COURSE CODE	COURSE NAME	L-T-P (C)	2017
08CE6202	**REGIONAL TRANSPORTATION PLANNING**	3-0-0 (3)	

Course Objectives

To give the Student:-

1. practice in developing forecasting models for demographic and employment opportunities
2. input for delineating regions in nation
3. awareness in influence of land use changes in transportation planning
4. knowledge in network planning and evaluation
5. ability to develop optimum bus route network and schedule

Syllabus

Demographic and Employment forecasting models

Theories of regional development and delineation of planning regions

Land use transportation planning and modeling

Regional travel demand estimation

Regional network planning

Urban bus transportation planning and evaluation

Course Outcome

1. Ability to delineate regions, estimate and forecast travel demand from regions accommodating land use.
2. Ability to generate and evaluate optimum network

References

1. Barra, T. D., Integrated Landuse and Transport Modelling: Decision Chains and Hierarchies, Cambridge University Press, 2005.
2. Bruton, M. J., An Introduction to Transportation Planning (The Living Environment), UCL Press, London, UK, 2000.
3. C.J. Khisty and B. Kent Lall, Transportation Engineering, Prentice Hall of India Pvt. Ltd., 2002.
4. C.S. Papacostas and P.D. Prevedouros, Transportation Engineering and Planning, Prentice Hall of India Pvt. Ltd., 2001.
5. Dicky J.W., Metropolitan Transportation Planning, Script Book Co., Washington, D.C., 1975.
6. John D. Edwards, Transportation Planning Handbook, Second Edition, Institution of Transportation Engineers, 1999.
7. Wilson, A.G., Regional and Urban Models in Geography and Planning, Wiley Press, 1974.
8. William R. Black, Transportation: A Geographical Analysis, Guilford Press, 2003.
9. Ashish Verma, T.V. Ramanayya, Public Transport Planning and Management in Developing Countries, CRC Press, 2014.
10. Norbert Oppenheim, Applied Models in Urban and Regional analysis, Prentice Hall, 1980.
11. Lo´ra´nt Tavasszy and Gerard de Jong, Modelling Freight Transport, Elsevier Publication.
12. Freight Transportation Planning: Models and Methods (Chapter 4) CRC Press LLC, 2003.
13. Quick Response Freight Manual II - Publication No. FHWA-HOP-08-010, Sept 2007.
14. Yosef Sheffi, Urban Transportation Networks – Equilibrium Analysis with Mathematical Programming Methods, Prentice Hall, 1985.

COURSE PLAN

COURSE CODE	COURSE NAME	L-T-P (C)	
08CE6202	**REGIONAL TRANSPORTATION PLANNING**	**3-0-0 (3)**	
Modules	**Content**	**Contact Hours**	**Semester Exam Marks (%)**
I	**Demographic and Employment Forecasting Models**: Demographic Models - Linear, Exponential and Logistic Models; Cohort Survival Models - Birth, Aging and Migration Models; Employment Forecasting Models - Economic base Mechanism; Population and Employment Multiplier Models- Input and Output Models - Dynamic Models of Population and Employment – Multiregional Extensions	**8**	**15**
II	**Theories of Regional Development & Delineation of Transportation Planning Regions**: Concept of Region and Space – Types of Regions – Classification of Regions – Christaller's and Perouxian Theories of Regional Development - Delineation of Regions for Transportation Planning of a Nation.	**8**	**15**
FIRST INTERNAL EXAM			
III	**Landuse transportation models:** Classification of LUT Models, Economic Base Mechanism, Allocation Mechanism and Spatial Allocation and Employment Relationships, Garin Lowry Models, Contribution by Putman and Wilson, Issues Related to Landuse Transport - Interaction, Case Study Examples.	**9**	**15**
IV	**Regional Freight travel demand estimation**: Factors Affecting Goods Flows, Use of Mathematical Models to Estimate Freight Demand, Abstract Mode Models, Mode Specific Models, Direct Demand Models, IVF Models, IO Model, Case Studies, Truck Terminal location – planning	**9**	**15**
SECOND INTERNAL EXAM			
V	**Regional network planning**: Problems in Developing Countries, Network Characteristics - Circuity, Connectivity, Mobility, Accessibility and Level of Service Concepts - Network Structures and Indices – Network Planning – Evaluation - Graph Theory – Cut sets – Flows & Traversing – Optimum Network - Inter-modal Co-ordination.	**11**	**20**
VI	**Urban Bus Transportation Planning and Evaluation**: Introduction to Bus Network Design, Classification of	**11**	**20**

	Routes and their Alignment, Prediction of Transit Usage, Evaluation of Network, Accessibility Consideration in Route Frequency Analysis, Marginal Ridership for Dispatching Buses on Route, Scheduling of Buses and Minimum Wait Schedule.		
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P (C)	2017
08CE6204	**PAVEMENT CONSTRUCTION, EVALUATION AND MAINTENANCE**	3-0-0 (3)	

Course Objectives

To give the student

1. Knowledge about recent developments in construction practices and equipment.
2. Awareness about the importance of pavement condition evaluation and prediction
3. An understanding of various types of distresses, causes and remedies
4. Awareness about various maintenance strategies.

Syllabus

Stabilization techniques, pavement construction equipments, preparation of each layer of flexible pavement, preparation of rigid pavement, superpaves, new types of pavements. Pavement evaluation - Pavement Performance, Serviceability concept, Pavement distresses, pavement condition index, roughness characteristics and its determination – structural evaluation – pavement maintenance.

Course Outcome

Students will be able to

1. Choose appropriate stabilization technique as per the site requirements.
2. Acquaint with new construction practices adopted in the construction of pavements
3. Ability to evaluate the pavement condition using functional and structural methods.

References

1. Mallick, R.B. and T. El-Korchi Pavement Engineering – Principles and Practice, CRC, Press, Taylor and Francis Group, Florida, USA, 2009.
2. Peurifoy, R.L., Construction, Planning, Equipment and Method - McGraw Hill Book Co.2010.
3. Shahin, M.Y, Pavement Management for Airports, Roads and Parking lots, Chapman & Hall, 2005.
4. Haas. R, Hudson. W. Zaniewsk John, Modern Pavement Management, Kreiger Publishing Company, 1994.
5. Sharma S. C., Construction Equipment and its Management", Khanna Publishers, 1995.
6. Relevant IRC Codes.
7. Kadiyali L R, Transportation Engineering, Khanna Publishers, 2016
8. Bruce K. Ferguson, Porous Pavements, CRC Press, 2005.

COURSE PLAN

COURSE CODE	COURSE NAME	L-T-P (C)	
08CE6204	**PAVEMENT CONSTRUCTION, EVALUATION AND MAINTENANCE**	**3-0-0 (3)**	
Modules	**Content**	**Contact Hours**	**Semester Exam Marks (%)**
I	**Soil stabilization of subgrade**: Types of stabilization, Selection of stabilizers, Stabilisation with pozzolanic materials and bitumen.	**6**	**15**
II	**Pavement Construction -** Construction equipments, Construction and preparation of subgrade soil, sub-base, base and surface layers – construction of cement concrete surface layers - MoRT&H specifications	**8**	**15**
FIRST INTERNAL EXAM			
III	**New types of pavement** - super pave concept, new materials like polymer modified bitumen, geo synthetics, interlocked pavements. Applications of geosynthetics in pavements.	**6**	**15**
IV	**Pavement evaluation**: Types of Surveys; Distress Surveys, condition survey; Pavement Distress Indices; Pavement Condition Survey -Pavement Condition Index(PCI) – Estimation of PCI by Shahin's Deduct value method- Pavement surface condition: Skid resistance	**8**	**15**
SECOND INTERNAL EXAM			
V	**Characterisation of roughness**- Equipments for measuring roughness, profile indices, International Roughness Index (IRI), Factors affecting pavement structural condition, Structural Capacity, Structural evaluation by Non- Destructive Tests, Types – Benkelman Beam Deflection (BBD) measurement	**8**	**20**
VI	**Pavement Maintenance:** Routine maintenance, periodic maintenance, special repairs. Responsive maintenance programme, rehabilitation and reconstruction.	**6**	**20**
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P (C)	2017
08CE6206	**ADVANCED TRAFFIC ENGINEERING**	3-0-0 (3)	

Course Objectives

To give the Student:-

1. An introduction to the fundamentals of traffic operations at uninterrupted facilities, theories of traffic flow.
2. Ability to analyse the queuing behavior of vehicles at various traffic scenario
3. Introduction to simulation models and improve the knowledge in advanced theories of traffic flow.

Syllabus

Traffic Flow Modelling, Traffic flow characteristics, various traffic stream models, Car following, acceleration noise. Traffic flow modelling analogies, Shock waves and bottleneck. Lane changing models, Flow models under mixed traffic. Fundamentals of queuing theory. Capacity and Level of Service Simulation in Traffic Engineering

Course Outcome

The student will able to analyse and evaluate traffic stream performance.

1. Understanding the various traffic flow models, flow along bottle necks, shockwave phenomenon
2. Able to estimate demand service characteristics
3. Estimate the level of service of traffic infrastructure facilities.
4. Traffic simulation modeling

References

1. Wohl M and Martin, B.V., "Traffic System Analysis for Engineers and Planners", McGraw-Hill, 1967.
2. McShane W R & Roess R P, "Traffic Engineering", 4th Edition, Prentice-Hall, NJ, 2011.
3. May A. D., "Traffic flow fundamentals", Prentice Hall, NJ, 1990.
4. Drew D. R. "Traffic Flow Theory and Control", Mc. Graw Hill New York, 1968.
5. Highway Capaity Manual, Transportation Research Board, Washington, D.C., 2010.
6. Mannering F.L. and Kilaresky W. P. "Principles of Highway Engineering and Traffic Analysis", 5th Edition, John Wiley and Sons, 2012.
7. Neylor T. H. "Computer Simulation Techniques", John Wiley, 1966.
8. Traffic Flow Theory: A State-of-the-Art Report, TRB, Available for free download at http://www.tfhrc.gov/its/tft/tft.htm.
9. Wilhelm Leutzbach, Introduction to the Theory of Traffic Flow, Springer, 1988.
10. Gerlough, David L, Huber, Matthew J, Traffic Flow Theory, Transportation Research Board Special Report, Issue Number: 165, Transportation Research Board, 1976.

COURSE PLAN

COURSE CODE	COURSE NAME	L-T-P (C)	
08CE6206	**ADVANCED TRAFFIC ENGINEERING**	**3-0-0 (3)**	
Modules	**Content**	**Contact Hours**	**Semester Exam Marks (%)**
I	**Traffic Flow Modelling**: Traffic stream models: Traffic flow characteristics, Greenshield's model, Greenberg's logarithmic model, Underwood's exponential model, pipe's generalized model, multi-regime models;	**10**	**15**
II	Use of Counting, Interval and Translated Distributions for Describing Vehicle Arrivals, Headways, Speeds, Gaps and Lags; Fitting of Distributions, Goodness of Fit Tests.	**8**	**15**
FIRST INTERNAL EXAM			
III	Traffic flow modelling analogies: Fluid flow analogy, heat flow analogy, granular flow, Lighthill-Withams theory, Boltzman like behaviour of traffic. Flow concepts including shock waves and bottleneck. Flow models under mixed traffic. Car following, acceleration noise.	**10**	**15**
IV	Fundamentals of Queuing Theory, Demand Service Characteristics. Deterministic Queuing Models, Stochastic Queuing Models, Multiple Service Channels, Models of Delay at Intersections and pedestrian Crossings.	**8**	**15**
SECOND INTERNAL EXAM			
V	Highway capacity analysis: Capacity and level of service concepts; Factors affecting capacity and LOS; capacity of rural highways, Urban arterials; Capacity Analysis of Different Highway Facilities, Passenger Car Units, Problems in Mixed Traffic Flow.	**10**	**20**
VI	Simulation Models: Philosophy of Simulation Modelling, Formulation of Simulation Model, Methodology of System Simulation, Simulation Languages, Generation of Random Numbers, Generation of Inputs – Vehicle Arrivals, Vehicle Characteristics, Road Geometrics, Design of Computer Simulation Experiments, Analysis of Simulation Data, Formulation of Simulation Problems in Traffic Engineering and Validation.	**10**	**20**
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P (C)	2017
08CE6212	**GEOSYNTHETICS FOR HIGHWAY DESIGN**	3-0-0 (3)	

Course Objectives

1. To know about different types of geosynthetics used for pavement construction.
2. To study about various properties and testing of geotextiles
3. Identify potential areas of application in pavements, how it is applicable and its design

Syllabus

Introduction to geosynthetic, Geotextiles : Types, Manufacturing Methods, Functions, Basic Properties: Physical, Mechanical, Hydraulic, Constructabililty, Durability Testing and Evaluation: Test Condition, Sampling, Testing Methods Pavement Applications: Giroud and Noiray approach, Crack Control, Uses in paved roads Applications: Filtration and Drainage, Embankments, Retaining walls, Rigid and Flexible pavements, AASHTO design.

Course Outcome

1. Understand various types of geosynthetics
2. Understand potential areas of application of geotextiles, its testing standards.
3. Acquire capability for selection, design of geosynthetics for various applications

References

1. Koerner, R.M. Designing with Geosynthetics, 6th Edn., Xlibris Corporation, 2012.
2. G.V. Rao, PK Banerjee, J.T. Shahu, G.V. Ramana. Geosynthetics - New Horizons, Asian Books Private Ltd., New Delhi, 2004.
3. G. Venkatappa Rao, Geosynthetics-An Introduction, Sai Master Geo environmental Services Pvt Ltd., Hyderabad, 2011.
4. G. Venkatappa Rao & Goutam K. Pothal, Geosynthetics Testing-A Laboratory Manual, Sai Master Geoenvironmental Services Pvt Ltd., Hyderabad, 2008.
5. Rao G.V. & Rao G.V.S., "Text Book On Engineering With Geotextiles", Tata Mc Grawhill, 1990.
6. Rao G.V & Balan. K, Coir Geotextiles-emerging trends, Kerala state coir corporation Alappuzha, 2002.
8. J.N. Mandal, "Geosynthetics World", New Age International Private Limited, 1994.
9. G.L Siva Kumar Babu, "An Introduction to Soil Reinforcement and Geosynthetics", university press (India) private limited Hyderabad, 2006.

COURSE PLAN

COURSE CODE	COURSE NAME	L-T-P (C)	
08CE6212	**GEOSYNTHETICS FOR HIGHWAY DESIGN**	**3-0-0 (3)**	
Modules	**Content**	**Contact Hours**	**Semester Exam Marks (%)**
I	Historical background of reinforced soil, Principles of reinforced soil through Mohr circle analysis. Types of geosynthetics like geotextiles, geogrids, geonets, geocells, geo-composites, their manufacturing methods.	**6**	**15**
II	Geotextiles-overview, introduction, types including natural geotextiles, manufacturing methods, Functions of Geotextiles- fluid transmission, filtration, separation, protection, Sediment Control, Reinforcement, design principles and influencing factors	**8**	**15**
FIRST INTERNAL EXAM			
III	Basic Properties- physical(Mass per unit area, thickness, compressibility, apparent opening size, width and length), mechanical(Tensile strength, narrow strip tensile test, grab test, strip and wide width tensile test, seam testing, interface friction, creep resistance), hydraulic, constructability/survivability (puncture test, CBR push through test, trapezoidal tear test, diaphragm bursting strength test, cone drop test), durability (abrasion resistance, ultra-violet resistance, temperature stability, chemical stability)	**8**	**15**
IV	Testing and Evaluation- importance of testing, test conditions, sampling, testing methods- Techniques for testing of different index properties, strength properties, Apparent Opening Size, In-plane and cross-plane permeability tests, assessment of construction induced damage, extrapolation of long term strength properties from short term tests.	**6**	**15**
SECOND INTERNAL EXAM			
V	Pavement Applications- Paved Surface Rehabilitation, Reflective Crack Treatment for Pavements, Geotextiles for separation and reinforcement in flexible pavements, design by Giroud-Noiray, improvement of bearing capacity using geotextiles Use of geotextiles for construction of heavy container yards and railway lines. Applications in Bituminous Pavements- Model study on Geotextile Reinforced Asphaltic	**8**	**20**

	Concrete		
VI	Applications- Filtration and Drainage: geotextile filter requirements, drain and filter properties, design criteria. Embankments in soft soil: stability analysis, influence of reinforcement extensibility, relationships for design, settlement analysis; soil retaining walls: components, principles of design; Reinforcement design applications in rigid and flexible pavements, AASHTO design criteria; construction methods	**6**	**20**
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P (C)	2017
08CE6214	**GIS AND ITS APPLICATIONS IN TRANSPORTATION ENGINEERING**	3-0-0 (3)	

Course Objectives

1. Explain the basic concepts of GIS and different data models in GIS
2. Explain different data management and analysis techniques in GIS.

Syllabus

Coordinate systems, georelational vector data model, object based vector data model, raster data model, geometric transformations, Attribute data input and management, data exploration and vector and raster data analysis

Course Outcome

1. Practical knowledge in using GIS softwares like ArcGIS, MapInfo etc
2. Apply GIS techniques in different real world transportation engineering problems

References

1. Kang-Tsung Chang, Introduction to Geographic Information Systems, Tata McGraw Hill Publishing Company Ltd, New Delhi, 2008.
2. Lo C.P. & Yeung A.K.W., Concepts and Techniques of Geographic Information Systems, Pearson; 2 edition, 2006.
3. De Mers, M.N., Fundamentals of Geographic Information Systems, 4th edition, John Wiley & Sons, New York, 2008.
4. Peter A. Burrough and Rachael A. McDonnell, Principles of Geographical Information Systems, Oxford University Press, 2005
5. Clarke, K., Getting Started with Geographic Information Systems, Pearson; 5 edition, 2010.
6. Geo Information Systems – Applications of GIS and Related Spatial Information Technologies, ASTER Publication Co., Chestern (England), 1992
7. Jeffrey, S. & John E., Geographical Information System – An Introduction, Prentice-Hall, 1990
8. Marble, D.F., Galkhs HW & Pequest, Basic Readings in Geographic Information Systems, Sped System Ltd., New York, 1984.
9. GIS for Urban & Regional Planning, Scholten & Stillwen 1990, Kulwer Academie Publisher.
10. Geographical Information System, Volume I: Principal and Technical Issues, Edited by P.A.Longley, M.F. Goodchild, D.J. Manguire, D.W. Rhino,John Wiley & Sons, 1999.
11. Geographical Information System: Volume II: Management Issues and Applications, Edited By P.A. Longley, M.F. Goodchild, D.J. Manguire, D.W. Rhino, John Wiley & Son, 2005.

COURSE PLAN

COURSE CODE	COURSE NAME	L-T-P (C)	
08CE6214	**GIS APPLICATIONS IN TRANSPORTATION ENGINEERING**	**3-0-0 (3)**	
Modules	**Content**	**Contact Hours**	**Semester Exam Marks (%)**
I	**Introduction:** Introduction to GIS,- definition– Components of GIS –Applications of GIS. **Types of Geo-Spatial Data**: Spatial and non-spatial data, Vector and raster data, Primary and secondary data, Characteristics and sources of spatial data, attribute data. **Map Projection:** Types of Projection–Cylindrical projection, Conical projection, Selection of a particular projection **Coordinate Systems**: Geometric models of earth, Geographic and projected coordinate system	**6**	**15**
II	**Data models**: Topological and non-topological vector data, Topology rules, georelational data model, object based data model, Interface- Encapsulation, Inheritance, Polymorphism **Data models for Composite features**; TIN, Region and Routes. Raster data model- nature and elements, types, data storage, data compression, Data conversion.	**8**	**15**
FIRST INTERNAL EXAM			
III	**Geometric transformation**- map to map and image to map transformations, transformation methods, Affine transformation, RMS error, Resampling, pyramiding, **Geospatial Data quality and standards**: Data quality- accuracy, precision, errors, uncertainty, sources of errors, components and assessment of data quality, Data standards- classification of standards in GIS, components, international geospatial data standards. Spatial data editing- errors, topological and non topological editing. Attribute data input and management- type of attribute data, Relational model, normalization, types of relationships, attribute data entry. (Exposure to GIS tools can be given through assignments or mini projects)	**6**	**15**
IV	**Data exploration and analysis:** Data exploration- descriptive statistics, graphics, attribute data and spatial	**6**	**15**

	data query, map manipulation. Vector data analysis- buffering, overlay, slivers, distance measurement, pattern analysis, Raster data analysis- Local operations- reclassification, neighborhood operations, zonal operations, physical distance measurement		
SECOND INTERNAL EXAM			
V	**Application of GIS in Transportation Planning:** Application of GIS in urban planning, Intelligent information system for road accessibility study, location of transport terminals and roadside facilities, bus stops, Decision support systems for land use planning, Applications of Aerial Photography and Satellite Imageries.	**8**	**20**
VI	**Application of GIS in Highway and Traffic Engineering:** GIS based Highway alignment, GIS based road network planning, GIS based traffic congestion analysis and accident investigation, – Route optimization – Bus route rationalization Utility management, GIS applications in environment impact assessment and environment monitoring, case studies	**8**	**20**
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P (C)	2017
08CE6216	**OPERATIONS RESEARCH**	3-0-0 (3)	

Course Objectives

1. To introduce the methods of Operations Research
2. Emphasize the mathematical procedures of linear and non linear programming

Syllabus

Introduction to Operations Research-Formulation of LPP--Simplex Method, Duality Theory- Sensitivity Analysis-parametric programming: Integer Programming-cutting plane method-mixed integer programming-branch and bound methods. Inventory models-Models with deterministic demand – Non linear programming-Langarange multiplier method- Kuhn Tucker conditions-Quadratic programming.

Course Outcome

1. Proficiency in tools in optimization
2. To enable the students to build models for simple problems in managerial decision making and utilise proper mathematical methods to solve these models

References

1. Bazaraa M S, Jarvis & herali H D, Linear Programming and Network flows, 4th edition, John Wiley & Sons, Singapore 2009.
2. Bazaraa M S, Sherali H D & Shetty, C. M, Non Linear Programming, Theory & Algorithms 2nd edition, John Wiley &Sons, Singapore 1995.
3. Goel B S and Mittal S K ' Operations Research', Pragati Prakashan, 2014.
4. Taha, Hamdy, Operations Research, 9th edition, Pearson, 2010.
5. Wayne L Winston, Operations Research: Applications and Algorithms, Indian University, 4th edition, 2004
6. Mitsuo Gen, Runwei Cheng, Genetic Algorithms and Engineering Optimization, John Wiley & Sons, 2000

COURSE PLAN

COURSE CODE	COURSE NAME	L-T-P (C)	
08CE6216	**OPERATIONS RESEARCH**	**3-0-0 (3)**	
Modules	**Content**	**Contact Hours**	**Semester Exam Marks (%)**
I	Introduction to Operations Research: Basics definition, scope, objectives, phases, models and limitations of Operations Research. Linear Programming Problem – Formulation of LPP, Simplex Method, Artificial variables, Big-M method, two-phase method, degeneracy and unbound solutions.	**6**	**15**
II	Duality Theory, The Primal Vs- Dual-Solutions. Sensitivity Analysis: Changes in Objective-Function Sensitivity Analysis: Changes in RHS.- revised simplex method –parametric programming	**6**	**15**
FIRST INTERNAL EXAM			
III	Integer programming-relevance of integer variables and relevance of integer programming- formulation of problems with binary variables-cutting plane method-mixed integer programming-branch and bound methods.	**8**	**15**
IV	Inventory models. Inventory costs. Models with deterministic demand – demand rate uniform and production rate infinite - demand rate non-uniform and production rate infinite - demand rate uniform and production rate finite	**8**	**15**
SECOND INTERNAL EXAM			
V	Non linear programming-multi-variable optimisation with equality constraints- Langarange multiplier method-optimisation in the presence of inequality constraints-convexity and role in optimization- Kuhn Tucker conditions	**8**	**20**
VI	Quadratic programming-Wolf's method- Beale's method-Frank &Wolfe Method, Reduced Gradient method, Gradient projection method, convex simplex method,	**6**	**20**
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P (C)	2017
08CE6218	**TUNNEL ENGINEERING**	3-0-0 (3)	

Course Objectives

To give the Student:-

1. Awareness about suitability of site for tunneling and method of tunneling that can be adopted
2. Knowledge about various methods of tunnel designing and support designing
3. Information regarding excavation and construction methods for different soil condition
4. Concept of planning and designing of tunnels with less hazards, with proper environment management

Syllabus

Geotechnical considerations of tunneling – site investigation

Design of tunnels – Empirical, observational, analytical and numerical methods

Construction and excavation methods – Hard rock, soft rock, shallow excavation and deep excavation

Tunnel support design – rock reinforcement, concrete and shortcrete lining, NATM

Health, safety and environment considerations – identification of hazards, types and mitigation measures, risk assessment, environmental management related to tunneling

Course Outcome

1. Ability to understand the type and method of tunneling required for different type of soil
2. Ability to plan and design tunnels and tunnel supports with consideration for health, safety and environment.

References

1. Z T Bieniawski, Rock Mechanics Design in Mining & Tunneling, A.A. Balkema,1984
2. Hoek, E, Brown, E T, Underground Excavations In Rock, Transport Research Laboratory, 1980.
3. John Olusegun Ogundare, Precision Surveying: Principles and Geomatics Practice,John Wiley & Sons, 2015.
4. Thomas R. Kuesel, Elwyn H. King, John O. Bickel, Tunnel Engineering Handbook, 2nd edition, Springer Science & Business Media, 2012.
5. Whittaker, B N, Frith, R C, Tunnelling: Design, Stability And Construction, Transport and Road Research Laboratory (TRRL), 1990.
6. Megaw, T M, Bartlett, J V, Tunnels. Planning, Design, Construction. Volume 1, Ellis Horwood, 1982.

COURSE PLAN

COURSE CODE	COURSE NAME	L-T-P (C)	
08CE6218	**TUNNEL ENGINEERING**	**3-0-0 (3)**	
Modules	**Content**	**Contact Hours**	**Semester Exam Marks (%)**
I	**Geotechnical Considerations of tunneling** - Geological, geotechnical and hydrological contexts, Planning a site investigation for a tunnel, Site investigation methods for tunnels in different ground conditions, Geophysical methods Hydrogeological investigation, Geological profiles, In situ and laboratory testing, Stress measurements, Determination of design parameters and preparation of Geotechnical Interpretative Reports (GIR) and Geotechnical Baseline Reports (GBR), Sustainability: reuse of materials, spoil and space.	**6**	**15**
II	**Design of Tunnels** – Empirical design Terzhagis Rock Load method, Application of Bieniawsky's System, Application of Barton's System. Observational Design Methods; Analytical Design Methods; Numerical Design Methods.	**8**	**15**
FIRST INTERNAL EXAM			
III	**Construction & Excavation methods** Types and purpose of tunnels; factors affecting choice of excavation technique; Methods - soft ground tunnelling, hard rock tunnelling, shallow tunnelling, deep tunnelling; Shallow tunnels – cut and cover, cover and cut, pipe jacking, jacked box excavation techniques, methods of muck disposal, supporting, problems encountered and remedial measures.	**6**	**15**
IV	Lighting, Ventilation of tunnels, tunnel utilities, drainage and pumping.	**6**	**15**
SECOND INTERNAL EXAM			
V	**Tunnel support design** Rock reinforcement - Rock dowels, rock bolts, rock anchors, mechanisms of support, physical aspects, , typical dimensions of rock bolt, face plates, bond characteristics, role played by time in rock reinforcement, installation technology, installation process. Concrete and shotcrete linings - Concrete Segmental Supports, Role of steel reinforcement of concrete	**8**	**20**

	segments, Design and application aspects of precast concrete segmental linings, Yielding properties of segmental concrete linings, Cast In Situ or Monolithic Concrete Linings, Waterproofing of Concrete Linings, Shotcrete technology: operational and range of application aspects, Shotcrete, General applications of shotcrete. New Austrian Tunnelling Method - Historical aspects of NATM, General Concepts of NATM, Principal historical developments of NATM, NATM: Soft Ground Tunnelling Applications, Achieving improved ground support control, Influence of stand-up time, Advantages of NATM for soft ground tunneling		
VI	**Health, Safety and Environmental Considerations** - Health and Safety Considerations at Concept Planning Stage for different tunnel types / uses, Reducing / eliminating Hazards to Health, Safety and the Environment by good planning and design, Identification of hazards, strategies to mitigate these hazards by good design practice, Occupational health risk during construction and its mitigation, Hazard types and safety measures (e.g. Fire, Ventilation, Transport, Machines, etc.), Risk assessment processes for design, construction, operation and decommissioning, Modern approach to the improvement of safety standards (including Behavioural Based Safety). Environmental management on a tunnelling site - noise, dust, vibration, emissions, odours, traffic and other nuisances, waste management, waste water management, ecology and archaeology, Sustainability	**8**	**20**
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P (C)	2017
08CE6220	**PLANNING AND DESIGN OF FREIGHT TRANSPORTATION**	3-0-0 (3)	

Course Objectives

To give the Student:-

1. Concept of freight transportation demand estimation
2. Knowledge in contemporary planning issues related to freight transportation
3. Exposure to ITS and its application in freight transport

Syllabus

Characteristics of goods, problems in freight transportation, Freight Demand Estimation, Freight Transport Planning Issues, Distribution Management, Intermodal Freight Transport, ITS Applications in Freight Transport.

Course Outcome

1. Ability to estimate the freight transportation demand
2. Ability to plan freight transportation system

References

1. David Lowe, Intermodal Freight Transport, Elsevier Butterworth-Heinemann Publishers, 2005
2. Konstadinos G. Goulias, Editor, Transportation Systems Planning: Methods and Applications. CRC Press, 2003
3. Myer Kutz, Editor, Handbook of Transportation Engineering, McGraw-Hill Publishers, 2004
4. NCFRP Report 23, Synthesis of Freight Research in Urban Transportation Planning, TRB, Washington, 2013. http://onlinepubs.trb.org/onlinepubs/ncfrp/ncfrp_rpt_023.pdf
5. Blanchard S.Benjamen, "Logistics Engineering and Management", Pearson; 6 edition, 2003.
6. Coyle J.J. Bardi JE, "The Management of Business Logistics", West Publishing Company, New York, 1984
7. Daganzo F.C and Newell FG, Physical Distribution from a Warehouse; Vehicle Coverage and Inventory Levels, Vol.19B, No.5, pp.397-407, Transportation Research, 1985.
8. Edwin Bacht J.A., "Geography of Transportation and Business Logistics", Wm C Brown Company Publishers, Dubuque, IOWA, 1970.
9. Herron P. David, "Managing Physical Distribution for Profit", Harvard Business Review, 1979
10. Khanna K.K., "Physical Distribution Management", Logistical Approach, Himalaya Publishing House, Bombay, 2007.
11. Planning Commission, Government of India, Total Transport System Study – Report on Commodity Flows, Railways, Highways and Coastal Shipping, (Interim) by RITES, New Delhi, 1987
12. Shapiro D. Roy and Heskett L. James, "Logistics Strategy-Cases and Concepts", Wesg Publishing Company, New York, 1985.

COURSE PLAN

COURSE CODE	COURSE NAME	L-T-P (C)	
08CE6220	**PLANNING AND DESIGN OF FREIGHT TRANSPORTATION**	**3-0-0 (3)**	
Modules	**Content**	**Contact Hours**	**Semester Exam Marks (%)**
I	**Introduction:** Goods Characteristics, operators, problems in freight transportation, regional vs. urban goods travel, intermodal freight travel issues	**6**	**15**
II	**Freight Demand Estimation:** Operations, Planning - purpose, process, Data, Freight Agents, costs, Planning Models and Methods-freight demand estimation and forecasting at regional and urban level, IO model, Performance, Case studies	**8**	**15**
FIRST INTERNAL EXAM			
III	**Freight Transport Planning Issues**: Freight supply – capacity issues; freight productivity and performance; freight impacts – safety and environmental issues	**8**	**15**
IV	**Distribution Management:** Supply Chain – Warehousing – Facility Location, Inventory – Mode Choice – Distribution System, Vehicle Routing and Scheduling	**6**	**15**
SECOND INTERNAL EXAM			
V	**Intermodal Freight Transport:** Rail freight operations, Intermodal Networks and Freight Interchanges, Intermodal Road and Rail Vehicles and Maritime Vessels	**8**	**20**
VI	**ITS Applications in Freight Transport:** Introduction to ITS, Role of ITS, ITS components applicable to Goods travel, case studies	**6**	**20**
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P (C)	2017
08CE6222	**ADVANCED SOIL MECHANICS**	3-0-0 (3)	

Course Objectives

To give the student

1. An introduction to critical thinking in the analysis and design of geotechnical systems
2. A firm theoretical background necessary in the design of geotechnical systems
3. The concept of the theory of stress path in the Geotechnical design
4. An idea of basic principles of soil engineering

Syllabus

Soil composition and structure - Permeability and Seepage - Compressibility and Consolidation - Behaviour of compacted soil - Slope instability - Reinforced earth

Course Outcome

1. Understand the soil characteristics and select suitable soil for pavement construction
2. Understand the various field and laboratory testing methods required for different subgrade materials.
3. Evaluate the soil condition and recommend suitable treatment.

References

1. Atkinson, J.H. An Introduction to the Mechanics of Soil and Foundations. McGraw Hill, 1993.
2. Bolton, M. A Guide to Soil Mechanics. MacMillan Education, 1987.
3. Mitchell, R.J. Fundamentals of Soil Behaviour. 3rd Edition, Wiley, 2005.
4. Wood, D.M., Soil Behaviour and Critical State Soil Mechanics. Cambridge University Press, 1988.
5. Braja M. Das, Advanced Soil Mechanics, Fourth Edition, CRC Press, 2013.
6. Charles W. W. Ng, Bruce Menzies, Advanced Unsaturated Soil Mechanics and Engineering, CRC Press, 2007.
7. V.N.S. Murthy, Geotechnical Engineering: Principles and Practices of Soil Mechanics and Foundation Engineering, CRC Press, 2002.
8. Mitchell, R.J,. Fundamentals of Soil Behaviour. 3rd Edition, Wiley, 2005.
9. Lambe T.W, Whitman R. V, “Soil Mechanics”, John Wiley & Sons, 2008.
10. S. K. Khurana, Principles, Practice and Design of Highway Engineering.
11. Gopal Ranjan & A. S. Rao, Basic and Applied Soil Mechanics, New Age International Publishers – New Delhi, 2000.

COURSE PLAN

COURSE CODE	COURSE NAME	L-T-P (C)	
08CE6222	**ADVANCED SOIL MECHANICS**	**3-0-0 (3)**	
Modules	**Content**	**Contact Hours**	**Semester Exam Marks (%)**
I	**Soil composition and structure**: Soil formation: Types of soil, and their characteristics, particle size and shapes, their impact on engineering properties. Soil structure: Clay mineralogy, clay-water interaction - soil fabric. Clay mineral identification. X-ray and Differential Thermal Analysis.	**6**	**15**
II	**Permeability and Seepage**: Concept of Effective stress - permeability – seepage force and effective stress during seepage. Laplace equation of fluid flow for 1D, 2D and 3D seepage Flow nets – anisotropic and non-homogenous medium - Confined and unconfined seepage	**8**	**15**
FIRST INTERNAL EXAM			
III	**Compressibility and Consolidation**: Terzaghi 1 D consolidation theory– applications on different boundary conditions – Determination of coefficient of consolidation – normally and over consolidated soil- compression consolidation curve secondary consolidation –radial consolidation - settlement of compressible soil layers – methods for accelerating consolidation settlement	**8**	**15**
IV	**Behaviour of compacted soil:** surface compaction - Laboratory methods for determination of optimum moisture content and Maximum dry density – Field compression methods – effect of compaction on structure – swelling pressure, shrinkage, shear strength, pore water pressure - CBR – Lab and field methods to find CBR – Dynamic compaction test.	**6**	**15**
SECOND INTERNAL EXAM			
V	**Slope instability:** Stability analysis of slope – Finite and infinite – critical slip surface – sudden draw down condition – effective stress and total stress analysis – stability charts and stability number – methods for enhancing stability of unstable slopes	**6**	**20**
VI	**Reinforced earth:** principles – components – design	**8**	**20**

	principles – stability checks – soil nailing		
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P I	2017
08CE6224	**INTELLIGENT TRANSPORTATION SYSTEM**	3-0-0 (3)	

Course Objectives

To give the Student:-

1. To provide a broad exposure to ITS
2. To understand the relevance, technological applications and strategies using ITS
3. To understand the recent development and application process of ITS

Syllabus

Intelligent Transportation System:- needs, standards, system architecture and components of ITS. Development of ITS worldwide and Indian context and role of traffic management centres.

Various advanced 62raveler information systems available and data collection techniques to support ATIS. Application of ITS like Incident management and parking management, Electronic payment systems, Access control systems etc. ITS system design, sensor technologies and positioning systems to support ITS applications. Automated Highway Systems: Evolution, trends, Integration, system configuration, Implementation, communication technologies and its impact on environment.Transportation planning and ITS, Emergency management systems and possibilities of ITS in India.

Course Outcome

1. Understand the need for ITS and the subsets of ITS.
2. To equip the students with practical case studies leading to ITS rather than conventional methods

References

1. Joseph M. Sussman, Perspectives on Intelligent Transportation Systems, Springer 2005.
2. Bob Williams, Intelligent Transportation Systems Standards, Artech House 2008.
3. Sumit Ghosh and Tony S. Lee, Intelligent Transportation Systems: Smart and Green Infrastructure Design, CRC press, 2010.
4. Mashrur A. Chowdhury and Adel Wadid Sadek Fundamentals of Intelligent Transportation Systems planning, Artech House 2009.
5. Asier Perallos, Unai Hernandez-Jayo, Enrique Onieva and Ignacio Julio García Zuazola, Intelligent Transport Systems: Technologies and Applications, Wiley, 2015.
6. Petros A. Ioannou, Automated Highway Systems, Springer Science & Business Media, 2013

COURSE PLAN

COURSE CODE	COURSE NAME	L-T-P I	
08CE6224	**INTELLIGENT TRANSPORTATION SYSTEM**	**3-0-0 (3)**	
Modules	**Content**	**Contact Hours**	**Semester Exam Marks (%)**
I	**History of ITS**, ITS – Need, Standards and policy, System architecture, ITS Developments - Worldwide and Indian scenario, Metropolitan and Rural ITS. ITS user services: Traffic Management centers- Types and functions, Travel and traffic management, Public transportation operations, Commercial vehicle operations	**8**	**15**
II	**Advanced Traveller Information systems** :- Pre trip and En route information, Data collection techniques, Route Guidance Systems, Infrastructure based systems and its applications, Variable message signs, Vehicle to Center and Vehicle to Road side communication.	**6**	**15**
FIRST INTERNAL EXAM			
III	**Application of ITS**: Incident Management-, Parking management, Electronic payments, Electronic toll collection systems, Access controls: metering, Dynamic speed adaptation. Advanced traffic control systems, In-vehicle systems. Dynamic routing/scheduling.	**8**	**15**
IV	**ITS Design:** ITS system design- components and requirements, ITS for road network- System Design- Sensor technologies and data requirements for ITS. Positioning systems in ITS, GPS and Mobile phone locations and its potential on ITS applications. Telecommunication in ITS, Integration of GPS and GIS for ITS.	**6**	**15**
SECOND INTERNAL EXAM			
V	**Automated Highway Systems:** Evolution of AHS and new trends, Smart cars, Vehicle in platoons, Integration of AHS, System configuration, Implementation of AHS, Communication technologies for AHS, Control and sensor requirements in AHS, Effect of AHS on Environment.	**8**	**20**
VI	**Transportation planning and ITS:-** Relationships	**6**	**20**

	between problems, conventional approach and ITS approach.(Case studies), Operations and fleet management, Emergency management systems, Collision warning systems. Possibilities of ITS in India and Future of ITS.		
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P (C)	2017
08CE6226	**PROJECT MANAGEMENT**	3-0-0 (3)	

Course Objectives

To give the Student:-

1. The concepts of project formulation and capital investment
2. The idea regarding project costing and appraisal
3. The knowledge about various concepts of construction planning
4. The knowledge about construction scheduling and techniques
5. The concepts of quality control and safety concepts
6. The importance of organization and use of project information

Syllabus

Project formulation – Project costing and formulation – construction planning – Scheduling procedures and techniques – quality control and safety procedures during construction – organization and use of project information.

Course Outcome

1.The students able to get concepts of project formulation and capital investment
2.The students get the idea regarding project costing and appraisal
3. The students understand the knowledge about various concepts of construction planning
4. The students able to get the knowledge about construction scheduling and techniques
5. The students get the concepts of quality control and safety concepts
6. The students get the importance of organization and use of project information

References

1. Joseph Berechman, The Evaluation of Transportation Investment Projects, Routledge Advances in Management and Business Studies, 1st Edition, 2014.
2. Primary Corridor Transportation Project, Major Investment Study: Environmental Impact Statement, Volume 1, United States. Federal Transit Administration, 2003.
3. David Banister and Joseph Berechman, Transport Investment and Economic Development, UCL press, London, 2000.
4. Heroil Keenzer – Project Management – A system approach to planning, scheduling and controlling –CBS publishers distributers 1997.
5. K. Waker A. Teraih and Jose M Grevarn: Fundamentals of Construction Management & Organization, Reston Pub Co, 1985.
6. Ghattas and Mckee – Practical Project Management – Pearson Education 2002.
7. Seetharaman- Construction Engineering and Management – Umesh Publications 2012.
8. Shore. B Operations Managements Mc. Graw Hill 1973.
9. Heggie. I. G, Transport Engineering Economics, Mc Graw Hill Publishers, 1972.
10. Winfrey. R, Economic Analysis for Highways, International Text Book Company, 1st edition, 1969.
11. L.R Kadiyali, Traffic Engineering and Transport Planning, Khanna Publishers, 2011.
12. Road User Cost Study, CRRI, Journal of the Indian Roads Congress, Volume: 44, Issue Number: 1, Indian Roads Congress, 1983.
13. J.W. Dickey, Road Project Appraisal, for Developing Countries, John Wiley & Sons, 1984.

14. IRC: SP: 19; 2001, Manual For Survey, Investigation & Preparation of Road Projects.
15. IRC:SP: 30, Manual on Economic Evaluation of Highway Projects in India.

COURSE PLAN

COURSE CODE	COURSE NAME	L-T-P (C)	
08CE6226	**PROJECT MANAGEMENT**	**3-0-0 (3)**	
Modules	**Content**	**Contact Hours**	**Semester Exam Marks (%)**
I	**Project formulation:** Project Concepts - Capital investments - Generation and Screening of Project Ideas Project identification –Preliminary Analysis, Market, Technical, Financial, Economic and Ecological – Pre Feasibility Report and its Clearance, Project Estimates and Techno Economic Feasibility Report.	**6**	**15**
II	**Project costing and appraisal :** Project Cash Flows - Time Value of Money –NPV-BCR -IRR -ARR -Urgency - Pay Back Period -Assessment of Various Methods - Indian Practice of Investment Appraisal International Practice of Appraisal -Analysis of Risk -Different Methods -Selection of a Project and Risk Analysis in Practice	**6**	**15**
FIRST INTERNAL EXAM			
III	**Construction planning:** Basic Concepts in the Development of Construction- Plans Choice of Technology and Construction Method -Defining Work Tasks -Defining Precedence Relationships among Activities -Estimating Activity Durations -Estimating Resource Requirements for Work Activities	**6**	**15**
IV	**Scheduling procedures and techniques:** Construction Schedules -Critical Path Method -Scheduling Calculations -Float -Presenting Project Schedules -Use of Advanced Scheduling Techniques -Crashing and Time/Cost Trade-offs	**8**	**15**
SECOND INTERNAL EXAM			
V	**Quality control and safety during construction**: Quality and Safety Concerns in Construction -Organizing for Quality and Safety -Work and Material Specifications -Total Quality Control -Quality Control by Statistical Methods Safety.	**8**	**20**
VI	**Organization and use of project information:** Types of Project Information -Accuracy and Use of Information -Computerized Organization and Use of Information -Organizing Information in Databases- Relational Model of data bases -Other Conceptual Models of Databases -Centralized Database	**8**	**20**

	Management Systems		
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P (C)	2017
08CE6228	**ADVANCED TRAVEL DEMAND MODELING**	3-0-0 (3)	

Course Objectives

To give the Student:-

1. Awareness about various qualitative variables used in forecasting and the scaling techniques
2. Proficiency in developing travel demand models by appropriate modeling techniques
3. Ability to test the model aggregation and transferability

Syllabus

Role of qualitative variables in travel demand forecasting – scaling techniques – factor analysis – discrete choice analysis – stated preference methods – time use analysis – model aggregation and model transferability – simplified transport demand models and advanced models.

Course Outcome

Students will be able to

1. Assess qualitative variables
2. Develop discrete choice models
3. Develop travel demand models using Stated Preference data
4. Estimate Travel Demand using activity based analysis
5. Test model aggregation and transferability
6. Develop Travel Demand Models for small cities using Quick response techniques

References

1. Akiva, B., Discrete Choice Analysis: Theory and Application to Travel Demand, MIT Press, 1985.
2. Moshe Ben -Akiva and Michel Bierlaire, Discrete choice methods and their applications to short term travel decisions, Transportation Science Handbook, 1999.
3. Alan Geoffrey Wilson. Optimisation in Location and Transport Analysis, John Wiley & Sons, 1981 (Digitized: 31 March 2011)
4. Yaron Hollander, Transport Modelling for a Complete Beginner, Ctthink, 2016.
5. Harry Timmermans, Progress in Activity Based Analysis, Elsevier Science, 2005.
6. Michael A. Florian, Lecture Notes in Economics & Mathematical Systems: Traffic Equilibrium Methods, Proceedings of the International Symposium Held at the Université de Montréal, Springer, 1976.
7. Oppenheim, N., Urban Travel Demand Modelling: From Individual Choices to general Equilibrium, John Wiley and Sons, Inc., 1995 (Digitized 29 June 2011)
8. Orterzar, J., and Willumasen, L. G., Modelling Transport, Wiley Publishers, 2011.
9. Time use Analysis, Special Issue, Transportation, 26, Kluwer Academic Publishers, 1999

COURSE PLAN

COURSE CODE	COURSE NAME	L-T-P (C)	
08CE6228	**ADVANCED TRAVEL DEMAND MODELING**	**3-0-0 (3)**	
Modules	**Content**	**Contact Hours**	**Semester Exam Marks (%)**
I	**Qualitative variables:** Role of Soft variables in Travel Demand Forecasting; Attitudes; Psychometric scaling Techniques – One-dimensional Scaling – Multidimensional Scaling; Basic Rating Scales: Comparative Rating Scales, Non – Comparative Rating scale, Itemised rating scale, graphic rating scale; Specific Attitude scales; Successive Categories; Principal Components Factor Analysis; Attitudinal Models.	**6**	**15**
II	**Discrete choice analysis:** Utility Concept; Mode choice; Logit Models; Dogit Model; Nested Logit Model; Probit Model; Route Choice Modelling; Combined Travel Demand Modelling; Model Parameter Estimation – Maximum Likelihood and Maximum Entropy Estimates.	**8**	**15**
FIRST INTERNAL EXAM			
III	**Stated preference methods:** Stated preference vs. Revealed Preferences; Design Issues; Survey Methods, Conjoint Analysis; Functional Measurement; Trade off Analysis, Transfer Price Method. **Time use analysis:** Activity patterns; Activity scheduling; Activity Time Allocation studies; Activity Episode Analysis; Travel Duration Analysis	**6**	**15**
IV	**Model aggregation and Model Transferability:** Aggregation bias and forecasting; Aggregation Methods; Temporal Stability and geographical stability of Models; Transfer Model Updating Procedures – Transferring with Aggregate and Disaggregate sample data; Transferability Measures	**6**	**15**
SECOND INTERNAL EXAM			
V	**Simplified transport demand models:** Sketch planning Methods; Incremental Demand Models; Model estimation from traffic Counts; IVF Models, Marginal and Corridor Models; Gaming Simulation, Quick Response Techniques	**8**	**20**
VI	**Introduction to advanced Modeling techniques:** GO Models; Entropy Models; Equilibrium Assignment Techniques, Multipath Assignment – Dial's Algorithm,	**8**	**20**

	Knowledge Based Expert System; Neuro – Fuzzy Application; ANN Techniques; Genetic Algorithms; Object Oriented Programming; Decision Support Systems; Goal Programming		
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P (C)	2017
08CE6230	**PLANNING AND DESIGN OF NON MOTORISED TRANSPORTATION**	3-0-0 (3)	

Course Objectives

To give the Student:-

1. The concept of NMT and its benefits
2. Knowledge in planning and design of NMT facilities
3. Ability to evaluate and prioritize bicycle and pedestrian plans with safety considerations.

Syllabus

Transport planning process
Evaluation and prioritization of NMT by conducting various analysis
Planning process and standards for pedestrian and bicycle facilities
Implementation, operation and maintenance
Safety assessment

Course Outcome

1. Quantify the benefits of creating walkable and bikeable environments.
2. Design pedestrian and bicycle facilities.
3. Establish processes to create, implement, and evaluate bicycle and pedestrian plans.
4. Assess bicycle and pedestrian safety.
5. Prepare comprehensive plans for encouraging non-motorized transportation.

References

1. ADB, Guidelines for Non-Motorised Transport Measures: Policy and Options, Asian Development Bank, 2008. http://sti-india-uttoolkit.adb.org/mod5/se2/002.html
2. Sekadi Phayane, Marianne Vanderschuren, Gail Jennings, L. Newton–Reid, Non-Motorised Transport – Best Practice Manual, Department of Environmental Affairs, south Africa, 2014.
3. Fruin J. J., Pedestrian Planning and Design, McGraw Hill Publication, 1987.
4. Hudson .M, The Bicycle Planning, Open Books, 1982.
5. IRC codes for Design and Layout of Cycle Tracks and Pedestrian Facilities.
6. IRC 11-1962.
7. John Forester, Bicycle Transportation: A Handbook for Cycling Transportation Engineers, MIT Press, 1994.
8. Myer Kutz, Editor, Handbook of Transportation Engineering, McGraw-Hill Publishers, 2004.
9. Rodney Tolley, Editor, Sustainable Transport: Planning for walking and cycling in urban environments; CRC Press, 2003.
10. Yedla, Sudhakar, Urban Transportation and the Environment Issues, Alternatives and Policy Analysis, Springer India, 2015.
11. Planning and Design Guideline for Cycle ... - TRIPP (IIT Delhi) http://tripp.iitd.ernet.in/publications/other_pub/Planning%20and%20Design%20Guideline%20for%20Cycle%20Infrastructure.pdf
12. https://www.peelregion.ca/pw/construction/pdf/pedestrian-bicycle-facility-design-guidance.pdf

COURSE PLAN

COURSE CODE	COURSE NAME	L-T-P (C)	
08CE6230	**PLANNING AND DESIGN OF NON MOTORISED TRANSPORTATION**	**3-0-0 (3)**	
Modules	**Content**	**Contact Hours**	**Semester Exam Marks (%)**
I	**Transport Planning Overview:** Planning Process; Measuring Current Non-motorized Travel; Predicting Potential Non-motorized Travel; Evaluating Existing Conditions and Prioritize Improvements	**6**	**15**
II	**Evaluation of Non-motorized Transportation:** Surveys, Demand Estimation and Analysis; Crash Data, Barrier Effect; Cycling Condition Evaluation Techniques; Pedestrian Condition Evaluation Techniques; Prioritizing Improvements and Selecting Preferred Options	**6**	**15**
FIRST INTERNAL EXAM			
III	**Planning for Pedestrians:** Types of pedestrians and Characteristics; Pedestrian facilities and planning; Pedestrian standards and improvements; Pedestrian facility Design, LOS; Pedestrian safety programs	**6**	**15**
IV	**Planning for Bicyclists:** Types of cyclists and Bikeways; Integrating cycling into roadway planning; Bicycle network planning; Accommodating cyclists on rural roads; Design of Bicycle boulevards/bike paths; Bicycle Parking/storage Facilities; Roadway maintenance for cyclists	**6**	**15**
SECOND INTERNAL EXAM			
V	**Safety Programs:** Safety education; Traffic law enforcement **Implementation Strategies and Tools:** Comprehensive plans; Road design, reconstruction and maintenance requirements; Major projects and site plan agreements; Land Use Connectivity, Urban Design exchange, Rural areas, utility corridors	**10**	**20**
VI	**Operations and Maintenance:** Operations and Maintenance Resources/Costs; Signs and Pavement Markings; Routine and Remedial Operations; Routine maintenance	**8**	**20**
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P (C)	2017
08CE6292	**MINI PROJECT**	0-0-4 (2)	

Course Objectives

To give the Student:-

1. Capability for identifying, understanding and analyzing a transportation problem and to provide appropriate solutions.
2. Ability to explain and present the problem and its solution individually.
3. Provide an exposure in real world transportation problems and solutions through internships.

Syllabus

The student shall present two seminars and submit a report. The first seminar shall highlight the topic, objectives, methodology, design and expected results. The second seminar is the presentation of the work / hardware implementation. Conference/Publication and MOOC courses will be considered among the criteria for the final evaluation.

The student shall undergo Internship/ Industrial Training for minimum four weeks in the same organization or in another Educational/Industrial organization after the End Semester Examinations and the student shall be eligible for next semester course registration only after undergoing the Internship/Industrial Training.

Course Outcome

Upon successful completion of the mini project, the student should be able to

1. Identify and solve various problems associated with designing and implementing a system or application.
2. Test the designed system or application.

Mark distribution (Total 100 Marks)
Level one evaluation by the internal guide : 30 Marks
Level two evaluation duly constituted by the departmental committee: 70 Marks

COURSE CODE	COURSE NAME	L-T-P (C)
08CE6294	**TRANSPORTATION ENGINEERING LAB**	0-0-2 (2)

Course Objectives

To give the Student:-

1. Awareness about the practical problems on traffic engineering and road safety
2. An introduction to various analysis and planning software
3. Ability to conduct various traffic studies for design and management of road facilities.

Syllabus

Traffic Surveys: Volume count, Speed study, Parking study, Intersection turning movements, Speed and Delay study, Moving observer survey, Traffic noise measurement, Vehicle emission testing, Road lighting, Driver reaction time. Road side and house hold interviews.

Course Outcome

1. Knowledge on analysing and solving traffic engineering problems
2. Ability to work with transportation planning softwares

References

1. C. Jotin Khistyhttp://www.amazon.com/Transportation-Engineering-Introduction-3rd-Edition/dp/0130335606/ref=sr_1_1?s=books&ie=UTF8&qid=1339240659&sr=1-1 and, B. Kent Lall, Transportation Engineering: An Introduction, Prentice Hall; 3rd Edition, 2002.
2. Currin, Introduction to Traffic Engineering: Manual F/data Collect & Analysis, CL Engineering, 2nd Edition, 2012.
3. L.R. Kadiyali, Traffic Engineering and Transportation Planning, Khanna Publishers, 2011.
4. Pignataro LJ. Traffic Engineering: Theory and Practice; Prentice hall, Inc, 1973
5. Roger P. Roesshttp://www.amazon.com/Traffic-Engineering-4th-Roger-Roess/dp/0136135730/ref=sr_1_1?s=books&ie=UTF8&qid=1338960921&sr=1-1,
6. Elena S. Prassas and William R. McShane, Traffic Engineering, Prentice Hall, 4th Edition, 2010.

List of Experiments

Minimum 10 exercises with atleast one from each major category

A. Traffic Engineering Studies (Field Studies):

1. Volume Studies – Straight Roads and at Intersections
2. Origin and Destination Survey.
3. Parking Surveys and Parking Turnover Studies
4. Speed Studies - Spot Speed Studies by Stop Watch, Enosocpe and Radar Speed Meter
5. Journey Time and Delay Studies - Floating Car Method
6. Headway and Gap-acceptance studies.
7. Delay Measurement at Signalised and Unsignalised Intersections
8. Road Safety Audit.
9. Traffic noise measurement.

B. **Study of Driver Characteristics**:

1. Reaction Time
2. Visual Acuity
3. Glare Recovery.

C. Software lab: (Any of the Transportation planning, traffic engineering or pavement design software can be given for learning purpose). A few examples are given below.

1. GIS Software
2. TransCAD / CUBE
3. EMME
4. HDM-4
5. Detailed drawings using CAD software
6. VISSIM