Un-drained test, Consolidation test, unconfined compressive strength test, direct shear test.

Recording and reporting of data for particular engineering use e.g. for machine foundations, earth dams etc.

Discussion and seminar on published papers of recent origin connected with exploration and testing of soils, case histories of failure of structures.

Recommended Books and Manuals:

1. *Simons, Noel, Menzies, Bruce and Matthews, Marcus., Geotechnical Site Investigation, Thomas Telford Publishing,(2002).*
2. *Hawkins, Brian. A., Site investigation Practice, Geological Society of London, (1986).*

PIN202 TRANSPORTATION PLANNING AND ECONOMICS

L T P Cr.
3 2 0 4.0

Hierarchical Level of Planning: Passenger and Goods Transportation, General Concept and Process, Urban Travel Characteristics, Private & Public Travel Behaviour Analysis Travel Demand Estimation and Forecasting, Trip Generation Methods and their Comparison, Modal Split Analysis, Behavioural Approach, Two stage Modal Split Models

Trip Distribution: Growth Factor Method, Gravity Model, Intervening Opportunity and Competing Opportunity Models, Entropy Maximizing and Linear Programming Methods

Network Assignment: Capacity Restrained and Simultaneous Distribution, Direct Demand Models. Land-use Transport Planning, Transport Related Land use Models. Corridor Type Travel Planning, State wise and Regional Transportation Planning

Recommended Books:

1. Hutchinson, B.G., *Principles of Urban Transport Systems Planning*, McGraw Hill, New York, (1974).
2. Kadiyali, L. R., *Traffic Engineering and Transport Planning*, Khanna Publishers, (1997).
3. Michael, F., *Transportation Planning Models*, Elsevier Science Publishers, B.V. Netherlands, (1984).
4. Wright H, and Paquette, R. J., *Highway Engineering*, John Wiley & Sons, U.S.A., (1987).
5. Ortuzar, J. D., and Willumsen, L. G., *Modelling Transport*, John Wiley & Sons, New York (1994).

PES212 ENVIRONMENTAL IMPACT ASSESSMENT

L	T	P	Cr.
3	1	0	3.5

Legal Aspects of EIA: EIA notification; Environmental clearance process - Screening, scoping, public consultation and appraisal, Objectives and scope of EIA; EIA process flow chart.

Project and the Environment Description: Environmental feasibility analysis, Identification of key issues, Defining objectives and scope of EIA, Baseline studies, environmental monitoring and environmental data collection.

Impact analysis: Tools and methods used to identify, predict and evaluate different types of impacts: checklists, matrices, networks, overlays and GIS, models and expert systems and professional judgements.

EMP (Environmental Management Plan): Principles, Elements of approach and measures used for mitigating the impacts, Anticipated environmental impacts and mitigation measures.

EIA Document: Purpose of preparing and submitting EIA documents, Summary EIA document, Draft EIA and final EIA document, Structure and contents of the EIA document.

EIA Case Studies: Mining projects, Mineral processing, Materials production and processing projects, Manufacturing projects, Physical infrastructure projects.

Recommended Books:

- Sadler, B. and McCabe, M., *Environmental Impact Assessment: Training Resource Manual*. UNEP (2002).
- MOEF, India, *EIA manual*. Ministry of Environment and Forests, Government of India (<http://www.envfor.nic.in/legis/eia/so195.pdf>).
- *EIA notification, Gazette Notification: SO 1533 dated 14-09-2006*, MOEF. GOI (2006).
- Munn, R. E. *Environmental Impact Assessment - Principles and Procedures*, Scientific Committee on Problems of the Environment (SCOPE)-5 (1979).
- Canter, R. L., *Environmental Impact Assessment*, Tata McGraw-Hill (1981).
- Rau J. G. and Wooten D. C., *Environmental Impact Analysis Handbook*, Tata McGraw-Hill (1980).

PCE301 EARTHQUAKE RESISTANT DESIGN OF STRUCTURES

L	T	P	Cr.
3	2	0	4.0

Past Earthquakes: Review of damage in past earthquakes, Earthquake response of structures, Idealization of structures, Response spectrum analysis, Equivalent lateral force concepts, Torsionally coupled systems, Orthogonal effects, Nonlinear, Pushover and Time history analysis.

Philosophy of earthquake resistant design: Ductility, Redundancy & Over strength, Damping, Base Isolation Supplemental Damping, Codal Provisions.

Seismic behaviour of Structures: Concrete structures, Steel and masonry structures, Material properties, Analysis of members under cyclic loads, Detailing provisions, Concepts of structural control.

Effects of soil-structure interaction

Recommended Books:

1. Clough, Ray W. and Penzien, Joseph, *Dynamics of Structures*, McGraw Hill (1975).
2. Den Hartog, J. P., *Mechanical Vibrations*, McGraw Hill Book Co. (1989).
3. Timoshenko, S. P., *Vibration Problems in Engineering*, D. Van Nostrand Company Inc. (2007).
4. Aggarwal, P., ShriKhande, M., *Earthquake Resistant Design of Structures*, McGraw Hills (2003).

PIN111 COMPUTATIONAL FLUID DYNAMICS

L	T	P	Cr.
3	0	2	4.0

Review of numerical techniques: Finite difference method, Method of characteristics, Crank-Nicolson scheme, explicit and implicit scheme, Discretization methods: Taylor series expansion method and integration over control volume method, convergence and stability analysis,

Method of solution: Gauss Seidal method, Tri-diagonal matrix algorithm, Finite Volume method for convection-diffusion problems, upwind difference scheme, numerical false diffusion, hybrid and power law scheme, total variation diminishing scheme, SIMPLE algorithm

Navier-Stoke equation, Exact solution of Navier-Stoke equation, Reynolds equation

Turbulence modeling: Mixing length model, K- ϵ model, Reynolds stress equation model,

Dam break problem, Surge tank analysis, Theory and computations of Gradual varied flow, rapidly varied flow and spatially varied flow

Recommended Books:

1. *Date, Anil W., Introduction to Computational fluid dynamics by, Cambridge University Press, (2005).*
2. *Versteeg, H.K. and Malalasekera, W., An introduction to Computational fluid dynamics the Finite volume method, Longman Scientific and Technical, England (1995).*
3. *Anderson, John D., Computational fluid dynamics, McGraw Hill (1995).*
4. *Subramanya, K., Flow in Open Channel, Tata McGraw Hill(2010).*

PCE323 INDUSTRIAL STRUCTURES

L	T	D	Cr.
3	0	2	4.0

Review of Plastic Design: Concept of minimum weight design

Design of Industrial Buildings: General, Framing, Crane girders & columns, Analysis of trussed bents, Design of industrial frame.

Design of Storage Structures: Design of containers like bunkers, silos.

Design of Space Structures: Transmission towers, Steel domes, Pre-cast building components.

Design using Light Gauge Sections: Structural use of pressed sections and light gauge sections, Aluminium as a material of construction for industrial structures and design of such structures, Tubular structures and Sandwich plate construction.

Aluminium structures: Introduction, Permissible stresses, Tension members, Compression members, Design of beams, Local buckling of compression elements, Riveted and bolted construction, Design of chimneys, Load analysis, Design of steel supporting chimney, Chimney foundation

Construction Practices: Shop practice in steel construction, Fabrication erection and production.

Recommended Books:

1. *Ajmani, A. L. and Arya, A. S., Design of Steel Structures, Nem Chand and Brothers (2000).*
2. *Dunham, C.W., Planning of Industrial Structures, John Wiley and Sons(2001).*
3. *Gary, W., Steel Designer's Manual, Prentice Hall (2008).*
4. *Glower, F., Structural Pre-cast Concrete, Oxford Publishers (2008).*

PIN112 GEOTECHNIQUES

L	T	P	Cr.
3	2	0	4.0

Sheet Piles and Cofferdams: Types of sheet piles, principal advantages of sheet piles, analysis of cantilever wall in sands, simplified approach in clays ($\phi=0$) Anchored bulk head stability, Free earth support method, fixed earth support method. Types of cofferdams, relative merits and their advantages as compared to other types, comparison between circular and diaphragm types, failure modes of cells, stability analysis of cofferdams by TVA method. Open cuts, necessity of bracing and strutting in open cuts, pressure distribution diagram under various cases, deep open cut in loose and dense sands, deep open cut in normally loaded and stiff clays. Heaving of vertical cuts in clay

Earth Dams: Introduction: Historical Development, selection of dam site, types of embankment dams, choice of type of dam, components of a dam, free board, slope protection, cause of failure, criteria for safe design. Foundation Exploration and Materials for Embankments: Methods of investigations, properties of ground, field and laboratory tests, suitability criteria for materials, critical conditions in earth dam; end of construction , steady seepage, rapid draw down. Drainage of Embankment: Horizontal drain, chimney drain, design of filter, use of impervious core in seepage control.

Control of Seepage through Foundation: General consideration, treatment of foundation; trench cut off partial cut off, grout cutoff, upstream impervious blanket, design of relief well.

Instrumentation in Earth Dam: Measurement of pore pressure, movement of dam and seepage, Instruments for measuring horizontal and vertical movement. Peizometers; types, choice for location, Instruments for measuring seepage.

Stability Analysis of Slope: Effective and total stress approach, shape of slip surface, methods of slices, graphic methods, location of critical slip circle, wedge analysis method, stability during critical conditions, stability during earth quake, Indian standard Code s of practice.

Quality Control in Construction: Method of compactions, quality control of compaction in the field, borrow area control.

Arching Action in Soils: Arching in soil, theory of arching in soils, practical utility of arching in various field problems.

Dewatering: Approximate computation for flow quantity to dewater an excavation, slurry wall and safety factor. Simple sketches to illustrate the principles of dewatering by different methods and their relative suitability. Ditches and sumps, well point system, deep well drainage installation, vacuum method Bleeder wells, sand drain installation, electro-osmosis.

Recommended Books

1. *Murthy, V N S, A textbook of Soil Mechanics & Foundation Engineering, UBS, New Delhi (1999).*
2. *Gopal Ranjan & Rao, A S R, Basic and Applied Soil Mechanics New Age Publishers, New Delhi (2003).*

3. *Alam Singh & Chowdhry, G.R., Soil Engineering in Theory and Practice, C.B.S. Publishers, New Delhi.*
4. *Bell, F.G., Chapman and Hall, UK Engineering Treatment of Soils (1993).*
5. *Hausmann, Engineering Principles of Ground Modification, McGraw Hill, New York (1990).*
6. *Swami Saran, Analysis and Design of Substructures, Oxford and IBH, New Delhi (1998).*
7. *Bowles, J. E., Foundation Analysis & Design, McGraw Hill Publishing Co., New Delhi (1994)*

PIN113 DESIGN OF WATER SUPPLY AND SEWERAGE SYSTEMS

L	T	P	Cr.
3	2	0	4.0

Introduction: Review of Unit processes and operations, characteristics of water and wastewater and gaseous effluents.

Treatment Systems: Preliminary Treatment Systems and their Design; Design of Secondary treatment units, Advanced Treatment Systems and Miscellaneous Methods

Review of Sewage and its characteristics: Biological Treatment, Aerobic and anaerobic processes and their applications in the waste waters treatment.

Aerobic Treatment units: Principles, design and operation of different systems.

Anaerobic Treatment Units: Principles, design and operation of different units,

Other Treatment methods: Tertiary and other advanced treatment methods

Recommended Books:

1. *Hammer, M.J., Water and Wastewater Technology , Regents/Prentice Hall, New Jersey (1991).*
2. *Metcalf & Eddy, Inc. Wastewater Engineering - Treatment, Disposal, and Reuse, Third Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi (1995).*
3. *Casey T.J., Unit Treatment Processes in Water and Wastewater Engineering, John Wiley & Sons England (1993).*

PIN114 SMART MATERIALS AND STRUCTURES

L	T	P	Cr.
3	2	0	4.0

Introduction: Introduction to Smart Materials and Structures – Instrumented structures functions and response – Sensing systems – Self diagnosis – Signal processing consideration – Actuation systems and effectors.

Measuring Techniques : Strain Measuring Techniques using Electrical strain gauges, Types – Resistance – Capacitance – Inductance – Wheatstone bridges – Pressure transducers – Load cells – Temperature Compensation – Strain Rosettes.

Sensors: Sensing Technology – Types of Sensors – Physical Measurement using Piezo Electric Strain measurement – Inductively Read Transducers – The LVDT – Fiber optic Techniques. Chemical and Bio-Chemical sensing in structural Assessment – Absorptive chemical sensors – Spectroscopes – Fibre Optic Chemical Sensing Systems and Distributed measurement.

Actuators: Actuator Techniques – Actuator and actuator materials – Piezoelectric and Electrostrictive Material – Magneto structure Material – Shape Memory Alloys – Electro rheological Fluids– Electro-magnetic actuation – Role of actuators and Actuator Materials.

Signal processing and Control Systems: Data Acquisition and Processing – Signal Processing and Control for Smart Structures – Sensors as Geometrical Processors – Signal Processing – Control System – Linear and Non Linear

Recommended Books:

1. *Brain Culshaw , Smart Structure and Materials, Artech House, Borton. London (1996).*
2. *Srinath, L. S., Experimental Stress Analysis, Tata McGraw-Hill, (1998).*
3. *Dally , J. W. & Riley, W. F., Experimental Stress Analysis, Tata McGraw-Hill, (1998).*

PIN211 HYDRO POWER ENGINEERING

L	T	P	Cr.
3	2	0	4.0

Introduction: Role of Hydropower, Types of hydropower plant

Water conveyance: Classification and design criteria of Penstock, Anchor blocks, conduit valves, bends and manifolds, Water hammer, Surge tanks

Turbines: different models – classification - suitability of different types, Velocity triangles, Draft tubes, Cavitation in turbines, Performance characteristics

Components of hydropower plants: power system terms and definitions, water power equations, hydraulic transients, demand curve, power economics, small hydropower development.

Recommended Books:

1. Barrows, H. K., *Hydropower engineering*, McGraw-Hill Publishing Company, New York (1999).
2. Varshney, R. S., *Hydro Power Structures*, Nem Chand Brothers, Roorkee (2001).
3. Dandekar, M. M. and Sharma, K. H., *Water Power Engineering*, Vikas Publishing House, New Delhi. (1996).

PCE212 TALL STRUCTURES

L	T	D	Cr.
3	0	2	4.0

Principles of Planning of Tall Buildings: Technological Planning, Mechanical systems, Fire rating, local considerations, Structures elements, Types of structural systems for tall buildings, Shear Walls and their arrangement.

Loads on Tall Buildings: Gravity loads, Live loads, Wind loads and seismic loading, Code Provisions, Discussion of relevant codes of practices and loading standards.

Analysis of Tall Buildings (With and Without Shear Walls): Approximate analysis for gravity loads, Lateral loads, Analysis of tube-in-tube constructional and 3-Dimensional analysis of shear core buildings, Stability, Stiffness and fatigue, Factor of safety and load factor.

Design of Tall Buildings: Procedures of elastic design, Ultimate strength design and Limit state design of super structures including structural connections, soil structure interaction.

Recommended Books:

1. *Smith, Byran Stafford and Coull, Alex, Tall Building Structures: Analysis and Design, John Wiley and Sons, (1991).*
2. *Symposium on Tall Buildings with particular reference to Shear Wall Structures, held at University of Southampton (1996).*
3. *Taranath, B. S., Analysis and Design of Tall Buildings, Tata McGraw Hill Limited, (1988).*

PIN212 MASS TRANSPORTATION SYSTEMS

L	T	P	Cr.
3	2	0	4.0

History and role of Transit: Recent Trends Mass Transportation Characteristics. Demand characteristics, Spatial, Temporal and Behavioural Characteristics of Transportation Demand.

Urban Mass Transportation Planning: Demand Surveys, Estimation and Demand Projection, Four Stages of Planning. Performance Evaluation of Mass Transport System, Structure of Decision Making, Evaluation and Selection Methods, Selection Procedures, Economic Evaluation Methods

Terminals and their Functions: Design, Typical Characteristics. Scheduling, Service Analysis, Vehicle Dispatch Policy, Vehicle Requirements, Spacing of Bus Troops, Route Spacing and Performance.

Operational and Management Issues: Fleet Management, Reserved Bus Lanes, Signal Preemption, Dial-a-Bus, Vehicle Monitoring and Control System, Modal Coordination, Special Studies, Underground Transportation, Para transit, Rail Transit, Case Studies

Introduction to Integrated Transportation Systems

Recommended Books:

1. Vuchic V.R., *Urban Public Transportation System and Technology*, Prentice Hall, Inc. Englewood Cliffs, New Jersey, (1981).
2. Agarwal M.K., *Urban Transportation in India*, INAE, Allied Publishers Ltd., (1996).
3. Grey G.E. & Hoel , L. A., *Public Transportation*, Prentice Hall, Englewood Cliffs, N.J. (1992).

PIN213 TRAFFIC ENGINEERING

L T P Cr.
3 2 0 4.0

Traffic characteristics: Basic characteristics of Traffic- Volume, Speed and Density- Relationship among Traffic parameters.

Traffic Measurement: Traffic Volume Studies-Objectives- Types of Volume Studies –Concept of PCU- Data Collection and Presentation – Speed Studies – Types of Speeds- Objectives of Speed Studies- Methods of Conducting speed studies- Data collection and Presentation- Statistical Methods for Analysis of Speed Data.

Highway Capacity: Definition of Capacity – Importance of capacity – Factors affecting Capacity- Concept of Level of Service- Different Levels of Service- Concept of Service Volume- Peak Hour Factor.

Parking Studies: Types of parking facilities – On street and Off Street Parking Facilities- Parking Studies- Parking Inventory Study – Parking Survey by Patrolling Method- Analysis of Parking Data and parking characteristics-Multi Story Car Parking Facility-Design standards

Traffic Control and Regulation: Traffic Problems in Urban areas- Importance of Traffic Control and regulation- Traffic Regulatory Measures- Channelization- Traffic Signals- Saturation Flow - Signal Design by Webster Method – Signal Phasing and Timing Diagrams.

Traffic and Environment: Detrimental effect of traffic on environment – Air Pollution – Pollutants due to Traffic – Measures to reduce Air Pollution due to Traffic- Noise Pollution – Measures to reduce Noise Pollution.

Traffic Signs and Road markings: Types of Traffic Signs- cautionary, Regulatory and Informative Signs- Specifications- Pavement markings- Types of Markings – Lane markings and Object markings- Standards and Specifications for Road Markings.

Highway Safety: Problem of Highway Safety – Types of Road accidents- Causes – Engineering Measures to reduce Accidents- Enforcement Measures – Educational Measures- Road Safety Audit- Principles of Road Safety Audit.

Recommended Books:

1. Kadiyali, L. R., *Traffic Engineering and Transportation planning*, Khanna publishers (2008).
2. Khisty, C. J. and Lall B. K., *Transportation Engineering : An Introduction*, Prentice Hall (2002).
3. Chakroborthy, Partha and Das, Animesh, *Principles of Transportation Engineering*, Prentice Hall of India (2003).
4. Papacostas, C.S., *Fundamentals of Transportation Engineering*, Prentice Hall, India (2009).
5. Mannering, F., Kilareski W. P. and Washburn S. S., *Highway Engineering and Traffic Analysis*, John Wiley Publications (2008).

PCE211 ADVANCED BRIDGE DESIGN

L	T	D	Cr.
3	0	2	4.0

General: Bridge System, Considerations in alignment, Planning, Economic consideration, Aesthetics and selection of type of bridge (Review).

Loading Standards: Standards followed in U.K., U.S.A. and Europe.

Super Structure Analysis: Bridge deck analysis using different methods, Load distribution theories – Courbon specifications for loading, Geometrical proportioning etc. of road, rail-cum-road bridges, Indian Road Congress (IRC) and Indian Railway Loading standards and their comparison with loading, Hendry-Jaeger, Morris-Little (Orthotropic plate theories) methods, Stiffness method, Finite difference method, Folded Plate method, Finite strip method and Finite Element method (General treatment), Limit analysis, Design of bridge decks.

Long Span Bridges: General discussion on analysis and design of suspension and cable stayed bridges.

Connections: Design of different connections, Bearings and joints.

Substructure Analysis and Design: Piers, Abutments, Wing walls and other appurtenant structures.

Foundations: Well foundations and pile foundation, Design and construction and field problems.

Construction & Maintenance: Erection of bridge super structure, Maintenance, Rating and Strengthening of existing bridges.

Dynamic Behaviour of bridges.

Recommended Books:

1. Bakht, B. and Jaeger, L.G., *Bridge Analysis Simplified*, McGraw-Hill Book Company (1985).
2. Cusens, A.R. and Parma, R.P., *Bridge Deck Analysis*, John Wiley & Sons Ltd. (1975).
3. Hambly, E.C., *Bridge Deck Behaviour*, Chapman and Hall. (1991).
4. Krishna Raju, N., *Design of Bridges*, Oxford and IBH Publications (1998).
5. Ponnuswamy, R., *Bridge Engineering*, Tata McGraw Hill (1997).
6. *Relevant Road & Railway Codes for Bridges*.
7. Raina, V K , *Concrete Bridge Practice*, Tata McGraw Hill Publications (1991).

PIN221 ADVANCED HYDROLOGY

L	T	P	Cr.
3	2	0	4.0

Review of basic concepts in hydrology: Hydrologic cycle, systems concept - hydrologic processes, precipitation, evaporation, surface flow, sub-surface flow, and groundwater flow - hill slope processes and runoff generation, Stream flow measurements

Hydrologic Analysis : watershed concepts, rainfall-runoff Modeling,, hydrograph analysis, unit hydrograph theory, linear and kinematic wave model, and overland flow models

Flood routing: Introduction to hydraulic and hydrologic routing - The Saint-Venant Equations for open channel flow, flood wave propagation, kinematic diffusion wave approximations.

Hydrologic Statistics: Statistical parameter estimation, probability distribution, goodness of fit, Time Series Analysis - Hydrologic real time forecasting; Probability, risks and uncertainty analysis for hydraulic and hydrologic design; Regional Flood Frequency analysis.

Hydrologic Simulation Models: Hydrologic model classification, philosophy of mathematical models of watershed hydrology, steps in watershed modeling, major hydrologic models.

Urban watershed hydrology

Ground Water Hydrology: Well hydraulics, Analysis of pumping test data, Groundwater recharge;

Water logging and salinity

Recommended Books:

1. *Chow, V. T et al., Applied Hydrology, McGraw-Hill Publishing Company, New York (1988).*
2. *Haan, C.T, Statistical methods in Hydrology, Iowa State University Press (2002).*
3. *McCuen, R.H., Modelling Hydrologic Change – Statistical methods, Lewis Publishers (2002)*
4. *Mays, L. W., Water Resources Engineering, John Wiley and Sons (2009).*
5. *Todd, D. K., Groundwater Hydrology, John Wiley and Sons, New York (2006).*

L	T	P	Cr
3	2	0	4.0

General Principal of Compaction: Mechanics, field procedure, quality control in field. **Ground**

Improvement in Granular Soil: In place densification by Vibrofloatation, Compaction pile, Vibro Compaction Piles, Dynamic Compaction, Blasting.

Ground Improvement in Cohesive Soil: Preloading with and without vertical drains. Compressibility, vertical and radial consolidation, preloading methods. Types of Drains, Design of vertical Drains, construction techniques. Stone Column: Function Design principles, load carrying capacity, construction techniques, settlement of stone column foundation.

Ground Improvement by Grouting: Grouting in soil, types of grout, desirable characteristics, grouting pressure, grouting methods.

Soil Reinforcement: Mechanism, Types of reinforcing elements, reinforcement-soil interaction, Reinforcement of soil beneath the roads, foundation. Stability and Design of Reinforced earth retaining wall Types of geosynthetics, Physical and Engineering properties of geosynthetics. Functions of geosynthetics, applications and designing with geosynthetics in pavement, foundations, embankments, retaining walls and filtration.

Soil Stabilization: Lime stabilization-Base exchange mechanism, Pozzolanic reaction, lime-soil interaction, lime columns, Design of Foundation on lime columns. Cement stabilization: Mechanism, amount, age and curing. Fly-ash – Lime Stabilization, Soil Bitumen Stabilization.

Recommended Books:

1. *Raj Parshotham; Geotechnical Engineering, Pearson Education(2009).*
2. *F.G. Bell; Engineering Treatment of Soils, E & FN Spon Publishers, UK(2001).*
3. *Moseley M.P.; Ground Improvement, Blackie A&P(2000).*
4. *Saran Swami; Reinforced Soil and its Engineering Applications, I.K. International (2006)*

Importance and functions of various component of pavement structures: Stresses in flexible pavements, Analytical techniques, Multilayered solutions, Design concepts, Sub grade stresses and deflection, Shear failures, equivalent single wheel and axle loads, vehicle Damage factor, Loading characteristics, Static, Impact and repeated loads, Effects of dual and tandem axles. Tyre pressure and total load, Equivalent stress and equivalent deflection criterion, wheel load, climatic and environmental factors, structural and functional distress in pavements

Design of flexible pavements: CBR method, Triaxial method, Mcleod method, Analytical methods, Multilayer elastic theory and design, Design for low cost pavements, Rigid pavements, Equivalent wheel load, Stresses, Sub grade theories, Westergaard’ s analysis , Methods of design for dense liquid, Elastic solid sub grades, Temperature stresses and their evaluation, CRC Pavements Prestressed concrete slabs, Tie bars, Dowel bars, SFRC pavements, Pavement flexible and rigid overlay, IRC method of design.

Pavement Management Process: Pavement Evaluation and Performance. Design Alternatives; Analysis Evaluation and Selection, implementation of PMS. Case Studies related to PMS.

Recommended Books:

1. Yoder, E.J., *Principles of Pavement Design, 2nd Edition, John Wiley & Sons, Inc. New York, (1975).*
2. Khanna & Justo, *Higway Engineering – Nem Chand & Brothers, Roorkee,(1997).*
3. Kadiyali L. R. *Principles & Practice of Highway Engg. Khanna Pub. (2000).*
4. Chakroborty , P., Das A, *Principles of Transportation Engg., PH1, (2005).*

PIN224 INTELLIGENT TRANSPORT SYSTEMS

L	T	P	Cr.
3	2	0	4.0

Advanced traveller information systems: transportation network operations; commercial vehicle operations and intermodal freight.

Public transportation applications; ITS and regional strategic transportation planning, including regional architectures: ITS and changing transportation institutions, ITS and safety.

ITS as a technology: deployment program, research, development and business models, ITS and sustainable mobility, travel demand management, electronic toll collection, and ITS and road-pricing.

Use of ITS for remote monitoring of bridge performance

Recommended Books:

1. *Chris Drane, Chris Rizos, Positioning Systems in Intelligent Transportation Systems, Artech House, (1998).*
2. *Chen, K and Miles John, ITS Handbook: recommendations from the World Road Association (PIARC), (2000).*
3. *Joseph Sussman, Introduction to Transportation Systems, Artech House, (2000).*
4. *Jotin Khisty, C. and Kent Lall, B. Transportation Engineering: An introduction, Prentice Hall of India, (2003).*

Principles and Fundamentals of Remote Sensing: Sources of Energy – Active and Passive radiation – Electromagnetic Radiation – Nomenclature, Reflectance, Transmission and Absorption, Thermal Emission – Plank’s formula, Stefan – Boltzman Law, Wein’s Displacement Law; Emissivity – Kirchoff’s Law, Characteristics of Solar Radiant Energy.

Sensors and Platforms: Types of sensors, Multispectral, hyper spectral, thermal, orbital characteristics, working principles and instrumentation. Storage and Retrieval of data - IRS and ERS satellite systems – Introduction, Stages of development, Sensory Characteristics, Orbit and Coverage’s, various types of data product and its uses.

Data Processing: Initial data statistics. Pre-processing – Atmospheric, Radiometric and Geometric corrections.

Data analysis: Image Interpretation Elements, Keys and Aids. Basic Instrumentation - Visual analysis of data in application of remote sensing to various engineering fields

Principles of Geographical Information Systems (GIS): Geographic information and spatial data types, Hardware and software; GIS; Steps of spatial data handling, database management systems, Spatial referencing

Data: Quality, measures of location errors on maps, Satellite-based positioning, Spatial data input, data preparation, Point data transformation

Analytical GIS capabilities; retrieval and classification; overlay functions, neighbourhood operations; network analysis; error propagation, Data visualization

Recommended Books

1. *Lillisand, T.M. & Kiefer R.W, Remote Sensing and Image Interpretation, John Wiley and Sons, (2004).*
2. *Campbell, J.B., Introduction to Remote Sensing, Taylor and Francis, (2002).*
3. *Nag. P. & Kudrat, M., Digital Remote Sensing, Concept Publication Company, (1998).*
4. *Jhanwar, M.L. and Chouhan, T.S., Remote Sensing and Photogrammetry – Principles and Applications, Vigyan Prakashan, Jodhpur, (1998).*

PIN311 MECHANICS OF SEDIMENT TRANSPORT

L	T	P	Cr.
3	2	0	4.0

Importance of sediment transport: Properties of sediment, Laminar and turbulent boundary flows, Rough and smooth bed.

Particle properties and mechanics: Particle settling, Forces on particles in fluid, initiation of motion and transport processes

Modes of sediment transport: Bed load, suspended load, Mechanics of sediment transport, Shield's Entrainment method, Flow regimes and resistance, Bed formations, Form drag and grain roughness
Computation of suspended load: Rouse equation, sediment concentration curve

Computation of bed load: Mathematical equations for bed load, Empirical formulas, Einstein's bed load equation, Regime concept, Design of stable channels, Kennedy's and Lacey's theory, seepage effects

Riverine morphology and sediment transport phenomena: Channel classification and transport regimes, River meandering and braiding, aggradation and degradation, scour around bridge piers
River training works

Recommended Books:

1. Graf, W.H., *Hydraulics of Sediment Transport*, McGraw Hill series in Water Resources and Environment Engineering, (1971).
2. Roudkivi, A.J., *Loose Boundary Hydraulics*, Pergamon Press, (1967).
3. Yang, C.T., *Sediment transport theory and practice*, Krieger Publisher, (2003).
4. Julien, P.Y., *Erosion and Sedimentation*, Cambridge University Press, (1998).

PIN312 RETAINING STRUCTURES

L	T	D	Cr.
3	0	2	4.0

Design of tanks: Types and Design joints, cylindrical tanks and towers, Rectangular tanks on ground, underground and O.H.S.R.S., Hydrodynamic pressures under earthquakes.

Design of Intze tank: Design of cylindrical and Intze tanks as shells of revolution taking into account the effects of continuity.

Design of water towers: With parallel and splayed legs for wind and earthquake forces.

Silos and Bunkers: General, Johnsons theory, Airy's Theory, Design of silos and bunkers by limit state theory

R.C.C. Pipes: Introduction. Stresses due to hydrostatic pressure, self weight and weight of water, earth fill over haunches, uniformly distributed load on top, design of pipes.

Soil Retention Systems

Recommended Books:

1. Dayaratnam P., *Design of Reinforced Concrete Structures*, Oxford IBH Publications, New Delhi, (1983).
2. IS 3370 codes on liquid retaining structures
3. Jaikrishan & Jain., *Plain & Reinforced Concrete, Vol. II*, Nem Chand and Bros, Roorkee, (1963).
4. Punmia, B.C., *Reinforced Concrete Structures, Vol. II*, Standard Publishers, (1992).
5. SP: 16 -*Design Aids to IS:456-1978*, Bureau of Indian Standards

PIN313 REHABILITATION OF STRUCTURES

L	T	P	Cr.
3	2	0	4.0

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

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.

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.

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).

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.

Recommended Books:

1. Denison Campbell, Allen and Harold Roper, *Concrete Structures, Materials, Maintenance and Repair*, Longman Scientific and Technical UK, (1991).
2. R.T. Allen and S.C. Edwards, *Repair of Concrete structures*, Blakie and Sons, UK, (1987)
3. M. S. Shetty, *Concrete Technology – Theory and Practice*, S. Chand and Company, New Delhi, (1992).
4. Santhakumar, A.R., *Training Course notes on Damage Assessment and repairs in Low Cost Housing, "RHDC – NBO" Anna University, July (1992).*
5. Raikar, R., *Learning from failures – Deficiencies in Design, Construction and Service – R & D centre (SDCPL), Raikar Bhavan, Bombay, (1987).*
6. N. Palaniappan, *Estate Management*, Anna Institute of Management, Chennai, (1992).
7. Lakshmi pathy, M. et al. *Lecture notes of Workshop on Repairs and Rehabilitation of Structures, 29 -30th October 1999, (1999).*

PIN314 ADVANCED RAILWAY AND AIRPORT ENGINEERING

L	T	P	Cr.
3	2	0	4.0

Railway: Importance of transportation systems. History of railways and its development, development of Indian Railways - Surveys for Route location - Permanent way and its component parts Formation, Ballast, Sleepers, Rails. Creep and Tilt in Rails. Track fittings and fastenings - Points and crossings - Track resistance and tractive effort. Gauge problem, super- elevation near branching of curves; gradients - Station Platforms - Various types of yards and sidings - Signals.

Airport engineering: Introduction, classification of airports; planning, Surveys and site selection of airports.

Airport geometrics: Runway Length, Patterns and orientation- wind rose diagram - Width and grades of runway; Taxiways and aprons.

Airport pavement design: Difference between Highway and airport pavements; Introduction to various design methods.

Airport drainage.

Recommended Books:

1. Rangawala, S.C., *Railway Engineering*, Charotar Publishers, Anand, (2002).
2. Arora, S.P. and Saxena., *Railway Engineering*, Dhanpat Rai Publishers, New Delhi, (2001).
3. Khanna, Arora and Jain., *Airport Planning and Design*, Nem Chand and Brothers, Roorkee, (2002).
4. Robert Horenjeff; *Planning and Design of Airports (2nd edition)*, McGraw Hill Book Co

PIN315 DISASTER MITIGATION AND MANAGEMENT

L	T	P	Cr.
3	2	0	4.0

Natural Disasters: Meaning and nature of natural disasters, their types and effects - Floods, drought, cyclone, earthquakes, landslides, avalanches,

Earthquake: Description, Causes of earthquakes, distribution of earthquakes, Mitigation and management

Flood hazards - Control and management: Causes of floods, Environmental risks, Methods of flood forecasting, Mitigation planning in a flood prone area, flood plain management, Measures to mitigate flood damage, Flood control economics.

Volcanic eruptions, Heat and cold waves, ozone depletion

Climatic change: global warming, Sea level rise.

Man Made Disasters: Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, air pollution, water pollution, deforestation, industrial waste water pollution, road accidents, rail accidents, air accidents, sea accidents.

Disaster Management: Meaning, concept, principles, scope, objectives, and approaches. Element of disaster management; International strategy for disaster reduction; Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, community – based organizations and media; Central, state, district and local administration

Disaster Mitigation: Hazard assessment, Vulnerability assessment, Risk assessment

Remote-sensing and GIS applications: Applications real time disaster monitoring, prevention and rehabilitation, Case Studies

Recommended Books:

1. *Scneid, T and Collins, L., Disaster management and preparedness, Lewis Publishers, Washington, D.C. (1998).*
2. *Goel, S. L. Encyclopaedia of Disaster Management, Deep & Deep Publications Pvt. Ltd., (2006).*
3. *Ghosh, G.K., Disaster Management, A.P.H. Publishing Corporation, (2006).*
4. *Edwards, B., Natural Hazards, Cambridge University Press, UK, (2005).*
5. *Central Water Commission, Manual of flood forecasting, New Delhi, (1989).*
6. *Ahmad, Shaik Iftikhar, Disaster management in the wake of flood, Twenty first century publication, Patiala, (2008).*