COURSE CODE	COURSE NAME	L-T-P (C)	2017
08CE7201	**HIGHWAY GEOMETRIC DESIGN**	3-0-0 (3)	

Course Objectives

To give the Student:-

1. Concept of various highway system elements and their characteristics
2. Expertise in the geometric design of highway alignments and intersections
3. Idea of evaluation measures of highway design consistency
4. Knowledge in designing road side infrastructure such as parking and bus bays.

Syllabus

Highway System – Classification, components, characteristics
Horizontal alignment of roads
Vertical alignment of roads
Consistency evaluation of highway geometry
Design of intersections
Design of road side infrastructure

Course Outcome

1. Ability to understand the highway system and design highway geometry
2. Ability to evaluate the geometric design in relation to safety
3. Ability to design required type of road intersections road side facilities.

References

1. L.R. Kadiyali and N.B. Lal, Principles and Practice of Highway Engineering, Khanna, 2007.
2. L.R. Kadiyali, Traffic Engineering and Transportation Planning, Khanna Publications, 2007.
3. C.E.G. Justo and S.K. Khanna, Highway Engineering, Nem Chand and Brothers, 2015.
4. IRC Codes for Signs, Markings and Mixed Traffic Control in Urban Areas.
5. Gianluca Dell' Acqua, Fred Wegman, Transport Infrastructure and Systems: Proceedings of the AIIT International Congress on Transport Infrastructure and Systems (Rome, Italy, 10-12 April 2017), CRC Press, 2017.
6. United States Government Accountability, Transportation Infrastructure: Highway Pavement Design - Scholar's Choice Edition, 2015.
7. Lester A. Hoel, Nicholas J. Garber, Adel W. Sadek, Transportation Infrastructure Engineering: A Multimodal Integration, SI Version, Cengage Learning, 2010.

COURSE PLAN

COURSE CODE	COURSE NAME	L-T-P (C)	
08CE7201	**HIGHWAY GEOMETRIC DESIGN**	**3-0-0 (3)**	
Modules	**Content**	**Contact Hours**	**Semester Exam Marks (%)**
I	**Highway System:** Functional Classification of Highway System; Design Controls – Topography, Driver characteristics, Vehicle Characteristics, Traffic, Capacity and Level of Service, Design Speed. Objectives of Geometric Design, Cross Section Elements: Design specifications; Pavement Surface characteristics – Skid Resistance, Road Roughness; Camber, Objectives, design standards.	**6**	**15**
II	**Horizontal Alignment of Roads**: Sight Distances – Stopping Sight Distance, Overtaking Sight Distance and Intermediate Sight Distance ; Objectives of horizontal curves; Superelevation; Extra- widening on Curves; Transition Curves – Objectives and Design. Transition Curve setting methods, Introduction to MX Roads software.	**6**	**15**
FIRST INTERNAL EXAM			
III	**Vertical Alignment of Roads**: Gradients – Types of Gradients, Design Standards; Vertical Curves – Summit Curves, Valley Curves and Design criteria for Vertical Curves; Importance of Sight Distances for Horizontal and Vertical Curves ; Combination of Vertical and Horizontal Curves – Grade Compensation	**6**	**15**
IV	**Geometric Design Consistency**: Concept of consistency, Evaluation Measures, Existing criteria for evaluation of consistency. Correlation between highway safety and consistency.	**6**	**15**
SECOND INTERNAL EXAM			
V	**Geometric Design of Intersections** : Types of Intersections; Design Principles for Intersections; Design of At-grade Intersections – Channelization, Objectives; Traffic Islands and Design standards; Rotary Intersection – Concept, Advantages and Disadvantages; Grade separated Interchanges – Types, warrants and Design standards.	**10**	**20**
VI	**Miscellaneous Elements**: Requirements of Pedestrians; Pedestrian facilities on Urban Roads; Cycle Tracks – Guidelines and Design standards; Bus bays –Types and	**8**	**20**

	Guide lines; Design of On-street and Off street Parking facilities – Guidelines for lay out Design, Traffic Signs and Markings.		
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P (C)	2017
08CE7203	**PAVEMENT EVALUATION AND MANAGEMENT**	3-0-0 (3)	

Course Objectives

To give the Student:-

1. The ability to measure the performance of pavements
2. The ability to evaluate the adequacy and life of pavements
3. The capability of maintaining and managing the pavements

Syllabus

Structural and functional requirements of pavements – serviceability – pavement distresses – pavement condition survey – pavement roughness – design of overlay – destructive testing – performance prediction models – pavement management system – priority programming – life cycle cost analysis – economic evaluation and optimization tools.

Course Outcome

1. Students will be able to evaluate structural and functional performance of pavements
2. Students will be able to conduct pavement condition survey
3. Students will be enabled to manage and prioritise various road construction processes.
4. Students will be able to use various optimization tools for economizing resources.

References

1. Shahin, M.Y, Pavement Management for Airports, Roads and Parking lots, Chapman & Hall, 2005.
2. Haas. R, Hudson.W. Zaniewsk John, Modern Pavement Management, Kreiger Publishing Company, 1994.
3. Yang H Huang, Pavement Analysis and Design, Prentice Hall, 2004.
4. Latest revisions of IRC codes: IRC: 81 and IRC: 82
5. Prithvi S. Kandhal, Mary Stroup-Gardiner, Flexible Pavement Rehabilitation and Maintenance, Issue 1348, ASTM International, 1998.

COURSE PLAN

COURSE CODE	COURSE NAME	L-T-P (C)	
08CE7203	**PAVEMENT EVALUATION AND MANAGEMENT**	**3-0-0 (3)**	
Modules	**Content**	**Contact Hours**	**Semester Exam Marks (%)**
I	Structural and functional requirements of flexible and rigid pavements, Pavement performance, Serviceability concept, Factors affecting pavement surface condition, Pavement distresses, Causes, Methods of measurement, Maintenance treatments.	**6**	**15**
II	Pavement Condition Survey -Pavement Condition Index(PCI) – Estimation of PCI by Shahin's Deduct value method- Pavement surface condition: Skid resistance	**6**	**15**
FIRST INTERNAL EXAM			
III	Characterisation of roughness- Equipments for measuring roughness, profile indices, International Roughness Index (IRI), Factors affecting pavement structural condition, Structural evaluation by Non- Destructive Tests, Types – Benkelman Beam Deflection (BBD) measurement	**6**	**15**
IV	Falling Weight Deflectometer, Design of overlay using BBD data (IRC method), Destructive structural evaluation, Structural Capacity Index, Pavement performance prediction models: Mechanistic–Empirical, Regression, Stochastic, Static and Dynamic models	**8**	**15**
SECOND INTERNAL EXAM			
V	Pavement Management System (PMS): Concept, Objectives, Components of PMS, PMS functions, General Structure, Types of pavement Maintenance actions: Preventive and Corrective maintenance, Maintenance policy, Pavement management levels: Network, Programme and Project level, Priority programming of maintenance and rehabilitation actions	**8**	**20**
VI	Life Cycle Cost Analysis, Heuristic Approach: Decision Matrix and Decision Tree based on Economic Evaluation and Optimisation, Tools for Pavement Management: HDM-4, Road Economics Decision Model	**8**	**20**
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P (C)	2017
08CE7205	**SOFT COMPUTING TECHNIQUES**	3-0-0 (3)	

Course Objectives

To acquaint the students with soft computing methodologies such as neural networks, fuzzy logic, genetic algorithms and hybrid algorithms and enable the students to implement real time intelligent and adaptive systems.

Syllabus

Introduction to Fuzzy logic, Fuzzification, Defuzzification methods, Artificial Neural Networks concepts, Fundamentals of genetic algorithms and hybrid systems.

Course Outcome

The students will be able to apply soft computing methodologies to implement real time intelligent and adaptive systems.

References

1. S. Rajasekharan, G. A. Vijayalakshmi Pai, Neural Network, Fuzzy Logic and Genetic Algorithms Synthesis and Applications, Prentice Hall India, 2003.
2. S. N. Sivanandam, S. N. Deepa, Principles of Soft Computing, Wiley India, 2007.
3. Timothy J Ross, Fuzzy logic with Engineering Applications, 4^{TH} Edition, McGraw Hill, 2016.
4. S. Haykins, Neural Networks a Comprehensive foundation, 2^{nd} edition, Prentice Hall, 1998.
5. D. E. Goldberg, Genetic Algorithms in Search Optimisation and Machine Learning, Pearson Education, 1989.

COURSE PLAN

COURSE CODE	COURSE NAME	L-T-P (C)	
08CE7205	**SOFT COMPUTING TECHNIQUES**	**3-0-0 (3)**	
Modules	**Content**	**Contact Hours**	**Semester Exam Marks (%)**
I	**Introduction to Fuzzy logic**: Fuzzy sets- Fuzzy set operations- Fuzzy relations-Cardinality of Fuzzy relations- Operations on Fuzzy relations-Properties of Fuzzy relations-Membership Functions-Features of Membership functions- Fuzzification-Methods of Membership value Assignments- Fuzzy Rule Base-Defuzzification- Deffuzzification methods- Fuzzy logic controller(Block Diagram)	**8**	**15**
II	**Artificial Neural Networks:** Basic concepts-Neural network Architectures-Single layer feed forward network- Multilayer feed forward network.	**7**	**15**
FIRST INTERNAL EXAM			
III	**Recurrent Networks**-Characteristics of Neural Networks-Learning methods. Perceptron networks-Back Propagation networks-Radial base function network-Hopfield network- Kohonen Self	**7**	**15**
IV	**Fundamentals of genetic algorithms**: Basic concepts- working principle – encoding – different methods – Fitness function – reproduction-different methods. Genetic modelling-inheritance-Crossover mutation- Convergence of genetic algorithm	**6**	**15**
SECOND INTERNAL EXAM			
V	**Hybrid systems**: Neural network, fuzzy logic and genetic algorithm hybrids – Neuro fuzzy hybrids- neuro genetic hybrids-Fuzzy genetic hybrids	**7**	**20**
VI	**Genetic algorithm based back propagation network**- **Fuzzy back propagation networks** –fuzzy logic controlled genetic algorithms.	**7**	**20**
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P (C)	2017
08CE7207	**WATERWAY INFRASTRUCTURE PLANNING AND DESIGN**	3-0-0 (3)	

Course Objectives

To give the student

1. Knowledge in planning and design of various waterway infrastructure facilities like harbor and docks
2. Ability to plan and design coastal protection works
3. Knowledge about various navigational aids
4. Awareness about potential of inland navigations

Syllabus

Harbour Planning – various harbor works – docks and repair facilities – port facilities – dredging and coastal protection – inland navigation and its potential

Course Outcome

Students will be able to

1. Plan and design harbour facilities
2. Estimate Traffic demand for harbour planning
3. Discriminate harbour works, berthing structures and transit sheds
4. Understand repair facilities, port facilities and cargo handling facilities required
5. Design coastal protection facilities
6. Understand navigational aids and inland navigation for safe operations.

References

1. Bindra, S.P. A Course in Docks and Harbour Engineering, Dhanpat Rai & Sons, New Delhi, India, 2012.
2. Seetharaman, S. Dock and Harbour Engineering, Umesh Publications, New Delhi, India, 1999.
3. Srinivasan, R., Harbour, Dock and Tunnel Engineering, Charotar Publishing House, Anand, India, 2009.
4. Bart Wiegmans, Rob Konings, Inland Waterway Transport: Challenges and Prospects, Routledge, 2016.

COURSE PLAN

COURSE CODE	COURSE NAME	L-T-P (C)	
08CE7207	**WATERWAY INFRASTRUCTURE PLANNING AND DESIGN**	**3-0-0 (3)**	
Modules	**Content**	**Contact Hours**	**Semester Exam Marks (%)**
I	**Harbour Planning:** Types of water transportation, water transportation in India, requirements of ports and harbours, classification of harbours, selection of site and planning of harbours, location of harbour, traffic estimation, master plan, ship characteristics, harbour design, turning basin, harbour entrances, type of docks, its location and number, Site investigations – hydrographic survey, topographic survey, soil investigations, current observations, tidal observations.	**6**	**15**
II	**Harbour Works:** Design and construction of breakwaters, berthing structures - jetties, fenders, piers, wharves, dolphins, trestle, moles, navigational aids, requirements of signals, fixed navigation structures, necessity of navigational aids, light houses, beacon lights, floating navigational aids, light ships, buoys, radar.	**8**	**15**
FIRST INTERNAL EXAM			
III	**Docks and Repair Facilities:** Harbor docks, use of wet docks, design of wet docks, repair docks, lift docks, dry docks, keel and bilge blocking, construction of dry docks, gates for dry docks, pumping plant, floating docks, slipways, locks, size of lock, lock gates, types of gates.	**6**	**15**
IV	**Port facilities:** Port development, port planning, port building facilities, transit sheds, warehouses, cargo handling facilities, container handling terminal facilities, shipping terminals, inland port facilities.	**6**	**15**
SECOND INTERNAL EXAM			
V	**Dredging and Coastal Protection:** Classification, types of dredgers, choice of dredger, uses of dredged materials, coastal erosion and protection, sea wall, revetment, bulkhead, coastal zone and beach profile.	**8**	**20**
VI	**Inland Navigation and its potential:** Inland waterways, Inland water transportation in India, classification of waterways, economics of inland waterways transportation, national waterways	**8**	**20**

END SEMESTER EXAM

COURSE CODE	COURSE NAME	L-T-P (C)	2017
08CE7209	**LAND USE TRANSPORTATION PLANNING**	3-0-0 (3)	

Course Objectives

To give the Student:-

1. Insight about the effect of land use in transportation planning
2. Knowledge about activity based modeling approach
3. Knowledge in modeling travel demand of people and goods

Syllabus

Land Use And Transportation Engineering, Land Use Transportation and Activity Models, General Travel Demand Models and Regional Transport Models, Regional Transport Models, Regional Network Planning, Advanced Spatial analysis Modelling

Course Outcome

1. Understand urban regional dynamics
2. Prepare integrated land use and transportation plans for a city
3. Estimate demand for both passenger and goods travel at regional level
4. Plan and evaluate regional transportation networks

References

1. Jhan De Dios Ortuzar. Luis E. Willumsen, Modelling Transport, 4TH EDITION, John Wiley& Sons. 2011.

2. R. Baxter, M. Echenique and J. Owers, Urban Development Models - The Institute of Transportation Engineering, University of California.

3. Robert S, Pindyek, Daniel L. Rubin Field, Econometric Models and Economic Forecast -; McGraw Hill, 1991.

4. S. R. Chari, Land Use Transportation Planning Notes, REC Warangal.

5. A. G. Wilson, Entropy in urban and regional modelling, Pion, London 1970.

6. Michael Batty, Urban Modeling. Algorithms, Calibrations, Predictions, Cambridge University Press, 2010.

7. Peter R. Stopher Arnim. H. Meyburg, Behavioral Travel Demand Models, Lexington Books, 1976.

8. Morlok E K, Introduction to Transportation Engineering and Planning, McGraw Hill, 1978.

9. Yan Liu, Modelling Urban Development with Geographical Information Systems and Cellular Automata, CRC Press, 2008.

COURSE PLAN

COURSE CODE	COURSE NAME	L-T-P (C)	
08CE7209	**LAND USE TRANSPORTATION PLANNING**	**3-0-0 (3)**	
Modules	**Content**	**Contact Hours**	**Semester Exam Marks (%)**
I	**Land Use And Transportation Engineering**: Transportation modeling in Planning; Models and their role, Characteristics of Transport demand and supply, Equilibrium of supply and demand, Modeling and decision making, Issues in Transportation modeling and structure of the classic transport model.	**6**	**15**
II	**Land Use Transportation and Activity Models**: Introduction to Land Use Planning; Relation between Transportation and Land Use Planning; The economic base mechanism and allocation mechanism; Spatial allocation and employment interrelationship; Garin Lowry models.; Activity modeling	**8**	**15**
FIRST INTERNAL EXAM			
III	**General Travel Demand Models and Regional Transport Models**: Aggregate, Disaggregate models ; Behavioral models; Recursive and direct demand Models; Linear, Non-Linear models; Logit, discriminant and probit models; Mode split models - Abstract mode and mode specific models.	**8**	**15**
IV	**Regional Transport Models**: Factors affecting goods and passenger traffic; Prediction of traffic; Growth factor models; Time function iteration models; internal volume forecasting models.	**6**	**15**
SECOND INTERNAL EXAM			
V	**Regional Network Planning**: Problems in Developing Countries, Network Characteristics - Circuitry, 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. – Rural Road Network Planning.; User equilibrium concepts	**8**	**20**
VI	**Advanced Spatial analysis Modelling**: Applications of Artificial Neural networks, Cellular automata, Fuzzy logic systems, Genetic algorithms, artificial intelligence concepts to transportation Modelling	**6**	**20**

END SEMESTER EXAM

COURSE CODE	COURSE NAME	L-T-P (C)	2017
08CE7211	**SUSTAINABLE TRANSPORTATION**	3-0-0 (3)	

Course Objectives

To give the Student:-

1. Awareness about the importance of sustainability in transportation planning
2. Knowledge of various aspects of sustainable transportation
3. Ability to develop a transportation system which is sustainable
4. Knowledge about pricing policies related to transportation.

Syllabus

Problem of Sustainability in Transport, Pricing Transportation, Planning for Sustainability, Sustainable Policies, Sustainable Technology, Nationally Appropriate Mitigation Actions

Course Outcome

1. Ability to define sustainable transportation and differentiate sustainable transportation systems from non-sustainable transportation systems
2. Ability to develop a sustainable transportation system.
3. Ability to perform methods to improve sustainability in freight transportation.
4. Ability to suggest policies that improve the sustainability of transportation.

References

1. Black, W. R., Sustainable Transport: Definitions and Responses, In Transportation Research Board, Integrating Sustainability into the Transportation Planning Process, Conference Proceedings 37. Washington, D.C., National Research Council, 2005

2. Black, W.R., Sustainable transport: Problems and Solutions. Gulford Press, New York, 2010.

3. Cervero, R. Accessible Cities and Regions: A Framework for Sustainable Transport and Urbanism in the 21st Century. Center for Future Urban Transport, Institute of Transportation Studies, University of California, Berkeley, 2005

4. Mehrdad Ehsani, Fei-Yue Wang and Gary L. Brosch (Eds.) Transportation technologies for sustainability, 2013.

5. Preston L. Schiller, Eric C. Brunn and Jeffrey R. Kenworthy. An Introduction to Sustainable Transportation: Policy, Planning and Implementation, 2010.

6. Rodney Tolley, Editor, Sustainable Transport: Planning for walking and cycling in urban environments; CRC Press, 2003.

7. Tolley, R., Sustainable Transport: Planning for Walking and Cycling in Urban Environments, CRC Press, 2003

COURSE PLAN

COURSE CODE	COURSE NAME	L-T-P (C)	
08CE7211	**SUSTAINABLE TRANSPORTATION**	**3-0-0 (3)**	
Modules	**Content**	**Contact Hours**	**Semester Exam Marks (%)**
I	**Problem of Sustainability in Transport:** Energy use in transport sector; Transport and climate change; Greenhouse gas emissions, urban air quality, Congestion and sustainability	**6**	**15**
II	**Pricing Transportation:** Full cost of transportation, pricing and taxation	**6**	**15**
FIRST INTERNAL EXAM			
III	**Planning for Sustainability:** Urban form, Indicator based planning, landuse transportation integration	**6**	**15**
IV	**Sustainable Policies:** Continuum of Policies, speed and speed limit policies, national policies, sustainable travel demand management; public awareness	**8**	**15**
SECOND INTERNAL EXAM			
V	**Sustainable Technology:** Telecommuting, Information and Communication technologies, E-commerce, Alternative Cleaner Fuels, vehicle technologies, fuel cells, Intelligent Transport Systems	**8**	**20**
VI	**Nationally Appropriate Mitigation Actions:** Mobility Management policies, Supporting Bicycling, Creating pedestrian friendly facilities, encouraging Public Transportation	**8**	**20**
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P (C)	2017
08CE7213	**TRANSPORTATION ECONOMICS**	3-0-0 (3)	

Course Objectives

To give the Student:-

1. The fundamental concepts and need for economics in transportation.
2. The ability to conduct economic analysis for different projects in transportation field.
3. Knowledge to apply the principles of economic theory in transportation planning process.

Syllabus

Fundamental concepts and overview of economic evaluation; Benefits due to Transport Improvements; Transport Costs, Accounting prices of goods and services; Economic Analysis: The generation and screening of project ideas; Application of economic theory in traffic assignment problem.

Course Outcome

The student will able to conduct economic analysis of transportation infrastructure projects.

References

1. David A. Hensher, Ann M. Brewer, "Transport: An Economics and Management Perspective", Oxford University Press, 2001.
2. Emile Quinet, Roger Vickerman, "Principles Of Transport Economics", Edward Elgar Publishing, 2005.
3. Road User Cost Study, Central Road Research Institute, 1983
4. Ian G. Heggie, Transportation Engineering Economics, McGraw Hill, 1972.
5. IRC:SP:30-1993, Manual on Economic Evaluation of Highway Projects in India
6. Kadiyali L.R., "Principles & Practice of Highway Engineering", Khanna Publishers,2005
7. Khanna S.K., Justo C.E.G., "Highway Engineering", Nem Chand & Bros., Roorkee, 2001
8. Woods, K.B., Berry, D.S. and Goetz, W.H., `Highway Engineering', McGraw Hill Book Co.
9. Winfrey R, Highway Economic Analysis, International Textbook Company.

COURSE PLAN

COURSE CODE	COURSE NAME	L-T-P (C)	
08CE7213	**TRANSPORTATION ECONOMICS**	**3-0-0 (3)**	
Modules	**Content**	**Contact Hours**	**Semester Exam Marks (%)**
I	**Introduction**- Significance of transport, Demand and supply of transport, Elasticity of demand and supply concepts and principles of highway engineering economy. Costs and Benefits Identification and measurements of transportation costs and benefits, Capital cost, Inflation cost Interest during construction, Maintenance cost, Road user costs, Fixed and operating costs.	**8**	**15**
II	**Benefits due to transport improvements**: Direct benefits- Reduced vehicle operation cost, value of travel time savings, value of increased comfort and convenience, cost of accident reduction, reduction in maintenance cost. Negative impacts due to increased noise and air pollution, Indirect benefits: increased land value, increased development and demand.	**6**	**15**
FIRST INTERNAL EXAM			
III	**Transportation costs**: fixed and variable cost, cost of improvement, maintenance cost and other related cost, cost estimation methods, accounting for inflation, theory of transport supply and road planning.	**8**	**15**
IV	Accident cost, Methodology for monetary evaluation of passenger's travel time, Value of increased comfort and convenience, Congestion cost and pricing, Consumer's surplus and social surplus criteria, Fare policy for bus transit.	**6**	**15**
SECOND INTERNAL EXAM			
V	**Economic analysis** – the generation and screening of project ideas. Different methods of economic analysis – capital budgeting. Case studies.	**6**	**20**
VI	**Application of economic theory in traffic assignment problem** – user optimal assignment and system optimal assignment. Economic analysis of projects – financing of road projects, methods of financing – PPP, toll collection. Economic variability of Build-Operate-Transfer schemes – Risk analysis.	**8**	**20**
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P (C)	2017
08CE7215	**TRANSPORTATION SYSTEM MANAGEMENT**	3-0-0 (3)	

Course Objectives

To give the Student:-

1. An understanding of different methods of data collection for transportation system management.
2. Knowledge to analyse traffic problems and plan transportation system management actions.
3. Fundamentals of management systems for parking and non-motorised transport

Syllabus

Fundamental concepts of Methodology & Data Collection; Area wide data collection methodology, corridor data collection methodology; TSM Actions; Public transportation & HOV treatment; Priority at ramp terminals; Demand management, Traffic Operations Improvement; Parking Management

Course Outcome

1. Understand TSM, the need for TSM and the objectives of TSM.
2. Apply a strategy based on a TSM goal or objective.
3. Recommend methods to manage a transit system to improve its management efficiency.
4. Recommend a detailed transportation demand management strategy for a transportation system based on a goal or objective.

References

1. D. Arlington, Transportation System Management in 1980: State of the Art and Future Directions, Transportation Research Board, 1980.
2. Manheim M, “Fundamentals of Transportation system approach”, MIT press, Cambridge, MA, 1985.
3. Institute of Transportation Engineers, Transportation and Traffic Engg. Hand Book, Prentice Hall, 1982
4. John G Schoon, “Transportation system and service policy”, Chapman and Hall, New York, 1996.
5. Meyer Michael D and Eric J Miller, “Urban Transportation Planning – A Decision Oriented Approach”, Mc Graw Hill, New York, 2001.
6. Michael D. Meyer, Transportation Planning Handbook: Institute of Transportation Engineers, John Wiley & Sons, 2016.
7. Piyushimita (Vonu) Thakuriah and D. Glenn Geers, Transportation and Information Trends in Technology and Policy, Springer New York, 2013.

COURSE PLAN

COURSE CODE	COURSE NAME	L-T-P (C)	
08CE7215	**TRANSPORTATION SYSTEM MANAGEMENT**	**3-0-0 (3)**	
Modules	**Content**	**Contact Hours**	**Semester Exam Marks (%)**
I	**Methodology & Data Collection:** Methodological frame work, objectives and problems, conflicts resolution, strategic categories and action elements. **Impact of TSM**: Travel behaviour impact and response time, TSM actions combinations and interactions, impact assessment and evaluation, monitoring and surveillance	**6**	**15**
II	**Area wide data collection** methodology, corridor data collection methodology. **TSM Actions**: Study of following TSM actions with respect to problems addressed, conditions for applications, potential implementation problems, evaluation & impact analysis	**8**	**15**
FIRST INTERNAL EXAM			
III	**Public transportation & HOV treatment** - Toll discounts for car pools during peak periods, park and ride, car pooling, exclusive lanes. Priority at ramp terminals, bus transfer stations, limited and skip-stop bus services, shared ride.	**6**	**15**
IV	**Demand Management**: Staggered work hours, flexible work hours, high peak period tolls, shuttle services, circulation services, extended routes	**6**	**15**
SECOND INTERNAL EXAM			
V	**Traffic Operations Improvement**: On-street parking ban, freeway ramp control & closure, travel on shoulders, one-way streets, reversible lanes, Traffic calming, Right turn phase, right turn lanes, reroute turning traffic.	**8**	**20**
VI	**Parking Management**: Short term reserved parking, increased parking rates, time duration limits, expanded off-street parking, Non Motorized Transport- pedestrian only streets, Dial a ride for elderly & handicapped.	**8**	**20**
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P (C)	2017
08CE7217	**RAILWAY INFRASTRUCTURE PLANNING AND DESIGN**	3-0-0 (3)	

Course Objectives

To give the Student:-

1. Understanding of railway track, its components and purpose.
2. Understanding of planning and design of ordinary and high speed rail way tracks.
3. Awareness of rolling stock and measures to avoid rail accidents

Syllabus

Alignment of railway track, Permanent way, track maintenance and rehabilitation, Railway accidents, Rolling stock, Railway stations and yards, Signaling and interlocking, design of tracks for high speed.

Course Outcome

1. Ability to align and design a new track and associated facilities
2. Ability to plan, design and analyze the railway track system and signal system with the available methods.
3. Maintain the railway track and apply remedial measures.

References

1. Agarwal, M.M. Indian Railway Track, 19th edition, Prabha & Co., New Delhi, India, 2017.
2. Chandra S. and M.M. Agarwal Railway Engineering, Oxford University Press, New Delhi, India, 2007.
3. Gupta, B.L and B.L.Gupta. Railway Engineering, Standard Publishers, New Delhi, India, 2005.
4. Rangwala, S.C. Principles of Railway Engineering, Charotar Publishing House, Anand, India, 2014.
5. S.C. Saxena and S.P. Arora, A text book of Railway engineering, Dhanpat Rai, 2011.
6. Satish Chandra and M. Agrawal, Railway Engineering, Second Edition, Oxford University Press, 2013.
7. J. S Mundrey, Railway Track Engineering, Mc Graw Hill, 2009.

COURSE PLAN

COURSE CODE	COURSE NAME	L-T-P (C)	
08CE7217	**RAILWAY INFRASTRUCTURE PLANNING AND DESIGN**	**3-0-0 (3)**	
Modules	**Content**	**Contact Hours**	**Semester Exam Marks (%)**
I	**Alignment of Railway Lines:** Modes of transportation, developments in railways, classification of railway lines, rail transportation in India, railway track gauges, choice of gauge, uni-gauge policy, ideal alignment, need for construction of new railway lines, traffic survey, reconnaissance survey, preliminary surveys, and engineering surveys, geometric design, gradients, grade compensation, speeds of trains, curves and superelevation, extra clearance on curves, widening of gauge on curves, cutting rails on curves.	**6**	**15**
II	**Permanent Way:** Requirements, capacity, cross-sections, forces acting on the track, coning of wheels, tilting of rails, function of rails, types of rails, rail wear, defects in rails, creep of rails, rail fixtures and fastenings, ballast, functions, types, sizes, physical properties, subgrade and formation, slopes of formation, switches, tongue rails, crossing, angle of crossing, turnouts, inspection and maintenance, track junctions and track layouts, symmetrical split, three-throw switch, double turnout, diamond crossing, scissors crossover, gauntleted track, gathering line, triangle, double junctions.	**6**	**15**
FIRST INTERNAL EXAM			
III	**Track maintenance and Rehabilitation:** Maintenance tools, maintenance of rail surface, track drainage, maintenance in track circuited lengths, track tolerances, mechanized method of track maintenance, off-track tampers, shovel packing, directed track maintenance, classification of renewal works, through sleeper renewals, mechanized relaying, track renewal trains.	**6**	**15**
IV	**Railway accidents:** Train accidents, derailments and its causes, restoration of traffic, safety measures, disaster management, classification of level crossings, accidents at level crossings, remedial measures, and maintenance of level crossings. **Rolling Stock:** Types of traction, locomotives and other	**8**	**15**

	rolling stock, brake systems, resistance due to friction, wave action, wind, gradient, curvature, starting, Tractive effort of a locomotive, hauling power of a locomotive.		
SECOND INTERNAL EXAM			
V	**Railway stations and yards:** Purpose, site selection, facilities, requirements, classification, platforms, building areas, types of yards, catch sidings, ship sidings, foot over bridges, subways, cranes, weigh bridge, loading gauge, end loading ramps, locomotive sheds, ash-pits, water columns, turntable, triangles, traverse, carriage washing platforms, buffer stop, scotch block, derailing switch, sand hump, fouling mark.	**8**	**20**
VI	**Signaling and interlocking:** Objectives, classification, fixed signals, stop signals, signaling systems, mechanical signaling system, electrical signaling system, systems for controlling train movement, interlocking, modern signaling installations. **Design of tracks for high speeds:** Modernization of railways, effect of high speed track, vehicle performance on track, high speed ground transportation system, ballastless track, elevated railways, underground and tube railways.	**8**	**20**
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P (C)	2017
08CE7219	**LOW VOLUME ROADS**	3-0-0 (3)	

Course Objectives

To give the student

1. The concept of rural road network planning
2. Ability to do the geometric design of rural roads keeping the standards.
3. Ability to do the structural design of rural road pavements
4. Knowledge regarding different materials that can be used in the pavement construction

Syllabus

Planning of low volume roads – geometric design – materials and use of waste materials for road construction – design of pavements – road construction – quality control in construction and maintenance.

Course Outcome

Students will be able to

1. Plan the rural road network.
2. Determine the sight distance, horizontal curvature, super elevation, grades, visibility on vertical curves, cross section elements.
3. Justify the geometric design standards adopted for low volume roads.
4. Plan surveys, and prepare survey forms.
5. Design both flexible and rigid pavements for low volume roads.

References

1. Veeraragavan, S.K Khanna and C.E.G. Justo, Highway Engineering, Nem Chand & Brothers, 2014.
2. Bruton, M. J., Introduction to Transportation Planning, UCL press, London, UK, 1992.
3. Robert A. Douglas, Low-Volume Road Engineering: Design, Construction, and Maintenance, CRC Press, 2017.
4. Ethiopian Roads Authority, Design Manual for Low Volume Roads, Parts A-G: http://www.icafrica.org/knowledge-publications/article/design-manual-for-low-volume-roads-parts-a-g-116/
5. Gordon Keller & James Sherar, Low-Volume Roads Engineering: Best Management Practices – Field Guide, USDA Forest Service/USAID, 2003.
6. IRC manual for rural roads. Special publication – 20(2002)
7. HMSO, Soil Mechanics for rural Engineers in, London
8. IRC related code books
9. NRRDA – guidelines and code books

COURSE PLAN

COURSE CODE	COURSE NAME	L-T-P (C)	
08CE7219	**LOW VOLUME ROADS**	**3-0-0 (3)**	
Modules	**Content**	**Contact Hours**	**Semester Exam Marks (%)**
I	**Planning of Low volume roads**: Introduction to planning of low volume roads, concepts of network planning, selection of roadway alignment, factors affecting rout selection, engineering surveys for new road location.	**6**	**15**
II	**Geometric design parameters**: basic principles of geometric design, design of horizontal alignment, curves, super elevation, design of vertical alignment, summit curve, and valley curve standard of design of low volume road.	**8**	**15**
FIRST INTERNAL EXAM			
III	**Materials:** Road materials for pavement construction, soil-subgrade, road aggregate, binder, test on soil, test on aggregates and test on bitumen, bituminous mix design, marshal stability method for mix design. **Waste material for pavement construction**: introduction, fly ash for road construction, design & construction, design &construction of fly ash embankment lime fly ash and stabilized soil, lime fly ash pavements, control of compaction, concrete stabilized fly ash with admixtures.	**6**	**15**
IV	**Design of pavement:** Factors affecting pavement design function of pavement components- Empirical and mechanistic empirical design procedures - design of flexible pavement by CBR method, Burmister layer and IRC method (IRC37-2012). Design of rigid pavement by using IRC method.	**6**	**15**
SECOND INTERNAL EXAM			
V	**Road construction:** Specifications of material and construction of sub grade, subbase, base and surface layer, construction of non bituminous road, construction of bituminous roads, equipment required for construction, maintenance of low volume roads.	**8**	**20**
VI	**Quality Control in Construction and Maintenance**: Introduction, Pre-requirements, organizational setup, specification and code of practice, Laboratory equipment, Earth and granular layers, bituminous courses, semi- rigid and rigid pavements, special requirements, recovered of quality control data. Distresses/Defects in rigid and flexible	**8**	**20**

	pavements, Maintenance and evaluation, inventory roads and inspections, types of Maintenance Activities, Maintenance		
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P (C)	2017
08CE7291	**SEMINAR – II**	0-0-2 (2)	

Course Objectives

To enable the students:

1. To Identify the current topics in the specific stream.
2. To Collect the recent publications related to the identified topics.
3. To Do a detailed study of a selected topic based on current journals, published papers and books.
4. To Present a seminar on the selected topic on which a detailed study has been done.
5. To Improve the writing and presentation skills

Approach

Students shall make a presentation for 20-25 minutes based on the detailed study of the topic and submit a report based on the study.

Course Outcome

Upon successful completion of this course, students will be able to

1. Get good exposure in the current topics in the specific stream.
2. Improve the writing and presentation skills.
3. Explore domains of interest so as to pursue the course project.

COURSE CODE	COURSE NAME	L-T-P (C)	2017
08CE7293	**PROJECT (PHASE I)**	0-0-12 (0)	

Course Objectives

To enable the students:

1. To do an original and independent study on the area of specialization.
2. To explore in depth a subject of his/her own choice.
3. To start the preliminary background studies towards the project by conducting literature survey in the relevant field.
4. To broadly identify the area of the project work, familiarize with the tools required for the design and analysis of the project.
5. To plan the experimental platform, if any, required for project work.

Approach

The project work can be a design project/experimental project and/or computer simulation project on any of the topic related to the stream of specialization. The project work is chosen individually on different topics. Work of each student shall be supervised by one or more faculty members of the department.

Phase I of the project is to be done in the Third semester and is continued in Fourth semester. Phase I includes identification of the topic, literature review, preliminary report and scope of the work which is to be completed in the 4th semester. Conference/Publication and MOOC courses will be considered among the criteria for the final evaluation.

Course Outcome

Upon successful completion of this course, students will be able to

1. Get good exposure in the current topics in the specific stream.
2. Improve the writing and presentation skills.
3. Explore domains of interest so as to pursue the course project.