

## I SEMESTER

### 21CN01 APPLIED STATISTICS AND RELIABILITY

3 1 0 4

**REGRESSION AND CORRELATION:** Curve fitting, method of least squares - inferences based on the least squares estimator - correlation - curvilinear regression - multiple regression. (11+4)

**STATISTICAL QUALITY CONTROL:** Statistical process control – chance and assignable causes of quality variation, statistical basis of control charts - control charts for variables -  $\bar{X}$ , R and s charts - control charts for attributes – p, np, c and u charts. (10+3)

**ACCEPTANCE SAMPLING:** Lot-by-Lot acceptance sampling for attributes – single sampling plans for attributes, double, multiple and sequential sampling plans, acceptance sampling by variables - chain sampling, continuous sampling, skip-lot sampling plans. (12+4)

**RELIABILITY:** Failure distribution - reliability function, mean time to failure, hazard rate function, bathtub curve, conditional reliability, constant failure rate model – exponential reliability function, failure models, time dependent failure models - Weibull and normal distributions - serial configuration, parallel configuration, combined series parallel systems, system structure function, minimal cuts and minimal paths, state dependent systems. (12+4)

Total L:45 + T:15 = 60

#### REFERENCES:

1. Richard A Johnson, Irwin Miller and John Freund's, "Probability and Statistics for Engineers", Pearson Education, New Delhi, 2018.
2. Charles E Ebeling, "An Introduction to Reliability and Maintainability Engineering", Tata McGraw Hill, New Delhi, 2017.
3. Eugene L Grant, Richard S Leavenworth, "Statistical Quality Control", Tata McGraw Hill, New Delhi, 2016.
4. Trivedi K S, "Probability and Statistics with Reliability, Queueing and Computer Science Applications", John Wiley & Sons, New Delhi, 2016.
5. Douglas C Montgomery, "Introduction to Statistical Quality Control", John Wiley & Sons, New York, 2019.

### 21CN02 PAVEMENT ANALYSIS, DESIGN AND EVALUATION

3 1 0 4

**PRINCIPLES OF PAVEMENT DESIGN:** Types of pavement - flexible and rigid - Components of pavement and their functions, Provisions of IRC Guidelines for each component, Comparison between highway and airport pavements, Factors influencing pavement stability: Vehicle and traffic factors-ESWL and Wheel Load Factor - Moisture and climate, soil-CBR, Hveem stabilometer method, Plate Bearing method for finding modulus of subgrade reaction and North Dakota Cone method - and stress distribution factor - Boussinesq and Burmister theories. (10+3)

**DESIGN OF FLEXIBLE PAVEMENT:** Empirical method based on arbitrary strength - CBR method - Provisions of IRC 37 - Plate Bearing method (US Navy method for airfields), Theoretical and semi - theoretical methods - Kansas and Texas triaxial methods, IRC guidelines for design of flexible rural roads. Federal Aviation Administration (FAA) method (Recommended by International Civil Aviation Organization) (10+4)

**DESIGN OF RIGID PAVEMENT:** Stresses in rigid pavement due to wheel load-Older, Westergaard, Bradbury and Kelly theories - Stresses due to change in temperature - warping stress - theory by Bradbury - Stress due to subgrade restraint, Critical combination of stresses. Modulus of Rupture of concrete, Design of airport pavement - Federal Aviation Administration (FAA) method (Recommended by International Civil Aviation Organization) - Design of rigid highway pavement - IRC 58 method - IRC guidelines for design of rigid rural roads. Types of joints, Types of rigid pavement based on reinforcement, Design of reinforcement in longitudinal and transverse direction, tie bars and dowel bars. (13+5)

**PAVEMENT EVALUATION AND REHABILITATION:** Distresses in flexible and rigid pavements - condition surveys - Types of roughness - present serviceability index - skid resistance - structural evaluation –Benkelman deflection method – Design of overlays both for highway and airport pavements - flexible overlay over flexible pavement, rigid overlay over rigid pavement, flexible overlay over rigid pavements – Methods suggested by IRC, FAA and Asphalt Institute. Stabilisation with special reference to highway pavements, Chemical and mechanical stabilisation, Use of Geosynthetics in roads. (12+3)

TotalL: 45 + T: 15 = 60

#### REFERENCES:

1. Sharma S. K., "Principles, Practice and Design of Highway Engineering", S Chand and Company Ltd., New Delhi, 2014.
2. Wright P.H and Dixon K.K., "Highway Engineering", John Wiley & Sons, Inc., New York, 2009.
3. Yoder E. J. and Witezak M. W., "Principles of Pavement Design", John Wiley and Sons Inc., New York, 2008.
4. Croney P and Croney D., "Design and Performance of Road Pavements", HMO Stationary Office, 2008.
5. Kadiyali L.R., "Principles and Practice of Highway Engineering", Khanna Tech. Publications, New Delhi, 2017

## 21CN03 DESIGN OF URBAN WATER SUPPLY AND WASTE TREATMENT SYSTEMS

3 0 0 3

**WATER TREATMENT SYSTEMS:** Quantity of water - population forecasting - per capita consumption - fluctuation in consumption rate - design period. Purification of water - screening - aeration - plain sedimentation - sedimentation with coagulation - filtration - slow sand filter, rapid sand filter, pressure filter - disinfection of water - optional treatment methods - design aspects - storage reservoir types and design. (11)

**WATER DISTRIBUTION AND SEWERAGE SYSTEMS:** Classification - layout of distribution system - residual pressure - analysis of distribution system - leakage / waste prevention - appurtenances in distribution system. Water carriage system - types - quantity of sewage - self cleansing velocity - non-scoring velocity - shapes of sewers - sewer materials-design of sewers-construction of sewers testing - plumbing systems - sewer appurtenances - sewage pumping. (11)

**WASTE WATER TREATMENT AND DISPOSAL:** Sewage characteristics – BOD - COD- population equivalent - relative stability - designing of waste water treatment units - screens - grit chamber - skimming tank – sedimentation - biological treatment methods - trickling filters - activated sludge process - oxidation pond - rotating biological contactors - design of septic tank and final disposal unit - disposal of sludge - disposal by dilution - oxygen sag curve - standards of dilution - self-purification process - zones of pollution - standards of waste water for irrigation - irrigation methods - percolation test. (12)

**SOLID WASTE AND AIR POLLUTION MANAGEMENT:** Solid wastes - composition – generation rate and factors influencing - collection systems - processing, component separation - volume reduction methods - size reduction - recovery of material - disposal methods, composting, land filling, anaerobic digestion. Effect of air pollution on human health, plants, animals, properties - air quality and emission standards - particulate removal - removal of gaseous pollutants - stack design - sampling techniques. (11)

**Total L: 45**

### REFERENCES:

1. Santhosh Kumar Garg, "Environmental Engineering Volume - I and II", Khanna Publishers, Delhi, 33<sup>rd</sup> Edition 2018.
2. Punmia B C, Ashok Kumar Jain and Arun K Jain, "Environmental Engineering Volumes I and II", Laxmi Publications, Jodhpur, Second Edition, 2019.
3. Peavy H S, Rowe D R and Tchobanoglous G, "Environmental Engineering", McGraw Hill Company Ltd., New Delhi, 2017.
4. MetCalf and Eddy, Inc. "Wastewater Engineering Treatment, Disposal, Reuse", Tata McGraw Hill Publishing Company Limited, New Delhi, 2018.
5. Rao M N and Rao H V N, "Air Pollution", Tata Mc Graw Hill Publishing Company Limited, New Delhi, 2016.
6. "Manual on Solid Waste Management", Central Public Health and Environmental Engineering Organisation, Ministry of Urban Development, New Delhi, 2016.

## 21CN04 CONSTRUCTION METHODS AND EQUIPMENT

3 0 0 3

**CONSTRUCTION EQUIPMENT:** Sources of equipment – Factors affecting selection of equipment – Equipment cost: Ownership cost, operating cost, accounting depreciation – Economic life of construction equipment. (10)

**EARTHWORK:** Fundamentals of soil movement – Short distance and long-distance haul (tractors, ripper, trucks, wagons, scrapers, Loaders) – Excavation (excavators, shovels and hoe) – Grading and leveling (gradalls, graders, dozers) – Compacting (rollers and its types) – RE walls. (12)

**CONCRETE AND BITUMEN:** Concrete – Types of mixers – Batching plant – Ready mix concrete – Handling and transporting – Placing – Consolidation; Bitumen: Batching – Distributing – Paving – Compaction – Recycling – Milling, Cold mix. (11)

**OTHER EQUIPMENT:** Cranes and its types – Launching gantry – Pumps – Compressors – Pile driving – Dragline and clamshell – Trenching – Aggregate production – Drilling – Tunnel Boring Machine – Pipeline laying – Building demolition. (12)

**Total L: 45**

### REFERENCES:

1. Robert Peurifoy, Clifford J. Schexnayder, Aviad Shapira. Construction Planning, Equipment and Methods, McGraw Hill Education, Seventh edition, 2010.
2. Sharma, S. C. Construction Equipment and Management, Khanna Book Publishing Co. Pvt. Ltd., New Delhi, 2016.
3. Douglas D. Gransberg, Calin M. Popescu, Richard C. Ryan. Construction Equipment Management for Engineers, Estimators, and Owners. CRC Press, Taylor & Francis Group, Florida, 2006.
4. John E. Schauffelberger, Giovanni C. Migliaccio. Construction Equipment Management, Routledge, Taylor & Francis Group, New York Second Edition, 2019.

## 21CN05 GEOGRAPHIC INFORMATION SYSTEMS

3 0 0 3

**GIS TECHNIQUES, DATABASE AND DATA STRUCTURES:** Map – Types of map - Map analysis, Digital Cartography and Evolution of GIS, Components of GIS - Software, Hardware and organization - Types of Map Projections and Coordinate concepts- Datums, ellipsoids, geoids, Type of data - spatial and non spatial data, Various Sources of data - Conceptualization of real world in GIS, georeferencing, vector and raster data structure, database concepts, E-R Model, Geodatabase, Object Oriented Database, Online mapping softwares. (11)

**DATA INPUT, DATA OUTPUT AND ERROR ANALYSIS:** Digitizer, scanner, files and data formats, Collection of Data using GPS - Data transfer from other spatial data sources, GIS flow chart for projects, Types of output data, Map Design, source of errors, types of errors, elimination, accuracies. Data quality and data standards: Concepts – Definition and assessment of data quality, Multimedia GIS, 3D GIS, meta data, Open source GIS and OGC standards. (11)

**ADVANCED ANALYSIS:** Spatial Analysis, data retrieval, query, simple analysis, spatial statistics, Topology, Measuring distance, area and connectivity, buffering and neighbourhood functions - Raster and Vector overlay method - Reclass, Recode, vector data analysis, raster data analysis, Modeling in GIS, digital Elevation Model, DTM, Cost and path analysis, Spatial interpolation - Analysis of surfaces - Network analysis - shortest path problem, traveling salesman problem, location and allocation of resources. Artificial Intelligence and expert system, Multicriteria analysis, Analytical Hierarchy process. (11)

**GIS APPLICATIONS:** GIS for water distribution network, sewer network, transportation network, telecom network, power network and other utilities, Site selection for larger projects based on GIS analysis, Remote Sensing data integration, Navigation and tracking using GPS and GIS, GIS database for buildings, Emergency planning, Internet GIS, Virtual Reality Applications in GIS. (12)

**Total L: 45**

**REFERENCES:**

1. Demers M. N., "Fundamentals of Geographical Information Systems", John Wiley & Sons, New York, 2008.
2. Chang K. T., "Introduction to Geographical Information Systems", Tata McGraw Hill, 2018.
3. Elangovan K., "GIS: Fundamentals, Applications and Implementation", New India Publishing Agency, New Delhi, 2006.
4. Chrisman N. R., "Exploring Geographic Information Systems", John Wiley & Sons, New York, 2001.
5. Clarke K. C., "Getting Started with Geographic Information Systems", Prentice Hall, 2011.
6. Burrough P. A., "Principles of GIS for Land Resources Management", Oxford Publication, 2015.

**21CN72 AUDIT COURSE – I**  
**vide Automotive Engineering 21AE72**

**21CN06 Research Methodology and IPR**  
**vide Automotive Engineering 21AE06**

**21CN51 HIGHWAY AND PAVEMENT ENGINEERING LABORATORY**

**0 0 4 2**

**MATERIAL CHARACTERIZATION:** Soil – Soil classification based on GI method and IS 1498, Light compaction test, CBR test, Field density test; Aggregates – Sieve analysis and combining aggregates, abrasion, impact, crushing, and stripping value test; Bitumen – Specific gravity, penetration test, softening point test, flash and fire point test, viscosity test, ductility test.

**BITUMINOUS MIX DESIGN AND PAVEMENT EVALUATION:** Mix design for rigid pavement, Mix design for bituminous pavement – Estimation of optimum binder content; Binder recovery using centrifuge extractor; Functional evaluation - Distress survey - Calculation of Pavement Condition Indices (PCI); Structural evaluation – demonstration of Benkelman beam. Introduction to Rheometer (Demonstration only); Light weight deflectometer, Falling weight deflectometer, Skid resistance test - Virtual demonstration only

**Total P: 60**

**REFERENCES:**

1. Kadiyali, L. R. Principles and Practice of Highway Engineering, Khanna Publication, New Delhi, 2011.
2. Khanna, S. K., Justo, C. E. G. and Veeraragavan, A. Highway Materials and Pavement Testing, Nem Chand and Bros, Roorkee, 2013.
3. Ministry of Road Transport and Highways. Specifications for Road and Bridge Works, Fifth Edition, Indian Roads Congress, New Delhi, India, 2013.

**21CN52 GEOGRAPHIC INFORMATION SYSTEM LABORATORY**

**0 0 4 2**

**DATA, FILES AND DATABASE:** Input of data – Scanning, Manual and automatic digitization, Data import from available data sources - type of data - database, Files, Methodology of GIS data creation and analysis.

**DATA MANIPULATION:** Sources of errors, cleaning of errors, topology building, raster cell resolution, georeferencing-classification of data- Symbology

**SIMPLE ANALYSIS:** Reclass, Recode, Buffering, area, distance, perimeter measurement, Database initiated analysis, Simple overlay, raster and vector data analysis-Weighted overlay -network analysis-

**ANALYSIS IN GIS:** DEM, DTM, TIN, Perspective view -satellite image processing-Site selection for infrastructure projects -. DATA OUTPUT: Multimedia - GIS Maps, images, Texts, Graphs, Cartographic symbolism-cartographic design of maps

**Total P: 60**

**EXERCISES:**

1. Onscreen digitisation for points, lines and polygons in a map.
2. Data collection and import from various sources for GIS projects
3. Cleaning up the data, error removal, topology building, georeferencing and map projection
4. Classifications of spatial data, layer and symbol concept using a GIS software.
5. Attribute data query on maps, simple analysis
6. Simple overlay and weighted overlay
7. Network analysis in GIS.
8. Creating DEM, slope, aspect, hill shade and perspective view maps
9. Satellite image processing to produce landuse / landcover maps
10. Site selection of infrastructure projects using GIS.
11. Output generation and cartographic design of maps.

## II SEMESTER

### 21CN07 CONSTRUCTION PROJECT MANAGEMENT

**3 1 0 4**

**PLANNING:** Management objectives and concepts as a blend of art and science; Functions of management – Project, program and portfolio management; Project life cycle – Phases and characteristics; Periods of planning – Pre-tender, pre-contract and contract period planning; Project time management – Work breakdown structure; Activities – Define activities, sequence activities, estimate activity resources, estimate activity duration. (12+4)

**PROJECT SCHEDULING:** Bar chart scheduling – Inter-dependence of activities; Critical path method – Relationship between activities – Activity on node – Forward and Backward pass – Critical path analysis and critical period estimation; Float – Types and estimation – Scheduling with lead and lag; PERT – Time estimates based on statistical data – Probability of achieving desired time targets for construction projects. (11+4)

**RESOURCE AGGREGATION, LEVELING & TIME COST OPTIMIZATION:** Optimal use of resources – Resource constraint and need for leveling – Aggregation as per early start time of activities – Leveling of resources by traditional approach and minimum moment theorem – Leveling multiple resources; Project cost components – Direct cost and Indirect cost – Cost-duration relationship – Crashing algorithm and crashing limits – Cost profile and updating network. (12+4)

**CONTRACTS IN PROJECT MANAGEMENT:** Tender document and tender process – Stages in tender process – Award of contract – Typical parties in contract and privity of contract – Types of contract – Important clauses in contract agreement – Purchase order and sub-contract agreements – Delays, suspension and termination of work – Breach of contract – Liquidated damages and Force Majeure – Dispute resolution and Arbitration – Legal aspects including labour laws (10+3)

**Total L: 45+T:15=60**

**REFERENCES:**

1. Albert Lester. Project Management, Planning and Control, Butterworth-Heinemann, USA, Seventh Edition, 2017.
2. Chitkara K K., Construction Project Management, Planning, Scheduling and Control, McGraw Hill (India) publishers, New Delhi, Third edition, 2014.
3. Saleh.A. Mubarak. Construction Project Scheduling and Control, John Wiley and Sons, Third edition, 2015.
4. PMBOK Guide. A Guide to the Project Management Body of Knowledge, Project Management Institute, Pennsylvania, 2008.

### 21CN08 TRAFFIC ENGINEERING AND TRANSPORT PLANNING

**3 1 0 4**

**TRAFFIC AND TRAFFIC STREAM CHARACTERISTICS:** Physical, Physiological, Psychological, environmental characteristics of Road user, vehicle characteristics and their relations; Fundamental parameters and relations of traffic flow: speed, density, volume, travel time, headway, spacing, time-space diagram, time mean speed, space mean speed and their relation, relation between speeds, flow, density, fundamental diagrams; Traffic stream models: Green shield's model, Greenberg's logarithmic model, Light hill-Withams theory, shock waves. (12+4)

**TRAFFIC SURVEYS STUDIES AND QUANTITATIVE TECHNIQUES IN TRAFFIC ENGINEERING:** Measurement at a point: Traffic volume measurement, equipment for flow measurements, data analysis, concepts of ADT, AADT; Measurement over a short section: Speed measurements, 15<sup>th</sup> and 85<sup>th</sup> percentile speeds, design speed, speed distributions; Moving observer method: Concepts and derivation, illustration, Measurement along a length of road: Density measurement, travel time measurement; Automated traffic measurement: GPS devices, loop detectors, video analysis, and other technologies. Specialized traffic studies: Parking studies, Accident studies, Congestion studies. Quantitative techniques: Probability distributions, significance testing and linear regression models. (11+4)

**TRAFFIC CONTROL OPERATION AND MANAGEMENT:** Principles of traffic control: Requirements, basic driving rules, priority movements, principles of traffic control, intersections conflicts; Traffic signs and road markings: Regulatory, warning, and information signs; longitudinal, transverse, and object marking; Channelization: channelizing devices, geometrical aspects, turning radius ;Traffic rotary: Conflict resolution in a rotary, geometric layout, design elements, capacity of rotary; Grade separated intersection: Road over bridges, under pass, overpass, trumpet interchange, diamond interchange, fully and partial clover leaf intersection. Elements of traffic signal, Design principles of a traffic signal, Evaluation of a traffic signal, coordinated traffic signal. (12+4)

**URBAN TRANSPORT PLANNING AND TRANSPORT ECONOMICS:** Transportation system and planning process - System approach in transport planning, stages in transport planning survey and analysis of existing conditions, forecast analysis of future conditions. - Interdependence of land use and traffic - transportation survey. Conventional and four stage modelling process - trip generation and trip distribution, model spilt, and land use transport model. Urban transportation systems - Mass rapid transit system - Light rail transit - Personal rapid. transit, guided way systems, cabin taxi, dual mode bus - Para transit systems – Demand responsive system - Intermediate public transport. Transport planning strategies, TSM, TDM, Traffic calming, road pricing and ITS. Economic evaluation of transport plans - accident cost - traffic congestion, restrain and road pricing, (10+3)

**Total L: 45 +T:15 =60**

**REFERENCES:**

1. Shan Somayaji, "Civil Engineering Materials", Second Edition, Prentice Hall Inc., 2001.
2. Mamlouk M.S, Zaniewski J.P., "Materials for Civil and Construction Engineers", Prentice Hall Inc., 4<sup>th</sup> edition 2016.
3. Neveille A.M and Brooks J J., "Concrete Technology", Longman, 2010.
4. EdwarNawy E G., "Concrete Construction Engineering Handbook", CRC press, New York, 2008.
5. Sherwood, P.T. Alternative materials in road construction, Thomas Telford, New York, USA, 2<sup>nd</sup> edition 2001.

**21CN82 AUDIT COURSE – II**  
vide Automotive Engineering 21AE82

**21CN61 ADVANCED CONCRETE LABORATORY**  
vide Structural Engineering 21CS51

**21CN62 COMPUTER AIDED PROJECT PLANNING AND SCHEDULING LABORATORY**

**0 0 4 2**

**OVERVIEW AND STRUCTURING PROJECTS:** Optimize the project plan, Understand data structures, Create a project, Create a Work Breakdown Structure, Add activities, View calendars, Create relationships, Schedule the project, Assign constraints, Format schedule data, create reports

**CUSTOMISING THE PROJECTS:** Working with layouts, grouping, sorting, and filtering data; Customising layouts printing layouts and reports, Publishing a project on the web

**RESOURCE MANAGEMENT AND RISK ASSESSMENT:** Roles and Resource, Assigning Roles, Assigning Resources, Analyzing Resources, Optimizing the Project Plan,

**UPDATING AND MANAGING THE SCHEDULE:** Managing the Baselines, updating, scheduling and leveling ,sumarising projects issues and thresholds, managing risks, Project Execution and Control, Reporting Performance, Apply a risk assessment to a project schedule, resources and costs, comparing actual with schedule comparison.

**Total P: 60**

**REFERENCES:**

Oracle-Project Management Reference Manual-2015

**21CN63 INDUSTRIAL VISIT AND TECHNICAL SEMINAR**  
vide Automotive Engineering 21AE63

**SEMESTER – III**

**21CN71 PROJECT WORK – I**  
vide Automotive Engineering 21AE71

**SEMESTER – IV**

**21CN81 PROJECT WORK – II**  
Vide Automotive Engineering 21AE81

## PROFESSIONAL ELECTIVE THEORY COURSES (Four to be opted)

**21CN21 ADVANCED REINFORCED CONCRETE DESIGN**  
vide Structural Engineering 21CS04

**21CN22 ADVANCED STRUCTURAL STEEL DESIGN**  
vide Structural Engineering 21CS05

**21CN23 PRESTRESSED CONCRETE STRUCTURES**  
vide Structural Engineering 21CS22

**21CN24 BRIDGE ENGINEERING**  
vide Structural Engineering 21CS23

**21CN25 ADVANCED CONCRETE TECHNOLOGY**  
vide Structural Engineering 21CS26

**21CN26 MAINTENANCE AND REHABILITATION OF STRUCTURES**  
vide Structural Engineering 21CS36

**21CN27 CORROSION IN REINFORCED CONCRETE**

**3 0 0 3**

**BASICS OF CORROSION:** Theoretical Concepts of Corrosion of Steel in Concrete Structures. Mechanism of Chloride induced and carbonation induced Corrosion - parameters influencing rebar corrosion (11)

**FORMS OF CORROSION & CORROSIVE ENVIROMENTS:** Galvanic Corrosion, Crevice Corrosion, Pitting Corrosion, Integranular corrosion, Erosion and hydrogen embrittlement. Mineral Acids, Organic Acids, Atmosphere Corrosion, sewage water treatment plants. (11)

**CORROSION MEASUREMENT & EVALUATION:** Weight Loss method, Half cell potential Technique – Linear Polarization Resistance, Galvanostatic Pulse Technique – Electrochemical Impedance Spectroscopy, Cyclic Polarisation and Voltammetry and Corrosion Sensors for field monitoring. (11)

**CORROSION PREVENTION:** Materials Selection: Metals & Alloys - Metal purification, Alteration of Environment changing mediums - Electrochemical techniques - Cathodic & Anodic protection, Sacrificial Anode. Coatings: metallic & other Inorganic coatings - Organic coatings - Corrosion inhibitors. (12)

**Total L: 45**

### REFERENCES:

1. Amir Poursaee, "Corrosion of Steel in Concrete Structures", First Edition, Elseiver, Wood Head Publishing, 2016.
2. Luca Bertolini et al, "Corrosion of Steel in Concrete, Prevention, Diagonisis, Repair", Second Edition, Wiley Publishing, 2014.
3. Mars G. Fontana, "Corrosion Engineering", Third Edition, McGraw Hill Book Company, New York 1988.
4. Hans Bohni, "Corrosion in Reinforced Concrete Structures", Woodhead Publishing Limited, Cambridge England, 2005.

**21CN28 PREFABRICATED STRUCTURES**  
vide Structural Engineering 21CS35

**21CN29 OPTIMIZATION TECHNIQUES**  
vide Structural Engineering 21CS27

**21CS30 EXPERIMENTAL TECHNIQUES AND INSTRUMENTATION**  
vide Structural Engineering 21CS29

**21CN31 ENVIRONMENTAL IMPACT ASSESSMENT**

**3 0 0 3**

**ENVIRONMENTAL IMPACT ASSESSMENT (EIA) OBJECTIVES AND NEED:** Impact of Civil Engineering development projects on environment – International scenario of environment protection – Environmental protection methods – Environmental Impact Assessment (EIA) – Objectives and need - Environmental Impact statement (EIS) – EIA capability and limitations – Legal provisions on EIA – Indian legislation to protect environment - environmental clearance procedure - Guidance for Industrial licensing. (11)

**EIA METHODOLOGIES - PREDICTION AND ASSESSMENT:** Methods of EIA – Checklists – Matrices – Networks – Cost-benefit analysis – environmental pricing – analysis of alternatives - case studies. Assessment of Impact on land, water and air, noise, social, cultural flora and fauna - Mathematical models - public participation. (12)

**ENVIRONMENTAL MANAGEMENT PLAN:** Plan for mitigation of adverse impact on environment – options for mitigation of impact on water, air and land, flora and fauna; Addressing the issues related to the project affected people - Rapid EIA - ISO 14000 - EIA in India – Environmental guidance for infrastructure projects and river valley projects – Legislations and Institutional support – International cooperation. (11)

**EIA FOR INFRASTRUCTURE PROJECTS:** Case studies on bridges – power plants – highways – dams – urban development – water supply and drainage projects. (11)

**Total L: 45**

**REFERENCES:**

1. Anji Reddy M, "Environmental Impact Assessment: Theory and Practice", BS Publications, Hyderabad, 2017.
2. Barthwal RR, "Environmental Impact Assessment", New Age International P Ltd, New Delhi, 2014.
3. Charles H Eccleston, "Environmental Impact Assessment: A Guide to Best Professional Practices", CRC Press, 2011.
4. Judith Petts, "Handbook of Environmental Impact Assessment Vol. I & II", Blackwell Scientific Publications, London 2005.
5. Peter Morris and Rikki Therivel, "Methods of Environmental Impact Assessment", SPON Press, London, 2003.

## 21CN32 MODERN MATERIALS FOR CONSTRUCTION

**3 0 0 3**

**MICROSTRUCTURE AND MATERIAL BEHAVIOUR:** Introduction to the physics and chemistry of materials, focusing on chemical bonding, crystal structure, mechanical properties, phase transformation, Energy in building materials and buildings, Green and climate responsive buildings . (11)

**STRUCTURAL MATERIALS:** Criteria and application of structural materials: Ceramics and Glass, Metals, Polymers, Fire proofing materials. Different types of cladding Materials-Cladding systems for interior and exterior sides for different types of buildings. Different types of wall paneling materials-types of wall paneling system-gypsum based boards-GFRG, light weight pillar blocks, foam concrete blocks etc., Typical industrial by products, agro waste and other biomass resources. Materials used in Pavement Construction-Sub grade materials, Rigid and Bituminous paving materials. Application of Geo textiles in roads and infrastructure projects. (11)

**NON-STRUCTURAL MATERIALS:** Criteria for selection of non-construction materials: PVC, EPOXY, Thermocole, Geotextile, Acoustics, Thermal and sound insulation materials, Green building materials, special paints for Road marking. Construction chemicals – sealants, engineering grouts, mortars, admixtures and adhesives. Scope and application of different types of Smart and Intelligent materials. (11)

**SPECIAL CONCRETE:** Special concrete for Bridges, Pavement and Off shore structures- High strength and high-performance concrete - FRP - FRC- Lightweight concrete - vacuum concrete - silica fume concrete – Ferro cement concrete – Bacterial concrete, self-curing and self-healing concrete, Polymer concrete composites, roller compacted concrete. (12)

**Total L: 45**

**REFERENCES:**

1. Shan Somayaji, "Civil Engineering Materials", Second Edition, Prentice Hall Inc., 2001.
2. Mamlouk M.S, Zaniewski J.P., "Materials for Civil and Construction Engineers", Prentice Hall Inc., 4<sup>th</sup> edition 2016.
3. Neveille A.M and Brooks J J., "Concrete Technology", Longman, 2010.
4. EdwarNawy E G., "Concrete Construction Engineering Handbook", CRC press, New York, 2008.
5. Sherwood, P.T. Alternative materials in road construction, Thomas Telford, New York, USA, 2<sup>nd</sup> edition 2001.

## 21CN33 SMART MATERIALS AND SMART STRUCTRES vide Structural Engineering 21CS37

## 21CN34 CITY PLANNING AND URBAN DESIGN

**3 0 0 3**

**CITY AND METROPOLITAN PLANNING:** Evolution of cities; principle of city planning; type of cities & new towns; Indian cities and metropolises constraints and prospects, Polarization of economic socio cultural and administrative activities: Distribution of urbanization process; National settlement polices; eco city concept; sustainable development. Metropolitan plan making processes, metropolitan plans in India, Metropolitan planning strategies. (11)

**TECHNIQUES OF PLANNING:** Planning survey techniques; Conducting survey; statistical methods of data analysis; report presentation; application of GIS and remote sensing techniques in urban and regional planning; decision making models. (11)

**DEVELOPMENT ADMINISTRATION AND MANAGEMENT:** Scope and content of master plan and structure plan, integrated urban development plans and IDSMT and urban development projects; Planning laws; development control and zoning regulations; law relating to land acquisition; development enforcements, urban land ceiling, scope and content of zonal

development plans, detailed town planning schemes, area development plans, action plans and subject plans. Land management techniques; planning and municipal administration; disaster mitigation management; 73<sup>rd</sup> and 74<sup>th</sup> constitutional amendments; public participation and role of NGO & (12)

**URBAN DESIGN:** Definition of urban design, scope of urban design under Indian context and its integration with urban planning; Historical development and approach to urban design; urban form; Urban structure and design rational inter - relationship between economic activities, public organization, communication system, urban conservation and land-use structure. Organization of space. Review and designing of urban renewal and redevelopment projects for old and new town. (11)

**Total L: 45**

**REFERENCES:**

1. Pratap Raw M, "Urban Planning Theory and Practice", CBS Publisher, 2005.
2. Simon Eisner, Arthur B Gallion, "Urban Pattern City Planning and Design, CBS Publisher, 2004.
3. Peter Hall, "Urban and Regional Planning", Taylor and Francis, 2003.
4. Sundaram K.V, "Urban and Regional Planning in India", Vikas Publishing House Pvt. Ltd., New Delhi, 2000.
5. Malcolm Moor, Jon Rowland "Urban Design Futures" Taylor & Francis, 2006.

## **21CN35 INFRASTRUCTURE PLANNING AND MANAGEMENT**

**3 0 0 3**

**OVERVIEW OF INDIAN INFRASTRUCTURE ASSETS:** Infrastructure – Definition – Infrastructure management – Importance of infrastructure management; Types of infrastructure – Physical Infrastructure – Current scenario and government policies related to different sectors – Roads, Railways, Ports, Airports, Energy, Power, Telecommunication, MRTS – Key issues in different sectors – Phases in infrastructure project – Stakeholders and key players. (11)

**PROJECT ECONOMICS AND FINANCE:** Cash flow diagram – Time value of money – Single payment, uniform series of payment – Arithmetic gradient, geometric gradient; Financial returns analysis – Present worth analysis, annual worth analysis, future worth analysis – Rate of return, Incremental rate of return, benefit-cost analysis. (10)

**PROJECT IMPLEMENTATION:** Traditional approach; Private sector participation – BOO, BOT, DBOT, DBOOT, BOOT, EPC & Turnkey – Case studies; Execution of PPP Projects : Need analysis – Evaluation of technical, economic and financial feasibility – Value proposition of projects – Risk analysis – Project structuring. (11)

**EVALUATION OF EXISTING ASSETS:** Infrastructure asset management framework – Planning, needs assessment – Performance Indicators; Data requirement and database management – Inventory, historical and environmental data – In-service monitoring and Evaluation data; Illustration of asset management for road sector – Pavement evaluation – Pavement condition indices – Pavement deterioration modeling – Prioritization and optimization based on cost and agency criteria – Introduction to HDM-4 software (13)

**Total L: 45**

**REFERENCES:**

1. Uddin, W., Hudson, W. R and Haas, R. Public Infrastructure Asset Management, McGraw Hill Publication, USA, Second edition, 2013.
2. Yescombe, E. R. & Edward, F. Public-Private Partnerships for Infrastructure: Principles of Policy and Finance, Elsevier Science & Technology, Second edition, 2018.
3. Khan, Z. A., Siddiquee, A. N., Kumar, B. and Abidi, M. H. Principles of Engineering Economics with Applications, Cambridge University Press, United Kingdom, Second Edition, 2018.

## **21CN36 FINANCIAL MANAGEMENT AND ACCOUNTING**

**3 0 0 3**

**BASIC ACCOUNTING, BALANCE SHEET & MANAGEMENT ACCOUNTING:** Meaning of Accounting - Definition and objectives. Need for accounting- Internal and external users of accounting information-Branches of Accounting - Accounting Information system - Accounting Cycle – Accounting Concepts, Conventions and Principles - The Corporate Balance Sheet – Format of Balance sheet – Balance Sheet as per company law and annexure to it– Generally Accepted Accounting Principles - Financial Accounting vs. Management Accounting. (11)

**FINANCIAL STATEMENTS ANALYSIS & MARGINAL COSTING:** Characteristics – limitations - Ratio Analysis (Including Dupont Model); Interpretation - Difference between Cash flow and Fund flow - Meaning of a cash flow statement – classification of cash flows – Preparation and Interpretation of Cash Flow Statement - Direct Cost - Overheads – Cost Sheet – Cost - volume profit analysis – Break Even Point - Application of marginal costing techniques to Managerial Decision making. (11)

**FINANCIAL MANAGEMENT & TIME VALUE OF MONEY:** An overview – Nature & scope - Finance functions - goals of financial management - Financial manager's role - agency problems, agency cost - Long term finance - ordinary shares, right issue of equity shares, preference shares, debentures, term loan, asset-based financing-hire purchase, leasing, venture capital financing. Short term finance - trade credit, bank credit, bill discounting, commercial paper - Time value of money - Concept - future value - present value – single cash flows, annuity, uneven cash flows, multi period and continuous - yield calculation, applications: bond's valuation and yield - valuation of preference shares - valuation of ordinary shares. (11)



**COST OF CAPITAL & RECEIVABLES MANAGEMENT:** Concept - determining component cost of capital - weighted average cost of capital - weighted marginal cost of capital - Capital budgeting decisions - Evaluation of capital budgeting - discounted & non discounted cash flows methods – simple problems - Principles and concepts of working capital – operating cycle - determinants of working capital - policies for financing current assets - Inventory management and cash management – basic concepts only. (12)

**Total L: 45**

**REFERENCES:**

1. Sudarsana Reddy, "Financial Management", 2<sup>nd</sup> Revised Ed., Himalaya PH, 2010
2. Pandey, I.M., "Financial Management", Vikas Publishing House, New Delhi, 10<sup>th</sup> Ed, 2010.
3. Chandra Prasanna, "Financial Management: Theory and Practice", Tata McGraw, New Delhi, 2010.
4. Jonathan Berk, "Financial Management", Pearson Education, 2010.
5. Ehrhardt, Michael and Brigham, Engene F, "Corporate Finance: A Focused Approach", Cenage Learning, Australia, 2009.
6. Bhat and Sudhindra, "Financial Management: Principles and Practice", Excel books, ND, 2007.

**21CN37 ORGANISATIONAL BEHAVIOUR**

**3 0 0 3**

**IMPORTANCE OF OB & PERSONALITY:** Definition, Meaning and Importance of OB, Historic developments of OB, Hawthorne experiment, Basic OB Model, Different approaches to OB, Contributing disciplines to OB, Scope of OB, Significance of OB - Origin of the word Personality, Determinants of Personality, Theories of Personality (Psychoanalytic theory, Self theory, Holland's personality theory, Myers Briggs Type Indicators and Big 5 personality theory), Attributes of personality. (11)

**EMOTIONAL INTELLIGENCE & MOTIVATION:** Definition and Meaning, Categories of intelligence, EI Dimensions, Physiology of EI, OB applications of emotions – Characteristics of Motivation, Process of Motivation, Theories of Motivation (Maslow's need theory, ERG theory, Hertzberg theory, Expectancy theory, Theory X & Y, McClelland's theory of needs, Goal setting theory, Equity theory), Incentives for Motivation. (12)

**LEADERSHIP & GROUP DYNAMICS:** Definition and Meaning, Styles of leadership, Theories of leadership (Trait theory, Ohio state theory, Managerial grid, Contingency theory, Path goal theory, Leader Member Exchange (LMX), Transactional & transformational leadership theory, Charismatic and Visionary leadership theory) - Difference between Group and Team, Groups in Organisation, Team Effectiveness model, Troubles with team, Social loafing. (11)

**ORGANISATIONAL CULTURE & ORGANISATIONAL CHANGE:** Meaning and Definition, Characteristics of Organisational culture, Elements of Organisational culture, Organisational sub culture, Artifacts for Organisational culture, Bicultural audit, Strategies to merge different organisational culture. - Factors of Organisational change, Lewin's forced field model, Human reactions to change, Resistance to change, Strategies for reducing change, Ethical issues in Organisational change. (11)

**Total L: 45**

**REFERENCES:**

1. Fred Luthans, "Organisational Behaviour", New York, McGraw Hill, 2011.
2. Stephen P. Robins, "Organisational Behaviour", Pearson Education, 2011.
3. Edwin Gerlof, "Organisation Theory and Design", McGraw Hills, 2011.
4. Dania C. Fieldman and Hugh Arnold, "Managing Individual and Group Behaviour in Organization", McGraw Hills, 2010.
5. Robrt Kreitener and Angelo Kinieki, "Organisational Behavior", Tata McGraw Hill, New Delhi, 2008.

**21CN38 REMOTE SENSING**

**3 0 0 3**

**REMOTE SENSING SYSTEM:** Elements of EMR - wavelength regions – energy interaction in atmosphere – scattering - atmospheric windows – terrestrial interaction – spectral reflectance curves – Planck's blackbody law – displacement law and emissivity effects - heat capacity, thermal property of objects – Radar interaction with Earth surface and vegetation, Surface scattering theory - active and passive remote sensing - platforms. Sensors used in remote sensing - types of resolutions. (11)

**SATELLITE DATA PRODUCT AND INTERPRETATION OF SATELLITE IMAGERIES:** Thermal sensors - thermal image interpretation, Radar principles and applications – SRTM and its application -Types of data product - software and hardware requirement for data processing - Elements of visual image interpretation - Digital Image processing techniques, Landuse / landcover classification. (11)

**CHARACTERISTICS OF SATELLITES AND THEIR APPLICATIONS:** GOES, NOAA, METEOSAT, INSAT - Land observation satellites: LANDSAT, SPOT, IRS, IKONOS, GEOEYE, QUICKBIRD, WORLDVIEW – SEASAT, SIR "A", SIR "B", SIR "C", ERS, JERS, RADARSAT and other currently available satellites. (12)

**REMOTE SENSING APPLICATIONS:** Urban land use planning – urban sprawl - cadastral mapping - site selection for various infrastructure projects - resource management - mapping of infrastructure facilities and planning - integration of satellite imageries in GIS. (11)

**Total L: 45**

**REFERENCES:**

1. Lillesand T, Kiefer R. W and Chipman J., "Remote Sensing and Image Interpretation", John Wiley & Sons, New York, 2015.
2. Jensen, John R., "Remote Sensing of the Environment: An Earth Resource Perspective", 2nd Ed., Pearson India, 2013.
3. Sabins F F and Ellis J M, "Remote Sensing - Principles and Interpretation", 4<sup>th</sup> Edition, Waveland Press Inc., 2020.
4. Campbell J B and Wynne R H, "Introduction to Remote Sensing", Guilford Press, 2011.
5. George Joseph, Fundamentals of Remote Sensing, 2<sup>nd</sup> Edition, Universities Press, 2005

### **21CN39 FOUNDATION STRUCTURES** vide Structural Engineering 21CS39

### **21CN40 GEOSYNTHETICS IN INFRASTRUCTURE PROJECTS**

**3 0 0 3**

**GEOSYNTHETIC MATERIALS AND THEIR PROPERTIES:** Basic descriptions of geosynthetics, types, functions, materials, manufacturing processes, properties and testing, Concepts and mechanism of reinforced soil, Factors influencing behaviour and performance. (12)

**REINFORCED SOIL RETAINING WALLS AND SLOPE STABILITY:** Components of reinforced soil walls, Principles of design – Internal and external stability – Design – Slope stabilization. (11)

**ENVIRONMENTAL CONTROL, FILTRATION AND DRAINAGE:** Liners for ponds and canals, covers and liners for landfills, material aspects and stability considerations; Applications, Geotextile filter requirements, boundary conditions, drain and filter properties, design criteria. (11)

**EMBANKMENTS IN SOFT SOILS AND PAVEMENT:** Embankment in soft soils - Analysis, Influence of reinforcement extensibility, deformation in foundation, Overall stability with respect to bearing. Pavement applications, Role of subgrade conditions, Design – The Giroud and Noiray approach, Geotextile serviceability, Application in pavement overlays. (11)

**Total L: 45**

**REFERENCES:**

1. Sivakumar Babu G L, "Introduction to Soil Reinforcement and Geosynthetics", Universities Press, Hyderabad, 2009.
2. Mandal J N, "Geosynthetics Engineering: In Theory and Practice", Research Publishing, Singapore, 2018.
3. Robert M Koerner, "Designing with Geosynthetics", Pearson Education Inc., 2012.
4. Sanjay Kumar Shukla, "An Introduction to Geosynthetic Engineering", CRC Press, 2017.

### **21CN41 GROUND IMPROVEMENT TECHNIQUES** vide Structural Engineering 21CS40

### **21CN42 CHARACTERISATION OF BITUMINOUS MATERIALS**

**3 0 0 3**

**BITUMEN:** Refinery processing – Post-processing methods and their influence – Chemical composition – Characterisation – Fractionation procedures – Changes in chemical composition – Reversible and irreversible aging – Grading of bitumen. (11)

**VISCOELASTICITY:** Definition of viscoelastic material - Linear viscoelasticity – Scaling and superposition – Material functions for viscoelastic materials – Time domain: creep compliance, stress relaxation function – Frequency domain: complex modulus and phase angle – Time-temperature superposition principle – Construction of master curve (12)

**BITUMINOUS MIXES:** Design of mixes – Volumetrics of mix – Mixing and compaction procedures – Dynamic modulus and resilient modulus of mixtures – Simulation of rutting and fatigue of bituminous mixtures in laboratory: flow time, flow number, rut wheel and beam bending. (11)

**ADDITIVES IN BITUMEN:** Modifiers, Warm mix additives, Rejuvenators – Interaction with bitumen -Changes in microstructure – Influence on rheological properties – Current design procedures for bitumen modification, warm mixes, and recycling bitumen. (11)

**Total L: 45**

**REFERENCES:**

1. Huang, Y. Pavement Analysis and Design, Prentice hall, New Jersey Second edition, 2004.
2. Alan S. Wineman and Rajagopal, K. R. Mechanical Response of Polymers, Cambridge University Press, New York, 2000.
3. MS-2: Asphalt Mix Design Methods, Asphalt Institute, Seventh Edition, 2015.
4. Relevant ASTM and IS Standards as well as downloadable public documents will be provided for relevant topics.

### **OPEN ELECTIVE THEORY COURSES (One to be opted)**

**21CN91 WASTE TO ENERGY**  
vide Structural Engineering 21CS91

**21CS92 SUSTAINABLE SOLID WASTE MANAGEMENT TECHNOLOGIES**  
vide Structural Engineering 21CS92