

**SCHOOL OF ENGINEERING**

**SYLLABUS AND COURSE STRUCTURE**

**M. TECH (TRANSPORTATION ENGINEERING)**

**ACADEMIC YEAR 2020-21**

**M.Tech. (Transportation Engineering)**

**Code & Subject Scheme**

**Semester I**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Code** | **Subject** | **Contact Hours/week** | | | **Total Credits** |  |
| **L** | **T** | **P** |
| MCI042A | Statistical Methods in Transportation  Engineering | 4 | 0 | 0 | 4 | C |
| MCI043A | Highway Materials | 4 | 0 | 0 | 4 | C |
| MCI044A | Traffic Engineering | 4 | 0 | 0 | 4 | C |
| MCI045A | Modelling and Simulation in Transportation | 4 | 0 | 0 | 4 | C |
| MCI046A | Highway Material Testing Laboratory | 0 | 0 | 2 | 2 | C |
| MCI047A | Computer Aided Traffic Engineering Lab | 0 | 0 | 2 | 2 | C |
| MCI007A | Seminar | 0 | 0 | 2 | 2 | C |
|  | **Total** | **16** | **0** | **6** | **22** |  |
|  |  |  |  |  |  |  |

**Semester II**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Code** | **Subject** | **Contact Hours/week** | | | **Total Credits** |  |
| **L** | **T** | **P** |
| MCI048A | Urban Mass Transportation System | 4 | 0 | 0 | 4 | F |
| MCI049A | Transportation Planning | 4 | 0 | 0 | 4 | C |
| MCI050A | Pavement Analysis, Design and  Construction | 4 | 0 | 0 | 4 | C |
| MCI051A | Transportation-Environment Interaction and Analysis | 4 | 0 | 0 | 4 | C |
| MCI052A | Transportation Planning Studio | 0 | 0 | 4 | 4 | C |
| MCI013A | Seminar | 0 | 0 | 2 | 2 | C |
|  | **Total** | **15** | **0** | **7** | **22** |  |

**Semester III**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Code** | **Subject** | **Contact Hours/week** | | | **Total Credits** |  |
| **L** | **T** | **P** |
| MCI053A | Pavement Maintenance and  Management System | 4 | 0 | 0 | 4 | C |
| MCI054A | Transportation System Analysis | 4 | 0 | 0 | 4 | C |
|  | Elective-I | 4 | 0 | 0 | 4 | S |
|  | Elective-II | 4 | 0 | 0 | 4 | S |
| MCI016A | Dissertation Part – I | 0 | 0 | 12 | 12 | C |
|  | **Total** | **16** | **0** | **12** | **28** |  |

|  |  |  |  |
| --- | --- | --- | --- |
| **Elective Subjects (one from each group)** | | | |
| **Elective I** | | **Elective II** | |
| MCI055A | Railway Infrastructure, Planning and Design | MCI058A | GIS Application in Transportation Engineering |
| MCI056A | Construction Project Management & BOT System | MCI059A | Airport Infrastructure, Planning and Design |
| MCI057A | Transport Economics and Finance | MCI060A | Intelligent Transportation Systems |

**Semester IV**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Code** | **Subject** | **Contact Hours/week** | | | **Total Credits** |  |
| **L** | **T** | **P** |
| MCI023A | Dissertation Part – II | 0 | 0 | 28 | 28 | C |
|  | **Total** | **0** | **0** | **28** | **28** |  |

**SEMESTER-I**

|  |  |  |
| --- | --- | --- |
| **L-T-P** | **MCI042A-Statistical Methods in Transportation Engineering** | **Credits: 4** |
| **4-0-0** |

**Objective:**

**STATISTICAL METHODS IN TRANSPORTATION ENGINEERING**

**Unit 1:**

**Probability distributions:** Introduction to probability and random variables, Binomial distribution, Poisson distribution, Geometric distribution, Hyper Geometric distribution, Normal distribution, Log-Normal distribution, Uniform distribution, Exponential distribution, Gamma distribution, Beta distribution, and Weibull distribution.

**Unit 2:**

**Parameter Estimation and hypothesis Testing:** Random samples, sampling distributions of mean and variance. Point estimators, the method of maximum likelihood, and the method of moments. Confidence interval, Statistical hypothesis tests, Operations characteristic curve. Tests of hypothesis on the mean of a Normal Distribution, Tests of hypothesis on the means of two, Normal distributions, The paired t-test, Tests of hypothesis on one variance, Tests of hypothesis for the equality of two variances, The testing of goodness of fit.

**Unit 3:**

**Design and Analysis of Experiments**: Fundamental assumptions of analysis of variance, single factor experiments, Latin square and Greco-Latin square designs, Design of experiments with several factors- Two factor factorial experiments.

**Unit 4:**

**Regression and Correlation Analysis:** Introduction, Bi-Variate Normal distribution and the associated marginal and conditional distributions, estimation and analysis of simple regression models, correlation coefficients, analysis of correlation coefficients.

**Unit 5:**

**Hypothesis tests associated with regression and correlation coefficients**, curvilinear regression models, Multiple regression models, multiple and partial correlation coefficients.

Applications should be taken from transportation planning and traffic engineering.

**Outcome:**

***Text Book:***

1. Hines, W. W. and Montgomery, D. C., et. al. *Probability and Statistics in Engineering and Management Science.* New York: John Wiley and Sons, 1990.

2. Freund, J. E. *Mathematical Statistics*. New Delhi: PHI, 1998.

***Reference book:***

1. Montgomery, D. C. *Design and Analysis of Experiments.*New York: John Wiley and Sons,2007.
2. Johnston, J. and Dionard, J.*Econometric Methods.* McGraw-Hill International, 1997.

|  |  |  |
| --- | --- | --- |
| **L-T-P** | **MCI043A-Highway Materials** | **Credits: 4** |
| **4-0-0** |

**OBJECTIVES**

**HIGHWAY MATERIALS**

**Unit 1:**

**Aggregates:** Classification, physical and strength characteristics, Proportioning of aggregates, Aggregate texture and skid resistance, polishing of aggregates.

**Unit 2:**

**Soil:** Classification, Structural and Constructional problems in soil subgrade, Identification and strength tests, Soil-moisture movement, Sub-soil drainage, Soil stabilization, Characteristics and use of Fly Ash, Bottom ash and Pond Ash.

**Unit 3:**

**Bitumen:** Bitumen sources and manufacturing, Bitumen constituents, structure and Rheology, Mechanical and engineering properties of bitumen, Tests on bitumen, Emulsions, Tar – Properties, types, modifications, Durability of bitumen, Adhesion of bitumen, Modified bitumen.

**Unit 4:**

**Bituminous Mixes:** Desirable properties of mixes, Design of bituminous mixes, Tests on bituminous mixes, Fillers, Theory of fillers and specifications. Marshall, Hubbard Field &Hveam Methods.

**Unit 5:**

**Cement Concrete:** Constituents and their requirements, Physical, plastic and structural properties of concrete, Factors influencing mix design, Design of concrete mixes for DLC and PQC with appropriate admixtures like fly-ash and high range water reducing admixtures etc.

**Outcomes:**

***Text Book***

1. Krebs, Robert D., Walker, R. D.*Highway Materials.*New York: McGraw HillBook Co., 1971.

2. Majesty’s Stationery Office. *Soil Mechanics for Road Engineers.*Ministry of Transport, Road Research Laboratory UK,1966.

***Reference Book***

1. Majesty’s Stationery Office. *Concrete Roads Design and Construction.* Ministry of Transport, Road Research Laboratory UK,1966.

2. Read, J.,Whiteoak, D. *The Shell Bitumen Handbook.* London:Thomas Telford Publishing, 2003.

3. Relevant IRC and IS codes

|  |  |  |
| --- | --- | --- |
| **L-T-P** | **MCI044A-TRAFFIC ENGINEERING** | **Credits: 4** |
| **4-0-0** |

**Objectives**

**TRAFFIC ENGINEERING**

**Unit 1:**

**Scope of Traffic Engineering & Study of its elements**: Introduction, Objectives and Scope of Traffic Engineering; Components of Road Traffic – Vehicle, Driver and Road; Road User and Vehicle Characteristics and their effect on Road Traffic; Traffic Manoeuvers.

**Unit 2:**

Traffic Stream Characteristics- Relationship between Speed, Flow and Density.

**Unit 3:**

**Traffic Engineering Studies and Analysis**: Sampling in Traffic Studies, Adequacy of Sample Size; Objectives, Methods of Study, Equipment, Data Collection, Analysis and Interpretation (including Case Studies) of (a) Speed (b) Speed and Delay (c) Volume (d) Origin and Destination (e) Parking (f) Accidents.

**Unit 4:**

**Design of Traffic Engineering Facilities**: Control of Traffic Movements through Time Sharing and Space Sharing Concepts; Design of Channelizing Islands, T, Y, Skewed, Staggered, Roundabout, Mini-roundabout and other forms of AT-Grade Crossings including provision for safe crossing of Pedestrians and Cyclists; Grade Separated Intersections, their Warrants and Design Features; Bus Stop Location and Bus Bay Design, Design of Road Lighting

**Unit 5:**

**Traffic Control Devices:** Traffic Signs, Markings and Signals; Principles of Signal Design, Webster's method of Signal Design, Redesign of Existing Signals including Case Studies; Signal System and Coordination.

**Outcomes**

***Text Book:***

1. Pignataro, L. *Traffic Engineering – Theory & Practice*. Wiley Publication, 1973.

2. Kadiyali, L.R. *Traffic Engineering and Transport Planning.* Khanna publishers, 2007.

***References:***

1. McShane W R, Roess R P.*Traffic Engineering, Prentice-Hall*. 2010.

2. IRC-SP41: *Guidelines for the Design of At-Grade Intersections in Rural & Urban Areas.*

|  |  |  |
| --- | --- | --- |
| **L-T-P** | **MCI045A-Modelling and Simulation in Transportation** | **Credits: 4** |
| **4-0-0** |

**Objective:**

**Modelling and Simulation in Transportation**

**Unit 1:**

**Introduction:** Transportation simulation & modeling, decision making, issues in transport modeling, structure of transport models

**Unit 2:**

**Multivariate Data Analysis Techniques:** Types of Data, Basic Vectors and Matrices, Sample Estimate of Centroid, Standard Deviation, Dispersion, Variance and Covariance, Correlation Matrices, Principal Component, Factor Analysis, Manova and Cross Classification Procedure in Multivariate Data Analysis and Application to Problems in Traffic and Transportation Planning, Best fit analysis, Distribution analysis.

**Unit 3**

**Simulation & Data and Spacing:** Elements and attributes, Random number generation, Pseudo random number generation, Cycle repeatability, Feedback & evaluation, Evaluation of system performance, Marginal & corridor simulation, Gaming simulation. Sampling theory, Errors in modeling and forecasting, Data collection methods, Network and zoning system

**Unit 4:**

**Discrete Choice Models & Simplified Transport Models:** Theoretical framework, specification and functional form of models, statistical estimation and validation of models, binary choice, multinomial and nested logitmodels, modeling with stated preference data, model aggregation, updating and transferability**,** Sketch planning method, Model estimation from traffic count.

**Unit 5:**

**Time Series Analysis:** Basic Components of Time Series – Stationary and Non-Stationary Process – Smoothing and Decomposition Methods – Correlation and Line Spectral Diagrams –Auto Correlations and Moving Averages.

Study of large scale simulation models such as VIT, Transyt, Sigop etc.

**Outcomes:**

***Text Book:***

1. Ortuzar de D.O., Willumsen, L.G.*Modelling Transport.* Wiley &Sons,1993.

2 Banks, J., Carson, J.S. and Nelson, B.L. *Discrete Event SystemSimulation.* Prentice-Hall of India.

***Reference Book*:**

1. Hutchinson, B.G.*Principles of Urban Transport Systems Planning.*SCRIPTA Book Company, 1974.

|  |  |  |
| --- | --- | --- |
| **L-T-P** | **MCI046A-Highway Material Testing Lab** | **Credits: 2** |
| **0-0-2** |

**List of Experiments:**

1. Identification tests on soils; Heavy compaction test on subgrade soil.

2. Triaxle test on pure subgrade soil.

3. California Bearing Ratio test.

4. Tests on aggregates – Determination of Deleterious substance as per IS code.

5. Aggregate polishing and skid resistance test (demonstration); GSB mix design.

6. Test for aggregate durability; Preparation of mix for BC/DBC/ SDBC.

7. Tests on fly-ash, Pond-Ash and bottom-ash- gradation and other engineering properties.

required for use as embankment material.

8. Tests on Bitumen – Penetration Test and Ductility test.

9. Tests on Bitumen – Softening point test and Thin Film Oven test.

10. Elastic recovery/recovery test on binder.

11. Marshall Bituminous Mix design, Bitumen viscosity test (Rotational viscometer);

Retained stability test.

12. Benkelman Beam test on road.

13. Concrete Mix design – Sample preparations for DLC and PQC with proper ingredients and

admixtures for economy.

14. Concrete Mix design – Testing of samples and statistical inferences.

|  |  |  |
| --- | --- | --- |
| **L-T-P** | **MCI047A-Computer Aided Traffic Engineering Lab** | **Credits: 2** |
| **0-0-2** |

**List of Experiments:**

1. Traffic volume data collection at midblock section in urban area and its analysis

2. Traffic volume data collection at rural highway section and its analysis

3. Categorized vehicle speed data collection at urban and rural sections and its analysis

4. Deriving flow relationships between flow characteristics based on volume and speed data collected

5. Speed and delay study using Moving observed method

6. Volume study at a roundabout to examine its capacity

7. Volume and speed study at a four legged intersection

8. Parking study in a market or commercial area (accumulation and duration analysis)

9. Analysis of accident data procured from police stations

10. Demonstration and hands-on training with transportation software for design of flexible as well as rigid

pavements.

11. Road Safety Audit of a rural section of a highway

|  |  |  |
| --- | --- | --- |
| **L-T-P** | **MCI007A- Seminar** | **Credits: 2** |
| **0-0-2** |

**SEMESTER-II**

|  |  |  |
| --- | --- | --- |
| **L-T-P** | **MCI048A-Urban Mass Transportation System** | **Credits: 3** |
| **3-0-0** |

**Objectives:**

**Urban Mass Transportation System**

**Unit 1:**

**Introduction**: Mass transit systems, Elements / components of transit systems; Urban MassTransit systems- types, characteristics, suitability and adaptability of these systems; Evolution ofurban transportation.

**Unit 2:**

**Transit System Planning**: Planning needs; Short-range and long-range planning; Planningprocedures and methodology, Data collection; Medium performance transit systems and high performance transit systems; trends in transit planning.

**Unit 3:**

**Transit Demand Estimation and Evaluation:** Transit demand forecasting; transit modeevaluation; comparison and selection of most suitable transit mode.

**Transit System Operations:** Basic operational elements; transit travel characteristics; transitscheduling; transit line analysis – planning objectives, geometry, types and their characteristics, capacity of transit lines, system procedures for improving transit line capacity.

**Unit 4:**

**Transit Networks and System Analysis:** Transit networks – types and their characteristics;transfers in transit networks; system analysis in transit – conceptual models, modelingprocedures; terminal or station location planning – issues, objectives, station spacing decisions.

**Unit 5:**

**Economics and Financing of Transit Systems:** Transit system performance and economicmeasures; transit fares – structure, collection and levels; financing of transit services; public andprivate integration of transit services

**Case studies of urban mass transportation systems adopted in India in recent yearsincluding Delhi Metro, Jaipur Metro, metro bus service, mono rail etc.**

**Outcomes:**

***Text Books:***

1 Vukan R.*Urban Transit – Operations, Planning and Economics.*USA:Willey and Sons, Inc., 2004.

2 John W. D. *Metropolitan Transportation Planning.* Tata McGraw-Hill Book Company Ltd., 1980.

***Reference Books:***

1.Khisty C. J.,Lall B. *Transportation Engineering.* New Delhi: Prentice- Hall of India Pvt Ltd, 2003.

|  |  |  |
| --- | --- | --- |
| **L-T-P** | **MCI049A-Transportation Planning** | **Credits: 4** |
| **4-0-0** |

**Objective:**

**Transportation Planning**

**Unit 1:**

**Introduction to transportation planning:** Fields of transportation Engineering; System-Environment Ensemble; Transportation planning process; Transportation problems and problemsolving process.

**Unit 2:**

**Transportation data and survey methods:** Type of Transportation data and its sources, Dataquantity and quality, Accuracy and Precision, Sampling techniques, sample sizes, TransportationPlanning surveys – Documentation searches, Person surveys, Household surveys, In-transitsurveys, Road-side surveys, etc.

**Unit 3:**

**Transportation Modes and Technologies**: Technologies of Transport and System Components,Network Analysis; Minimum Path Algorithms, Path Characteristics, Path-Vehicle Interaction –Discrete Flows and Continuous Flows, Vehicle and its Performance, System Performance,Vehicle and Container, Weight to Volume relation, Terminal Planning, Operational Planning.

**Unit 4:**

**Four-stage Sequential Planning:** Urban transportation planning process; trip generation,correlation analysis and regression analysis; trip distribution, Growth factor methods andSynthetic methods; modal split models, first generation, second generation, behavioral models;minimum travel path computations; Trip assignments, route assignment, multiple assignment andnetwork assignment.

**Unit 5:**

**Land use–Transportation Planning:** Urban Forms, mobility and activity hierarchy;accessibility-based early-era models; Lowery’s model and its derivatives; Modern era models.

**Outcome:**

***Textbooks:***

1.Hutchinson B. G. *Principles of Urban Transport Systems Planning.*Scripta Book Co.,1974.

2. Anthony J. R., Elizabeth S. A., Arnim H. M. *Survey Methods for Transport Planning.* Australia:Eucalyptus Press,1995.

***References:***

1. Roy T.*Traffic Assignment Techniques.* Avebury Technical. England, 1991.

|  |  |  |
| --- | --- | --- |
| **L-T-P** | **MCI050A-Pavement Analysis, Design and Construction** | **Credits: 4** |
| **4-0-0** |

**Objective:**

**Pavement Analysis, Design and Construction**

**Unit 1:**

**Introduction:** Components of pavement structure, importance of sub-grade soil properties onpavement performance. Functions of sub-grade, sub-base, base course and wearing course.

**Unit 2:**

**Stresses in Flexible Pavements:** Stresses in homogeneous masses and layered systems, deflections, shear failures, equivalent wheel and axle loads.

**Unit 3:**

**Elements in Design of Flexible Pavements:** Loading characteristics-static, impact and repeated loads, effects of dual wheels and tandem axles, area of contact and tyre pressure, modulus orCBR value of different layers, equivalent single wheel load, equivalent stress and equivalentdeflection criterion, equivalent wheel load factors, climatic and environmental factors.

**Unit 4:**

**Design Methods for Flexible Pavements:** California bearing ratio (CBR) , U.S. Navy method.Triaxial method, Mcleod method, Boussinesq’s and Burmister’s analysis and design method,IRC method for Flexible Pavement Design.

**Rigid Pavements:** Wheel load stresses, Westergaard’s analysis, Bradbury’s approach Arlingtontest, Pickett’s corner load theory and charts for liquid, elastic and soil of finite and infinite depthsof subgrade. IRC Method of rigid pavement design.

**Temperature Stresses:** Westergaard’s and Thomlinson’s analysis of warping stresses,Combination of stresses due to different causes, Effect of temperature variation on RigidPavements.

**Unit 5:**

**Reinforced Concrete Slabs: P**re-stressed concrete slabs-general details. Design of Tie Bars andDowel Bars.

**Road Construction:** Bituminous road construction procedures and specifications, Qualitycontrol requirements. Concrete Road construction: Construction methods, Quality controlrequirements, Joints in cement concrete pavements, reinforced cement concrete roadconstruction. IRC & MORTH recommendations for construction of Bituminous and Concreteroads. Present practices being followed for quality assurance and speedy construction in thecountry like by NHAI.

**Pavement analysis, design and construction without joints and in integral bridges, casestudies of such construction adopted in the country including that in Delhi Metro.**

***Text Book:***

1. Yoder E.J. *Principles of Pavement Design.* John Wiley&Sons, Inc.1975.

2. Khanna, S.K., Justo, C.E.G. *Highway Engineering.*Nem Chand Jain & Bros, 2005.

|  |  |  |
| --- | --- | --- |
| **L-T-P** | **MCI051A-Transportation-Environment Interaction and Analysis** | **Credits: 4** |
| **4-0-0** |

**Objective:**

**Transportation-Environment Interaction and Analysis**

**Unit 1:**

**Introduction:** Interaction of transportation systems and facilities with surrounding environment,Imapct of transportation on surrounding environment, impact of surrounding environment ontransportation systems.

**Unit 2:**

**Impact on Natural Environment:** Air quality impacts - sources of air pollutants, effects of airpollutants, key legislations and regulations, impact prediction approaches, identification andincorporation of mitigation measures; Noise Impacts - Basic information, key legislation andguidelines, impact prediction methods, identification and incorporation of mitigation measures,Noise barriers and their design; Ground water and marine pollution impacts; Environmentalcapacities of streets, Environmental Impact statements.

**Unit 3:**

**Impact on Land Use and Value:** Conceptual approach for addressing socio-economic impacts;Visual impacts and criteria, scoring methodologies for visual impact analysis; Relocationimpacts; Land value impacted due to transportation facility; Spatial reorganization and RegionalDevelopment impacts.

**Unit 4:**

**Environmental Impact Analysis:** Concepts of environmental impact analysis, key features ofNational environmental policy act and its implementation, screening in the EIA process, utilityand scope of EIA process, Environmental protection acts EIA at national level, Conceptualapproach for environmental impact studies, planning and management of impact studies, matrixand network methodologies for impact identification, description of the affected environmental –environmental indices; Public Participation – Objectives, and techniques for conflictmanagement and dispute resolution, verbal communication in EIA studies.

**Unit 5:**

**Energy Issues in Transportation:** Energy consumption, alternate transportation fuels, energyconservation, energy contingency strategies, energy analysis information and methods,Transportation alternatives.

**Outcome:**

***Text Book:***

1. Peter M. *Methods of Environmental Impact Assessment*, Routledge, 2001.

2. CANTER, L.W.*Environmental impact assessment*. McGraw-Hill Publication, 1997.

***References Book***

1. Denver T.*Highway Impact Assessment*, Greenwood Publishing Group, 1993.

4. Edward K M.*Introduction to transportation Engineering and Planning.* New Delhi: Mc-Graw Hill BookCompany, 2015.

|  |  |  |
| --- | --- | --- |
| **L-T-P** | **MCI052A-Transportation Planning Studio** | **Credits: 2** |
| **0-0-2** |

|  |  |  |
| --- | --- | --- |
| **L-T-P** | **MCI013A-Seminar** | **Credits: 2** |
| **0-0-2** |

**Semester III**

|  |  |  |
| --- | --- | --- |
| **L-T-P** | **MCI053A-Pavement Maintenance and Management System** | **Credits: 4** |
| **4-0-0** |

**Objectives:**

**Pavement Maintenance and Management System**

**Unit 1:**

**Pavement Evaluation and Performance:** General concept of pavement evaluation, evaluationof pavement performance, evaluation of pavement structural capacity, evaluation of pavementdistress, evaluation of pavement safety.

**Types of Distress:** Structural and functional, serviceability, fatigue cracking, pavementdeformation and behavior in flexible and rigid pavements. Low temperature shrinkagecracking., Factors affecting performance, relation between performance and distress.

**Unit 2:**

**Pavement Evaluation & Measuring Equipments:** Functional & Structural Evaluation,Functions Parameters such as Roughness, Distress, Rutting, Skid Resistance etc. StructuralParameters such as Structural Capacity. Benkelman Beam, Bump Integrators of various types,dynaflect. Demonstration of equipments for dynamic testing of pavements. Digital ultrasonicconcrete tester. Radiographic and infra-red testing. Pavement skid resistance measuringequipments, fatigue testing equipments, on-site and on- line testing with sensors, strain-gagesLVDTs and data acquisition system.

**Unit 3:**

**Pavement Overlays:** Flexible overlays and determination of overlay thickness. Rigid overlaysand determination of overlay thickness including thin toppings. Design of Overlay byBenkelman Beam and Falling Weight Reflectometer.

**Unit 4:**

**Design Alternatives – Analysis, Evaluation and Selection:** Framework for pavement design,design objectives and constraints, Basic structural response models, characterization of physicaldesign inputs, Generating alternative pavement design strategies. Economic evaluation ofalternative pavement design strategies, analysis of alternative design strategies. Predictingdistress, predicting performance, selection of optimal design strategies.

**Unit 5:**

**Pavement Management System:** Introduction to Pavement Management System (PMS) &Maintenance Management System (MMS), construction, maintenance and rehabilitation.Feedback data system. Examples of Working Design and Management Systems. Implementationof a pavement management system.

**Outcome:**

***Text book:***

1. Hass, R., Hudson, W.R. *Modern Pavement Management.* Krieger, 1994.

2. Fwa, T.F. *The Hand Book of Highway Engineering.* CRC Press, Taylor &Francies Group, 2006.

***References:***

1. Khanna, S.K., Justo, C.E.G. *Highway Engineering.*Roorkee India:Nem Chand &Bros,2005.

|  |  |  |
| --- | --- | --- |
| **L-T-P** | **MCI054A-Transportation System Analysis** | **Credits: 4** |
| **4-0-0** |

**Objectives:**

**Transportation Systems Analysis**

**Unit 1:**

**Introduction**: Scope of transportation and impact on society; System planning process andproblem solving process; transportation problems.

**Unit 2:**

**Transportation Technologies**: Transportation technologies, suitability and adaptability;Transportation system components; Transportation system characteristics – technological andoperational; Technologies for surface, below surface and above surface transportation and theircombinations, suitability of such systems in urban and rural areas.

**Unit 3:**

**Analysis of Systems:** Generation of alternatives; Performance evaluation of system andperformance functions; Operational planning and analysis of components; Travel in space andtime; Planning for non-motorized transportation; Freight transportation planning–models andmethods; Residential location choice models, Car-ownership models; transportation software.

**Unit 4:**

**Transportation Economics:** Transportation demand and supply; Equilibrium between supplyand demand, transportation system equilibrium; Elasticity – direct and cross; concept ofconsumer surplus; transport demand models – sketch planning, incremental demand model,model estimation from traffic counts; transportation cost, travel – market equilibrium.

**Unit 5:**

**Sustainable Transportation Planning:** Sustainable transportation – issues and principles; nonnotarizedtransportation planning; Impact evaluation and impact models.

**Outcome**

***Text book:***

1. Marvin L. M. *Fundamentals of Transportation SystemsAnalysis.* Cambridge, Massachusetts: The MIT Press, 1980.

2. Adib K.*Transportation Demand Analysis*, New York, U.S.A:McGraw Hill Inc., 1983.

***References:***

1. Steenbrink, P.A.*Optimization of Transport Network*. New York, U.S.A: John Wiley & Sons, 1974.

|  |  |  |
| --- | --- | --- |
| **L-T-P** | **MCI016A-Dissertation Part - I** | **Credits: 12** |
| **0-0-12** |

|  |  |  |  |
| --- | --- | --- | --- |
| **Elective Subjects (one from each group)** | | | |
| **Elective I** | | **Elective II** | |
| **MCI055A** | Railway Infrastructure, Planning and Design | **MCI058A** | GIS Application in Transportation Engineering |
| **MCI056A** | Construction Project Management & BOT System | **MCI059A** | Airport Infrastructure, Planning and Design |
| **MCI057A** | Transport Economics | **MCI060A** | Pavement Evaluation, Rehabilitation and Maintenance |

**Elective I**

|  |  |  |
| --- | --- | --- |
| **L-T-P** | **MCI055A-Railway Infrastructure, Planning and Design** | **Credits: 4** |
| **4-0-0** |

**Objective:**

To make the students conversant with the types of pavements and their design. To make them learn the importance oforientation of runways, Air traffic control devices and airport drainage.

**Unit 1:**

**Introduction:** Air transport- structure and organization, the challenges and the issues.

**Unit 2:**

**Airport Planning and Geometric Design:** Airport master plan, Aircraft characteristics, Geometric design of airfields.

**Unit 3:**

**Planning and design of the terminal area:** The planning terminal system; design considerations and visual aids.

**Unit 4:**

**Structural design of airport pavements:** Design factors, Design of flexible and rigid pavements.

**Airside Capacity and delay:** Mathematical models for capacity and delay, space time concept**.**

**Unit 5:**

**Air traffic control:** Elements; major components and functions of the National airspace system.

**Airport drainage:** Design runoff, inlet size and location design, surface and subsurface design

**Outcome:**

The students feel comfortable in design of airfield pavements and they can apply this knowledge in the field

***Text Book***

1. Khanna, S.K., Arora, M.G.,Jain S.S.*Airport Planning and Design.*NemChand & Brothers, 2012.

***References***

1. Kumar V., Chandra S.*Air transportation planning and design.*Delhi India:Galgotia Publications,

2012

|  |  |  |
| --- | --- | --- |
| **L-T-P** | **MCI056A-Construction Project Management & BOT System** | **Credits: 4** |
| **4-0-0** |

**Objective:**

**Construction Project Management & BOT System**

**Unit 1:**

**Construction Project Management: An Overview-**Construction industry; construction project; product development process; project management;main causes of project failure; BOT, BOOT, BORT and other variants of BOT. causes ofintroducing this system, Liberalization policies of GOI for these system; GOI, state governments,other local bodies, board, corporation etc. are adopting these systems for construction projectmanagement.

**Unit 2:**

**Project Management Information System:**PMIS concept; PMIS framework; information system computerization; user’s system specificationsdevelopment; acquiring a system; problems in information system management; benefits ofcomputerized information system.

**Unit 3:**

**Risk management in infrastructure projects:**Introduction; identification of risks: an important principle, task involvement, aspects toa analyze;Stages of project implementation: gestation stage, development stage, construction stage,operational stage, termination stage; Specific categories of risk: revenue risk, design risk,construction risk, operating risk, financial risk, political risk, legal risk, environmental risk, forcemajeure risk.; allocation & management of risks: concept of risk management, management of risk,risk matrix.; Developers perspective of risk; Government’s perspective of risk.

**Unit 4:**

**Management in Construction:**Overview; Risk Management process: when to use, procedure of providing Advice; RiskManagement Responsibility: risk manager, risk owner, team approach; Stages of risk Management:stages, assessment, management, typical sequence, identification classification, direct/ indirectcosts, risk matrix, quantification; Response: hold, avoid, reduce, transfer, share, review.;

conclusion.

**Management Process:**Introduction; risk identification; brainstorming: interviews, The Delphi Technique, expert systems.;Qualitative Assessment: classification and reference, description of risk, risk trigger, relationship toother risk, potential impact, likelihood of occurrence, response.; Mitigation: meaning, avoidance,risk avoidance risk transfer, residual or retained risk. Risk analyse: meaning, a brief introduction tostastics, method of risk assessment.

**Unit 5:**

**Technical procedure for management:**Introduction; phases of construction: the design phase, construction phase; post construction; riskmatrix; exhibits.

**Construction Project Insurance:**Introduction; insurance policy structure; types of insurance mentioned in the model; guidance oninsurance for construction projects; current conditions of contract; general services provided by theproject insurance companies.

**Outcome**

***Text Books:***

**1.** Chitkara K.K. *Construction project management.* Tata McGraw Hill, 2010.

***Reference:***

1. NHAI & CIDC websites with some national and international journals of construction field

with the proceedings of conferences/ seminars organized by CIDC & NICMAR.

|  |  |  |
| --- | --- | --- |
| **L-T-P** | **MCI057A-Transport Economics and Finance** | **Credits: 4** |
| **4-0-0** |

**Objectives:**To know Economic evaluation of transportation projects, ownership financing of transport, economic function oftransportation, road user and transportation cost, finance and taxation.

**Unit 1:**

**Economic evaluation of transport plans:** Need for economic evaluation, cost and benefits of transport projects, time horizon in economicassessment, basic principles of economic evaluation, interest rate, method of economicevaluation, benefit cost ratio method, first year rate of return, net present value method, internalrate of return method, comparison of various methods of economic evaluation.

**Unit 2:**

**Vehicle operating costs:** Introduction, road user cost study in India, components of VOC, factors affecting VOC, fuelconsumption relationship, spare parts consumption, maintenance and repairs, labor cost, tyrelife, lubricants, utilization, and fixed costs.

**Unit 3:**

**Value of travel time savings:** Introduction, classes of transport users enjoying travel time savings, methodology for monetary, evaluation of passengers’ travel time, review of work in India on passengers’ travel time.

**Unit 4:**

**Accident costs:** Introduction, relevance of accident costing for a developing country, review of alternativemethodologies for accident costing, Indian studies.

**Unit 5:**

**Traffic congestion, traffic restraints and road pricing:** Congestion as a factor in road traffic, traffic restraint, road pricing.

**Highway finance:** Basic principles, distribution of highway cost, sources of revenue, highway financing in India

**Outcomes:**

Ability to analyze and evaluate transportation project case studies

***Text Book***

1. Khanna, S.K., Justo, C.E.G. *Highway Engineering.*Roorkee India:Nem Chand &Bros,2005.

***References***

1. Kadyali L.R.*Principles and practices of Highway Engineering.* Khanna Publishers,2013.

**Elective II**

|  |  |  |
| --- | --- | --- |
| **L-T-P** | **MCI058A-GIS Application in Transportation Engineering** | **Credits: 4** |
| **4-0-0** |

**Objective:**

**GIS Application in Transportation Engineering**

**Unit 1:**

**Introduction: Definitions of GIS** – Components of GIS – Geographic data presentation: maps –mapping process – coordinate systems – transformations – map projections – geo referencing -data acquisition.

**Unit 2:**

**Geographic Data Representation, Storage, Quality and Standards**: Storage – Digitalrepresentation of data – Data structures and database management systems – Raster datarepresentation – Vector data representation – Concepts and definitions of data quality –Components of data quality – Assessment of data quality – Managing data errors – Geographicdata standards.

**Unit 3:**

**GIS Data Processing, Analysis and Modeling**: Raster based GIS data processing – Vectorbased GIS data processing – Queries – Spatial analysis – Descriptive statistics – Spatialautocorrelation – Quadrant counts and nearest neighbor analysis – Network analysis – Surfacemodeling – DTM.

**Unit 4:**

**GIS Applications**: Applications of GIS in Environment monitoring – Natural hazardmanagement, Transport Planning, Analysis and monitoring. Use of softwares related to GISapplications in Transportation Engineering.

**Unit 5:**

**Case studies.**

**Outcome:**

***Text Books:***

1. Lo, C.P., Yeung A.K.W. *Concepts and Techniques of Geographic Information Systems.* Prentice Hall of India, New Delhi, 2006.

***Reference Books:***

1. Burrough, P.A. *Principles of Geographical Information Systems.* Oxford Publication, 1998.

2. Clarke, K. *Getting Started with Geographic Information Systems*, Prentice Hall, New Jersy, 2010.

|  |  |  |
| --- | --- | --- |
| **L-T-P** | **MCI059A-Airport Infrastructure, Planning and Design** | **Credits: 4** |
| **4-0-0** |

**Objectives:**To make the students conversant with the types of pavements and their design. To make them learn the importance oforientation of runways, Air traffic control devices and airport drainage

**Airport Infrastructure, Planning and Design**

**Unit 1:**

**Introduction:** Air transport- structure and organization, the challenges and the issues.

**Unit 2:**

**Airport Planning and Geometric Design:** Airport master plan, Aircraft characteristics, Geometric design of airfields.

**Unit 3:**

**Planning and design of the terminal area:** The planning terminal system; design considerations and visual aids.

**Unit 4:**

**Structural design of airport pavements:** Design factors, Design of flexible and rigid pavements.

**Airside Capacity and delay:** Mathematical models for capacity and delay, space time concept.

**Unit 5:**

**Air traffic control:** Elements; major components and functions of the National airspace system**.**

**Airport drainage:** Design runoff, inlet size and location design, surface and subsurface design.

**Outcome**

The students feel comfortable in design of airfield pavements and they can apply this knowledge in the field.

***Text book:***

1. Horonjeff, R. Mickelvey, F.X. *Planning & design of airports*, Mc Graw Hill, NewYork,2010.

2. Khanna S.K., Arora, M.G., Jain S.S.*Airport Planning and Design.*NemChand & Brothers, 2012.

|  |  |  |
| --- | --- | --- |
| **L-T-P** | **MCI060A-INTELLIGENT TRANSPORTATION SYSTEMS** | **Credits: 4** |
| **4-0-0** |

**Objectives:** To familiarize the students with latest techniques of transportation systems, to learn the techniques of existing toll systemusing ITS.

**Unit 1:**

Advanced traffic management systems

**Unit 2:**

Advanced traveler information systems

**Unit 3:**

Commercial vehicle operations

**Unit 4:**

Advanced public transportation systems; Advanced rural transportation systems

**Unit 5:**

Advanced vehicle control systems; ITS standards; ITS technologies and future of ITS

**Outcome** Design and implement the application of Electronic Systems in Transportation, Develop the system of tacking thecongestion in the various transportation modes.

***Text Book:***

1. Chowdhury, M. A., Sadek, A.*Fundamentals of Intelligent TransportationSystems Planning*, Artech House, 2003.

2. Sussman, J. M.*Perspectives on Intelligent Transportation Systems (ITS)*. Springer, 2005.

***References:***

1. Turban, E., Aronson, J. E.*Decision Support Systems and Intelligent Systems.*Prentice Hall, 2004.

|  |  |  |
| --- | --- | --- |
| **L-T-P** | **MCI023A – Dissertation Part - II** | **Credits: 28** |
| **0-0-28** |