|  |
| --- |
| **KERALA TECHNOLOGICAL UNIVERSITY**  http://ktu.edu.in/images/logo_final.png  **SCHEME AND SYLLABUS**  **FOR**  **M. Tech. DEGREE PROGRAMME**  **IN**  **CIVIL ENGINEERING**  **WITH SPECIALIZATION**  **TRANSPORTATION ENGINEERING**  **CLUSTER 05 (ERNAKULAM II)**  **KERALA TECHNOLOGICAL UNIVERSITY CET Campus, Thiruvananthapuram Kerala, India -695016**  **(2015 ADMISSION ONWARDS)** |

**KERALA TECHNOLOGICAL UNIVERSITY**

**SCHEME AND SYLLABUS FOR M. Tech. DEGREE PROGRAMME**

**Branch: CIVIL ENGINEERING**

**Specialization: TRANSPORTATION ENGINEERING**

**SEMESTER - I**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **ExamSlot.** | **Course No.** | **Subject** | **Hrs / Week** | | | **Internal Marks** | **End Semester Exam.valuation Scheme (Marks)** | | **Credits** |
| **L** | **T** | **P** | **Marks** | **Duration (Hrs)** |
| C | **05CE6301** | Pavement Analysis and Design | **3** | **1** | **0** | **40** | **60** | **3** | **4** |
| B | **05CE6303** | Traffic Engineering I | **3** | **1** | **0** | **40** | **60** | **3** | **4** |
| A | **05CE6305** | **Urban Transportation planning.** | **3** | **1** | **0** | **40** | **60** | **3** | **4** |
| D | **05CE6307** | Applied Probability and Statistics | **2** | **1** | **0** | **40** | **60** | **3** | **3** |
| E | **05CE631x** | **Elective - I** | **2** | **1** | **0** | **40** | **60** | **3** | **3** |
|  | **05CE6377** | **Research Methodology** | **1** | **1** | **0** | **100** | **0** | **0** | **2** |
|  | **05CE6391** | Transportation Egg lab I | **0** | **0** | **2** | **100** | **0** | **0** | **1** |
| **Total** | | | **14** | **6** | **2** |  |  |  | **21** |

|  |  |
| --- | --- |
| **Elective-I** | |
| **05CE6311** | Highway Geometric Design |
| **05CE6313** | Intelligent Transportation Systems |
| **05CE6315** | Transportation System Management |

**SEMESTER -II**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **ExamSlot.** | **Course No.** | **Subject** | **Hrs / Week** | | | **Internal Marks** | **End Semester Exam.valuation Scheme (Marks)** | | **Credits** |
| **L** | **T** | **P** | **Marks** | **Duration (Hrs)** |
| A | **05CE6302** | Transportation Systems | **3** | **1** | **0** | **40** | **60** | **3** | **4** |
| B | **05CE6304** | Transportation Economics | **2** | **1** | **0** | **40** | **60** | **3** | **3** |
| C | **05CE6306** | Traffic Engineering II | **2** | **1** | **0** | **40** | **60** | **3** | **3** |
| D | **05CE632x** | Elective II | **2** | **1** | **0** | **40** | **60** | **3** | **3** |
| E | **05CE633x** | **Elective - III** | **2** | **1** | **0** | **40** | **60** | **3** | **3** |
|  | **05CE6366** | **Seminar-I** | **0** | **0** | **2** | **100** | **0** | **0** | **2** |
|  | **05CE6388** | **Mini Project** | **0** | **0** | **4** | **100** | **0** | **0** | **2** |
|  | **05CE6392** | Transportation Engineering Lab II | **0** | **0** | **2** | **100** | **0** | **0** | **1** |
| **Total** | | | **11** | **5** | **8** |  |  |  | **21** |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Elective-II** | |  | **Elective-III** | |
| **05CE6322** | Environmental Impact Assessment |  | **05CE6332** | Bridge Engineering |
| **05CE6324** | Optimization Techniques |  | **05CE6334** | Remote sensing and GIS in Transportation planning |
| **05CE6326** | Traffic Flow Theory |  | **05CE6336** | Road safety and Environment |

**SEMESTER – III**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **ExamSlot.** | **Course No.** | **Subject** | **Hrs / Week** | | | **Internal Marks** | **End Semester Exam. valuation Scheme (Marks)** | | **Credits** |
| **L** | **T** | **P** | **Marks** | **Duration (Hrs)** |
| A | **05CE734x** | **Elective IV** | **2** | **1** | **0** | **40** | **60** | **3** | **3** |
| B | **05CE735x** | **Elective V** | **2** | **1** | **0** | **40** | **60** | **3** | **3** |
|  | **05CE7367** | **Seminar-II** | **0** | **0** | **2** | **100** | **0** | **0** | **2** |
|  | **05CE7387** | **Project (Phase 1)** | **0** | **0** | **8** | **50** | **0** | **0** | **6** |
| **Total** | | | **4** | **2** | **10** |  |  |  | **14** |

|  |  |  |  |
| --- | --- | --- | --- |
| **Elective-IV** | | **Elective-V** | |
| **05CE7341** | Ground Improvement Techniques | **05CE7351** | Pavement Evaluation and Management |
| **05CE7343** | Pavement Materials | **05CE7353** | Public Transport Planning and Design |
| **05CE7345** | Transportation Facility Design | **05CE7355** | Advanced Highway Materials |

**SEMESTER – IV**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **ExamSlot.** | **Course No.** | **Subject** | **Hrs / Week** | | | **Internal Marks** | **End Semester Exam. valuation Scheme (Marks)** | | **Credits** |
| **L** | **T** | **P** | **Marks** | **Duration (Hrs)** |
|  | **05CE7388** | **Project (Phase II)** | **0** | **0** | **21** | **70** | **30** | **0** | **12** |
| **Total** | | | **0** | **0** | **21** |  |  |  | **12** |

**Total:68**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| COURSE CODE | | COURSE NAME | L-T-P-C | YEAR | |
| **05CE 6301** | | **PAVEMENT ANALYSIS AND DESIGN** | 3-1-0-4 | 2015 | |
| COURSE OBJECTIVES:   * Identify and categorize the factors affecting design and performance of pavements. * To explain the basic modelling concepts used to analyse flexible and rigid pavements. * To explain different design methods for flexible and rigid pavement design   **COURSE OUTCOMES:**  After completion of the course the student will be able to   * List and explain the various factors affecting design and performance of pavements * Calculate the stresses and deflection in flexible and rigid pavements * Design flexible and rigid pavements | | | | | |
| MODULE | COURSE CONTENT (36 hrs) | | | | HRS |
| **I** | **Types and Component parts of Pavements:** Flexible, rigid and semi-rigid pavements Factors affecting design and performance of Pavements - Influence of environment on pavement - Frost, Sub grade moisture  **Subgrade:** Functions and significance of subgrade properties - Methods of assessment of subgrade strength - Subgrade stabilization – Wheel loads – ESWL – EWLF | | | | 9 |
| **INTERNAL TEST 1(Module 1)** | | | | | |
| **II** | Analysis of Stresses in Flexible Pavements - Empirical, Semi empirical and Theoretical Methods of Flexible Pavement Design – Problems... | | | | 9 |
| **INTERNAL TEST 2(Module 2)** | | | | | |
| **III** | **Rigid pavement design:** Types, Causes and Analysis of Stresses in Rigid pavements - Types, Functions and Spacing of Joints in Cement Concrete Pavements - Design of Slab Thickness and Joint Details | | | | 10 |
| **IV** | **Pavement evaluation and rehabilitation:** surface characteristics – skid resistance – pavement roughness - pavement distress - Strengthening of existing pavements - Flexible and Rigid Overlays – pavement maintenance | | | | 8 |
| **END SEMESTER EXAM (ALL Modules)** | | | | | |
| **REFERENCES:**   1. Yoder and Witezak, “Principles of Pavement Design”, John Wiley and sons. 2. Yang, Design of functional pavements, McGraw-Hill. 3. Kadiyali L.R., “Principles & Practice of Highway Engineering”, Khanna Publishers,2003 4. Khanna S.K., Justo C.E.G., “Highway Engineering”, Nem Chand & Bros., Roorkee, 2001 5. IRC: 37-2001, “Guidelines for the Design of Flexible Pavements (Second Revision)”. 6. IRC: 58-2001, “Guidelines for the Design of Plain Jointed Rigid Pavements for Highways (Second Revision)”. 7. AASHTO – Design of pavement Structures 8. Huang - Pavement Analysis - Elsevier Publication | | | | | |
|  | | | | | |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| COURSE CODE | | COURSE NAME | L-T-P-C | YEAR | |
| **05CE 6303** | | **TRAFFIC ENGINEERING- I** | 3-1-0-4 | 2015 | |
| COURSE OBJECTIVES:  • To provide an insight on traffic and its components.  • To explain sampling, analysis and interpretation of data of various surveys  • To explain traffic movements, types of intersections, islands, crossings and their design.  • To illustrate the design of signals and explain the redesigning of existing signals.  **COURSE OUTCOMES:**  After the completion of the course students should be  • Able to acquire and apply knowledge of traffic, its components, factors affecting road traffic in intersection design.  • Able to apply the knowledge of sampling data in conducting various surveys and analysis.  • Capable of designing traffic signals.  • To make the students aware of signal coordination and road lighting. | | | | | |
| MODULE | COURSE CONTENT (36 hrs) | | | | HRS |
| **I** | **Introduction:** Objectives and scope of traffic engineering, Components of road traffic - the vehicle, driver and road. Road user characteristics; human and vehicle characteristics, factors affecting road traffic; methods of measurement. Concepts of passenger car units for mixed traffic flow. | | | | 9 |
| **INTERNAL TEST 1(Module 1)** | | | | | |
| **II** | **Traffic Engineering Studies and Analysis:** Sampling in traffic studies; adequacy of sample size; application of sampling methods for traffic studies, objectives, traffic surveys, equipment, data collection, analysis and interpretation of (i) Spot speed (ii) Speed and delay (iii) Volume (iv) Origin - destination (v) Parking and (vi) Accident studies, Traffic maneuvers and Stream Characteristics; application in intersection design. | | | | 9 |
| **INTERNAL TEST 2(Module 2)** | | | | | |
| **III** | **Traffic Regulations and Control:** General regulations: Regulations on Speed, Vehicles, drivers and flow; other regulations and control. Traffic management; noise and air pollution due to road traffic and methods of control. | | | | 10 |
| **IV** | **Traffic Control Devices:** Traffic signs, markings, islands and signals. Different methods of signal design; redesign of existing signal including case studies. Signal system and co-ordination. Evaluation and design of road lighting. | | | | 8 |

|  |
| --- |
| **END SEMESTER EXAM (ALL Modules)** |
| **REFERENCES:**   1. Matson, Smith & Hurd “Traffic Engineerin”, McGraw Hill Book Co. 2. Kadiyali, L.R. “Traffic Engineering and Transport Planning”, Khanna Publishers. 3. Wells, G.R. “Traffic Engineering and Hand Book”, Institution of Engineers, U.S.A. 4. RRL, DSIR Research on Road Traffic', HMSO Publication 5. IRC and IS Publications. 6. Institute of Transportation Engineers, Manual of Transportation Engineering Studies, Prentice Hall 7. Salter, R.J., and N. B. Hounsell, “Highway Traffic Analysis & Design”, Mac Millan 8. Fred C. Mannering and Walter P Kilaraski, “Principles of Highway Engineering and Traffic Analysis”, John Wiley and Sons. 9. Kadiyali L.R., “Principles & Practice of Highway Engineering”, Khanna Publishers. 10. Khanna S.K., Justo C.E.G., “Highway Engineering”, Nem Chand & Bros., Roorkee. |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| COURSE CODE | | COURSE NAME | L-T-P-C | YEAR | |
| **05CE 6305** | | **URBAN TRANSPORTATION PLANNING** | 3-1-0-4 | 2015 | |
| COURSE OBJECTIVES:   * To introduce the role of planning in analyzing and modelling travel demand * To understand the stages involved in the Urban Transportation Planning process * To study the principle of land use transport interaction models, it’s mathematical formulation and solution   **COURSE OUTCOMES:**  After the completion of the course students should be   * Understand the various transportation planning concepts * Understand four step modelling concept in Urban Transportation Planning * Familiarisethemathematicaltraveldemandmodeldevelopmentconceptsanditssolutions | | | | | |
| MODULE | COURSE CONTENT (36 hrs) | | | | HRS |
| **I** | **Urban Transportation Problems and Planning Process:**Role of transportation and change in concerns of society in transportation planning; Transportation problems and problem domain; objectives and constraints; flow chart for transportation planning process, inventory, model building, forecasting and evaluation stages | | | | 9 |
| **INTERNAL TEST 1(Module 1)** | | | | | |
| **II** | Introduction to Transportation Planning Practices. Trip generation models – Trip classification - productions and attractions – Trip rate analysis – Multiple regression models - Category analysis - Trip distribution models – Growth factor models, Gravity model and Opportunity modes. | | | | 9 |
| **INTERNAL TEST 2(Module 2)** | | | | | |
| **III** | Modal split models – Mode choice behavior – Trip end and trip interchange models - Traffic assignment – Transportation networks – Minimum Path Algorithms - Assignment methods – All or Nothing assignment, Capacity restrained assignment and Multi path assignment - Route-choice behavior. | | | | 10 |
| **IV** | **Land use and its interaction:** Lowry derivative models - Quick response techniques - Non-Transport solutions for transport problems. Ekistics - Science of human settlements - Characteristics of urban structure. Town planning concepts - Neighborhood planning. | | | | 8 |

|  |
| --- |
| **END SEMESTER EXAM (ALL Modules)** |
| **REFERENCES:**   1. Hutchinson B G (1974), “Principles of urban transportation system planning”, McGraw Hill 2. Bruton M J (1981), “Introduction to transportation planning”, Hutchinson of London 3. Dickey J W (1980), “Metropolitan Transportation Planning”, Tata McGraw Hill 4. Michael D Mayer and Eric J Miller (1974), “Urban transportation planning A Decision Oriented Approach”, McGraw Hill. 5. C. S. Papacostas and P.D. Prevedouros (2002), “Transportation Engineering and Planning”, Prentice Hall. 6. Kanafani, A (1983)., Transportation Demand Analysis, McGraw-Hill |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| COURSE CODE | | COURSE NAME | L-T-P-C | YEAR | |
| **05CE 6307** | | **APPLIED PROBABILITY AND STATISTICS** | 3-1-0-4 | 2015 | |
| COURSE OBJECTIVES:   * Explain measures of central tendency and different sampling techniques. * To illustrate different statistical distributions and the significance test to check goodness of fit. * To make the students aware of probability theory. * To explain regression and correlation and tests of hypothesis. * To illustrate analysis of variance, randomized design.   **COURSE OUTCOMES:**  After the completion of the course students should be   * Able to use appropriate statistical method in transportation engineering problems * Capable of applying the rule of probability and discrete distributions in solving problems * Capable of testing the goodness of fit by using statistical decision * Able to apply the knowledge of statistical software in analysis of transportation engineering problems | | | | | |
| MODULE | COURSE CONTENT (36 hrs) | | | | HRS |
| **I** | **Frequency distribution:** mean, standard deviation, moments, skewness and kurtosis- definition and applications  **Sampling techniques:** Simple random sampling, stratified sampling, systematic sampling, sample size determination- applications | | | | 9 |
| **INTERNAL TEST 1(Module 1)** | | | | | |
| **II** | **Statistical distribution:** Binomial, Poisson, uniform, exponential and normal distribution, mean and variance. Fitting of the distributions, Chi-square test of goodness of fit. Sampling error, sample size and design  **Probability**: Laws of probability, conditional probability and independent events, Laws of Expectation | | | | 9 |
| **INTERNAL TEST 2(Module 2)** | | | | | |
| **III** | **Regression and Correlation:** Linear regression and corrleation, multiple correlations, Multiple correlation coefficient, standard error of estimate, analysis of variance,  **Exact Sampling Distributions**: Chi-square distribution, Students t ,Srtedecor’s F distribution, Definitions and applications  **Test of significance**: Large samples and small samples tests, Test for single mean, means of two samples, proportions, two variances, two observed correlation coefficients (Fichers z transformations), Paired T tests, | | | | 10 |
| **IV** | **Confidence interval: Interval for mean**, variance and regression coefficients  **Design Experiments**: Analysis of variance, statistical principle of experimentation, Basic designs, completely randomized blocks, | | | | 8 |
| **END SEMESTER EXAM (ALL Modules)** | | | | | |
| **REFERENCES:**  1. Gupta.S.C. and Kapoor.V.K, Fundamentals of Mathematical Statistics, Sultan Chand and Sons, 1978.  2. Benjamin, Jack.R and Comell.C, Allin, Probability, Statistics and Decision for Civil Engineers, Mc-Graw Hill.  3. Kadiyali.L.R, Traffic Engineering and Transport Planning, Khanna Publishers.  4. Wohl, Martin and Martin, Brian. V, Traffic Systems analysis for Engineers and Planners, Mc-Graw Hill.  5. Richard.A. Johnson: Miller and Freunds, Probability and Statistics for Engineers (6thedition) Pearson. | | | | | |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| COURSE CODE | | COURSE NAME | L-T-P-C | YEAR | |
| **05CE6311** | | **HIGHWAY GEOMETRIC DESIGN** | 3-1-0-4 | 2015 | |
| COURSE OBJECTIVES:   * To explain the basic concepts of traffic Engineering. * To determine the cross section elements of the pavement. * To design the horizontal and vertical alignment of highways. * To explain the different types of intersections and parking.   **COURSE OUTCOMES:**  After the completion of the course students should be able   * To get an idea of traffic engineering * To design the various cross section elements. * To design the horizontal and vertical alignment of highways. * To make the students aware of design of different types of intersections | | | | | |
| MODULE | COURSE CONTENT (36 hrs) | | | | HRS |
| **I** | **Basic concepts of Traffic Engineering:** Objectives and requirements of highway geometric design, highway classification, terrain classification, importance of traffic data in geometric design, design hour volume, directional distribution of traffic, traffic composition, traffic forecasting, design vehicle, design speed, highway capacity, level of service. | | | | 9 |
| **INTERNAL TEST 1(Module 1)** | | | | | |
| **II** | **Cross Section Elements:** Right of way and width considerations, roadway, shoulders, kerbs, camber, side slope, lateral and vertical clearance, control of access, traffic barriers, medians, frontage roads, Pavement surface characteristics - types, cross slope, skid resistance, unevenness. | | | | 9 |
| **INTERNAL TEST 2(Module 2)** | | | | | |
| **III** | **Horizontal and Vertical Alignments:** Sight distances - types, analysis, factors affecting, measurements, Horizontal alignment - design considerations, stability at curves, super elevation, widening, transition curves; curvature at intersections, vertical alignment - grades, ramps, design of summit and valley curves, design of expressways, IRC standards and guidelines for design problems. | | | | 10 |
| **IV** | **Design of Intersections:** Characteristics and design considerations of at-grade intersections; Different types of islands, channelization; median openings; design of rotary intersections; Grade separations and interchanges - types, warrants, adaptability and design details; Interchanges - different types, ramps.  **Design of Parking lots**- Factors, design elements, different types of parking, design of ramps and other elements of multistoried parking lots. | | | | 8 |
| **END SEMESTER EXAM (ALL Modules)** | | | | | |
| **REFERENCES:**   1. AASHTO, A Policy on Geometric Design of Highways and Streets', American Association of State Highway and Transportation Officials, Washington D.C. 2. Khanna S.K. and Justo, C.E.G., Highway Engineering', Nem Chand and Bros. 3. DSIR, Roads in Urban Areas', HMSO, London. 4. Jack E Leish and Associates, Planning and Design Guide: At-Grade Intersections. Illinios. 5. IRC: 86-1983, IRC: 52- 1973, IRC: 64-1990, IRC: 3-1984, IRC: 38-1988, IRC:66-1976, IRC: 65-1976, IRC: 92-1985, IRC: 103-1988, IRC SP: 41 6. Kadiyali, L.R., Principles & Practice of Highway Engineering, Khanna Publishers,2003 7. Kadiyali, L.R. Traffic Engineering and Transport Planning, Khanna Publishers. | | | | | |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| COURSE CODE | | COURSE NAME | L-T-P-C | YEAR | |
| **05CE6313** | | **INTELLIGENT TRANSPORTATION SYSTEMS** | 3-1-0-4 | 2015 | |
| COURSE OBJECTIVES:   * Learn the objectives, benefits and the telecommunications in ITS. * Learn about the functional areas, user needs and services in ITS. * Learn the concepts of ITS operations and applications.   **COURSE OUTCOMES:**  After the completion of the course students should be   * Able to appreciate the advantages of ITS and suggest the appropriate technologies for field conditions. * Able to suggest the appropriate system/s in various functional areas of transportation. * Able to amalgamate the various systems, plan and implement the applications of ITS. | | | | | |
| MODULE | COURSE CONTENT (36 hrs) | | | | HRS |
| **I** | History of ITS, ITS – Need, Standards and policy, System architecture, ITS Developments –Worldwide and Indian scenario, Metropolitan and Rural ITS, ITS policy issues. ITS user services:  Traffic Management centers- Types and functions, Travel and traffic management, Publictransportation operations, Commercial vehicle operations, Advanced Traveler Information systems | | | | 9 |
| **INTERNAL TEST 1(Module 1)** | | | | | |
| **II** | 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 Roadside communication. | | | | 9 |
| **INTERNAL TEST 2(Module 2)** | | | | | |
| **III** | Application of ITS : Incident Management-, Parking management, Electronic payments, Electronic toll collection systems, Access controls: Ramp metering, Dynamic speed adaptation. Advanced traffic control systems, In-vehicle systems. Dynamic routing/scheduling. ITS Design: ITS system design-components and requirements and Evaluation, ITS for road network- System Design Sensor technologies and data requirements for ITS. Positioning systems in ITS, Mobile phone location and its impact on ITS. Telecommunication in ITS, Application of GIS in ITS. | | | | 10 |
| **IV** | 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.  Transportation planning and ITS: - Relationships 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. | | | | 8 |
| **END SEMESTER EXAM (ALL Modules)** | | | | | |
| **REFERENCES:**   1. ITS Hand Book 2000: Recommendations for World Road Association (PIARC) by Kan Paul Chen, John Miles. 2. Roger R. Stough, “Intelligent Transport Systems – Cases and Policies”, Publisher: Edward Elgar, 2001. 3. Chris Drane and Chris Rizos, “Positioning Systems in Intelligent Transportation Systems”, Artech House Publishers, London 4. Joseph M. Sussman, “Perspectives on Intelligent Transport Systems”, Springer Publishers. | | | | | |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| COURSE CODE | | COURSE NAME | L-T-P-C | YEAR | |
| **05CE6315** | | **Transportation System Management** | 3-1-0-4 | 2015 | |
| COURSE OBJECTIVES:   * To introduce the present day transportation problems * To familiarize various transportation system management techniques * To familiarize various transportation demand management techniques   **COURSE OUTCOMES:**   * Understandthevariousconcepts of transportation system management without capacity   augmentation   * Knowledge of Transportation Demand Management * Familiarizethemethods to improve the traffic operations | | | | | |
| MODULE | COURSE CONTENT (36 hrs) | | | | HRS |
| **I** | **Present Transportation Problems** – Transportation System Management and Transportation Demand Management – Short and Long Range Plans. TSM Actions: TSM actions, issues addressed applications, implementation problems, evaluation and benefits.  Public transportation & HOV priority - park and ride, car pooling, exclusive lanes, priority at ramp terminals, bus transfer stations, guaranteed ride home, commuter financial incentives, shared ride, -Dial a ride for elderly & handicapped. | | | | 9 |
| **INTERNAL TEST 1(Module 1)** | | | | | |
| **II** | **Demand Management**: Staggered work hours, flexible work hours, telework, high peak period tolls, shuttle services, circulation services, road pricing. New Urbanism | | | | 9 |
| **INTERNAL TEST 2(Module 2)** | | | | | |
| **III** | **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, Traffic signal co ordination and Optimization | | | | 10 |
| **IV** | **Parking Management**: Short term reserved parking, increased parking rates, time duration limits, expanded off-street parking Non Motorized Transport: pedestrian only streets, exclusive cycle paths | | | | 8 |

|  |
| --- |
| **END SEMESTER EXAM (ALL Modules)** |
| **REFERENCES:**  1) D, Arlington, Transportation System Management in 1980: State of the Art and Future Directions, Transportation Research Board, 1980.  2) Institute of Transportation Engineers, Transportation and Traffic Engg. Hand Book, Prentice Hall, 1982  3) TRB Publications. |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| COURSE CODE | | COURSE NAME | L-T-P-C | YEAR | |
| **05CE 6377** | | **RESEARCH METHODOLOGY** | 3-1-0-4 | 2015 | |
| COURSE OBJECTIVES:   * To generate awareness about the importance, types and stages of research along * To understand different methods for data collection, analysis interpretation and presentation of the results.   **COURSE OUTCOMES:**  The students will be able to understand   * The significance of different types of research and its various stages * The different methods for data collection * Different methods for analyzing data and interpreting the results * The proper way of reporting and presenting the outcome | | | | | |
| MODULE | COURSE CONTENT (36 hrs) | | | | HRS |
| **I** | Introduction to research methodology. Types of research, research methods Vs methodology - stages of research process. Literature review – Problem definition- Research design for exploratory, descriptive and experimental research – Brief introduction to completely randomized design, randomized block design and Latin square designs (description only). | | | | 9 |
| **INTERNAL TEST 1(Module 1)** | | | | | |
| **II** | Sampling fundamentals -Types of sampling: probability and non-probability sampling. Sampling theory, sampling distribution and sample size determination. Tools and techniques of data collection: Questionnaire and schedule for field surveys, interview, observation, simulation, experimental and case study methods. Collection, recording, editing, coding and scaling of data. Scale classification and types. Measurement of validity, reliability and practicality. | | | | 9 |
| **INTERNAL TEST 2(Module 2)** | | | | | |
| **III** | Descriptive and inferential statistics - Data analysis and interpretation –testing of hypothesis, testing of population mean, variance and proportion –Z test – t test – F test - chi square test. Test for correlation and regression –standard error of the estimate. Testing goodness of fit. | | | | 10 |
| **IV** | Meaning of interpretation and inference: importance and care for interpreting results. Presentation of reports: popular reports and technical reports - structure and style. Oral and written presentations: Parts of a research report. Guidelines for writing research papers and reports – Writing different sections of a research paper – Introduction, Methodology, Results, Discussion, Conclusion, Abstract – Writing the title. Methods of giving references and appendices: referencing styles. Ethics in research. Use of computers and internet in research. | | | | 8 |
| **END SEMESTER EXAM (ALL Modules)** | | | | | |
| **REFERENCES:**   1. C. R. Kothari, Research Methodology, Methods and techniques (New Age International Publishers, New Delhi, 2004). 2. R. Panneerseklvam, Research Methodology (Prentice Hall of India, New Delhi, 2011). 3. Ranjit Kumar, Research Methodology, A step by step approach (Pearson Publishers, New Delhi, 2005. 4. Management Research Methodology : K. N. Krishnaswami, Appa Iyer and M Mathirajan, Pearson Education, Delhi, 2010 5. Hand Book of Research Methodology : M N Borse, Sree Nivas Publications, Jaipur, 2004 6. Business Research Methods: William G Zikmund, South – Western Ltd, 2003 7. Research Methods in Social Science: P K Majumdar, Viva Books Pvt Ltd, New Delhi, 2005 8. Analyzing Quantitative Data: Norman Blaikie, SAGE Publications , London, 2003 9. SPSS for Windows: Pearson Education New Delhi, 2007 | | | | | |

|  |  |  |  |
| --- | --- | --- | --- |
| COURSE CODE | COURSE NAME | L-T-P-C | YEAR |
| **05CE 6391** | **TRANSPORTATION ENGINEERING LAB-I** | 3-1-0-4 | 2015 |
| COURSE OBJECTIVES:   * To explain the properties of aggregates and their tests. * To explain the various tests on bitumen. * To illustrate Rothfutch method of marshal mix design. * To determine strength characteristics of subgrade soil * To make the students aware of pavement evaluation techniques.   **COURSE OUTCOMES:**  **After the completion of the course students should be**   * Able to test the aggregates. * Able to test neat and modified bitumen * Qualified to design bituminous mix Rothfutch method of marshal mix design. * Capable of analyzing the strength of soil by conducting CBR test * Able to analyze the surface characteristics of pavement.   Tests on sub grade soil, aggregates, bitumen, modified binders - Pavement evaluation – skid resistance and roughness measurements, deflection measurement.  Mix Design: Granular Sub-base, Bituminous – DBM, SDBC, BC, etc., Cement concrete. | | | |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| COURSE CODE | | COURSE NAME | L-T-P-C | YEAR | |
| **05CE 6302** | | **TRANSPORTATION SYSTEMS** | 3-1-0-4 | 2015 | |
| COURSE OBJECTIVES:   * To explain the various modes of transportation with their relative merits and demerits * To make the students aware of the development of railways, modern trends in air transportation. * To explain the factors affecting development of harbours and ports and elements in harbour and port planning * To make the students aware of national waterways and pipeline transportation in the country with their important characteristics * To explain the need of urban mass transportation in developing countries and compare the various modes of urban mass transportation systems   **COURSE OUTCOMES:**  After completion of this course the student will be able   * To explain and compare the various modes of transportation with their relative merits and demerits * List and discuss the factors affecting development of harbours and ports. * List the various national waterways in the country and explain their important characteristics. * Explain the need of urban mass transportation in developing countries and compare the various modes of urban mass transportation systems | | | | | |
| MODULE | COURSE CONTENT (36 hrs) | | | | HRS |
| **I** | **Introduction–** Importance of transportation systems– Historical development of transport in India- Road development plans, National Transport Policy Recommendations, Vision 2021, NHDP, PMGSY-IRC and CRRI. Characteristics of different modes of transport, their integration and interaction, impact on environment. | | | | 9 |
| **INTERNAL TEST 1(Module 1)** | | | | | |
| **II** | **Railways systems**– Role of railways in transportation, Advantages of railways, Indian railways, classification, present scenario of railway development in India, Modernization of railways, development of high and super high speed railways. | | | | 9 |

|  |  |  |
| --- | --- | --- |
| **INTERNAL TEST 2(Module 2)** | | |
| **III** | **Airports** - .Overview of air transportation, Role of FAA and ICAO, air transport in India, types of airports, Heliports, STOL ports, complexities in airport planning, elements of airport planning, airport master plan, environmental impact.  **Harbours and Ports** –Development of harbours and ports in India, Harbour infrastructure-port facilities, Containerization, Inland waterways and their characteristics. Pipeline transportation. | 10 |
| **IV** | **Urban transportation systems** –Importance of collective transportation v/s individual transportation, freight transportation, Physical system components of urban transportation, Overview of Mass rapid transit, Light rail transit, Personal rapid transit, guided way systems, Para transit systems, Metro rail, Mono rail, bus rapid transit systems. | 8 |
| **END SEMESTER EXAM (ALL Modules)** | | |
| **REFERENCES:**   1. Khanna, Arora and Jain, Airport planning and design, Nem Chand and Bros., Roorkee. 2. H P Oza and G H Oza, Docks and Harbour Engineering, Charotar Publishing House. 3. Alan Black, Urban Mass Transportation Planning, McGraw-Hill, 1995. 4. Khanna, S.K., Justo, C.E.G., and Veeraragavan, A., `Highway Engineering’,   NemChandandBros, Roorkee   1. S.C.Saxena and S.P.Arora “A text book of Railway Engineering”, Dhanpat Rai publications | | |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| COURSE CODE | | COURSE NAME | L-T-P-C | YEAR | |
| **05CE6304** | | **TRANSPORTATION ECONOMICS** | 3-1-0-4 | 2015 | |
| COURSE OBJECTIVES:   * + To provide solid introduction to demand and cost analyses.   + Identificationofvariouscostsandbenefitsassociatedwithhighwayconstruction,maintenance, operations etc.   + To introduce the various concepts of generation and screening of projects and various methods of economic analysis.   + Introduction to the fundamentals of financing and funding for transportation projects.   **COURSE OUTCOMES:**   * Understandtheprincipleofeconomicsanditsapplicationintransportation * Understand the benefits and costs associated with various transport projects and   its monetary evaluation   * Familiarization with the application of various methods of economic analysis   and their comparison. | | | | | |
| MODULE | COURSE CONTENT (36 hrs) | | | | HRS |
| **I** | **Introduction:** Need for economic evaluation, costs and benefits of transport project, time horizon, basic principles, interest rate, and time value of money, Supply and demand Models, Consumer's surplus and social surplus criteria, framework of social accounting: accounting rate of interest, social opportunity cost, rate of interest, social time preference rate of interest, accounting prices of goods and services. | | | | 9 |
| **INTERNAL TEST 1(Module 1)** | | | | | |
| **II** | **Benefits due to Transport Improvements:** Direct Benefits: Reduced vehicle operation costs, value of travel time savings, value of increased comfort and convenience, cost of accident reduction, reduction in maintenance cost; negative benefits due to increased noise and air pollution. Indirect Benefits: Increased land values, increased development and demand.  **Transport Costs:** Fixed and Variable costs, cost of improvement, maintenance cost and other related costs, cost estimating methods, accounting for inflation, theory of transport supply and road planning. | | | | 9 |
| **INTERNAL TEST 2(Module 2)** | | | | | |
| **III** | **Economic Analysis:** The generation and screening of project ideas. Different methods of economic analysis - Annual cost and benefit ratio methods, discounted cash flow method, determination of IRR and NPV. Examples of economic analysis, application economic theory in traffic assignment problem. | | | | 10 |
| **IV** | **Financing:** Economic analysis of projects - Financing of road projects - methods – Private Public Partnership (PPP) - Toll collection - Economic viability of Build- Operate-Transfer Schemes – Risk Analysis - Case Studies. | | | | 8 |
| **END SEMESTER EXAM (ALL Modules)** | | | | | |
| **REFERENCES:**  1. Winfrey R, “Highway Economic Analysis”, International Textbook Company.  2. Kenneth J. Button, “Transport Economics”, Edward Elgar Publishing  3. David A. Hensher, Ann M. Brewer, “Transport: An Economics and Management Perspective”, Oxford University Press  4. Emile Quinet, Roger Vickerman, “Principles of Transport Economics”, Edward Elgar Publishing  5. Road User Cost Study, Central Road Research Institute  6. Ian G. Heggie, Transportation Engineering Economics, McGraw Hill.  7. IRC: SP: 30-1993, Manual on Economic Evaluation of Highway Projects in India  8. Kadiyali L.R., “Principles & Practice of Highway Engineering”, Khanna Publishers, 2003  9. Khanna S.K., Justo C.E.G., “Highway Engineering”, Nem Chand & Bros., Roorkee, 2001  10. Woods, K.B., Berry, D.S. and Goetz, W.H., `Highway Engineering', McGraw Hill Book Co. | | | | | |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| COURSE CODE | | COURSE NAME | L-T-P-C | YEAR | |
| **05CE 6306** | | **TRAFFIC ENGINEERING II** | 3-1-0-4 | 2015 | |
| COURSE OBJECTIVES:   * To learn the principles of traffic forecasting. * To learn the concept of design vehicle and design volume to be considered along with the   Concept of roadway capacity and level of service.   * To explain the importance of highway capacity and accident analysis. * To make the students aware of simulation and its applications in traffic engineering.   **COURSE OUTCOMES:**  After the completion of the course students should be   * Able to learn the principles of traffic forecasting. * Able to estimate the capacities of roadways and intersections and the prevailing level of   service.   * Able to explain the concepts of traffic flow theory and the probabilistic approach in traffic engineering. * Able to apply simulation techniques traffic engineering. | | | | | |
| MODULE | COURSE CONTENT (36 hrs) | | | | HRS |
| **I** | **Traffic Forecast:** General travel forecasting principles, different methods of traffic forecast - Mechanical and analytical methods, Demand relationships  **Design Hourly Volume for Varying Demand Conditions**: Concept of Design vehicle units and determination of PCU under mixed traffic conditions, Price-volume relationships, and demand functions. Determination of design hourly volume; critical hour concept. | | | | 9 |
| **INTERNAL TEST 1(Module 1)** | | | | | |
| **II** | **Highway Capacity:** Factors affecting capacity, level of service; Capacity studies - Capacity of different highway facilities including unsignalised and signalized intersections. Problems in Mixed Traffic flow; Case studies.  **Accident Analysis:** Analysis of individual accidents and statistical data; Methods of representing accident rate; Factors in traffic accidents; influence of roadway and traffic conditions on traffic safety; accident coefficients; Driver strains due to roadway and traffic conditions. | | | | 9 |

|  |  |  |
| --- | --- | --- |
| **INTERNAL TEST 2(Module 2)** | | |
| **III** | **Traffic Flow Theory:** Fundamental flow relationship and their applications, Traffic flow theories and applications; Shock waves; Queuing theory and applications.  **Probabilistic Aspects of Traffic Flow:** Vehicle arrivals, distribution models, gaps and headway distribution models; gap acceptance merging parameters, delay models, applications. | 10 |
| **IV** | **Simulation:** Fundamental principle, application of simulation techniques in traffic engineering, general simulation process, formulation of simulation models, physical, analog and symbolic models, measure of effectiveness, analytical, numerical and Monte Carlo techniques, representation and scanning, physical and memorandum, comparison, applications. | 8 |
| **END SEMESTER EXAM (ALL Modules)** | | |
| **REFERENCES:**   1. Babkov, V.F. “Road conditions and Traffic Safety”, MIR publications, - 1975. 2. Kadiyali, L.R., “Traffic Engineering and Transport Planning”, Khanna Publications. 3. Drew, D.R., “Traffic Flow Theory and Control”, McGraw Hill Book Co. 4. Wohl and Martin, “Traffic Systems Analysis for Engineers and Planners”, McGraw Hill Book Co. 5. Pignataro, Louis, “Traffic Engineering - Theory and Practice”, John Wiley. 6. Barenbag, `Traffic Flow Theory' - Monograph 7. Jerry Banks, John S. Carson II, Bary L. Nelson, David M Nicol, “Discrete event system Simulation”, PHI India | | |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| COURSE CODE | | COURSE NAME | L-T-P-C | YEAR | |
| **05CE6322** | | **ENVIRONMENTAL IMPACT ASSESSMENT** | 3-1-0-4 | 2015 | |
| COURSE OBJECTIVES:   * Explain the concepts of environmental impact assessment and apply in the projects. * List and define various indicators such as terrestrial subsystems, Indicators aquatic subsystems, * Socio-economic and able to Select various indicators for EIA studies. * Explain the impacts of transportation related components on environment * Explain and illustrate the methodologies for environmental impact assessment   **COURSE OUTCOMES:**  After completion of the course the student will able to   * To describe the environmental imbalances, indicators and explain the concept of EIA * To identify and describe elements to be affected by the proposed developments and/or likely to cause adverse impacts to the proposed project, including natural and man-made environment; * To assess the impacts of various development on environment * To summarise the methodologies for carrying out environmental impact assessment | | | | | |
| MODULE | COURSE CONTENT (36 hrs) | | | | HRS |
| **I** | Introduction: Concepts of environmental impact analysis, key features of National environmental policy act and its implementation, screening in the EIA process, utility and scope of EIA process, Environmental protection acts EIA at national level.  Conceptual approach for environmental impact studies, planning and management of impact studies, matrix and network methodologies for impact identification, description of the affected environmental – environmental indices. | | | | 9 |
| **INTERNAL TEST 1(Module 1)** | | | | | |
| **II** | Prediction and Assessment of Impact on Air Environment: Basic information on air quality, sources of air pollutants, effects of air pollutants, key legislations and regulations, conceptual approach for addressing air environment impacts, impact prediction approaches, assessment of significance of impacts, identification and incorporation of mitigation measures. | | | | 9 |

|  |  |  |
| --- | --- | --- |
| **INTERNAL TEST 2(Module 2)** | | |
| **III** | Prediction & Assessment of Impact on Noise & Social Environment: Basic information on noise, key legislation and guidelines, conceptual approach for addressing noise environment impacts, impact prediction methods, assessment of significance of impacts, identification and incorporation of mitigation measures Conceptual approach for addressing socio-economic impacts, traffic and transportation system impacts, visual impacts, scoring methodologies for visual impact analysis | 10 |
| **IV** | Decision Methods for Evaluation of Alternatives: Conceptual basis for trade-off analysis, weighting of decision factors, scaling, rating or ranking of alternatives, development of decision matrix.  Public participation in environmental decision making: Regulatory requirements, advantages and disadvantages, environmental impact assessment process, objectives of public participation, selection of public participation techniques, techniques for conflict management and dispute resolution, verbal communication in EIA studies. | 8 |
| **END SEMESTER EXAM (ALL Modules)** | | |
| **REFERENCES:**  1. CANTER, L.W., Environmental impact assessment, McGraw-Hill, 1997  2. Betty Bowers Marriott, Environmental Impact Assessment: A Practical Guide, McGraw-Hill Professional, 1997.  3. Peter Morris & Riki Therivel, Methods of Environmental Impact Assessment, Routledge, 2001.  4. Denver Tolliver, Highway Impact Assessment, Greenwood Publishing Group, 1993.  5. R. K. Jain, L. V. Urban, G. S. Stacey, H. E. Balbach, Environmental Assessment, McGraw-Hill Professional, 2001. | | |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| COURSE CODE | | COURSE NAME | L-T-P-C | YEAR | |
| **05CE 6324** | | **OPTIMISATION TECHNIQUES** | 3-1-0-4 | 2015 | |
| COURSE OBJECTIVES:   * + - * To study fundamentals of linear programming.       * To get an idea of advanced linear programming.       * To make the students aware of dynamic programming and game theory.       * To study the basics of network models.   **COURSE OUTCOMES:**  After the completion of the course students should be   * Able to study fundamentals of linear programming. * Able to study advanced linear programming. * Able to apply the concepts of dynamic programming and game theory in transportation problems. * Capable of using network models in traffic engineering. | | | | | |
| MODULE | COURSE CONTENT (36 hrs) | | | | HRS |
| **I** | Elementary Linear Programming: Systems of linear equations & inequalities – Convex sets – Convex functions – Formulation of linear programming problems - Theory of Simplex method – Simplex Algorithm – Charne’s M-Method – Two phase method – Duality in linear programming – Dual Simplex method | | | | 9 |
| **INTERNAL TEST 1(Module 1)** | | | | | |
| **II** | Advanced Linear Programming: Sensitivity analysis – Parametric programming – Bounded Variables problem – Transportation problem – Integrality property – MODI method – Degeneracy – Unbalanced problem – Assignment Problem – Development of Hungarian method – Routing problem. | | | | 9 |
| **INTERNAL TEST 2(Module 2)** | | | | | |
| **III** | Dynamic Programming and Game Theory: Nature of Dynamic Programming problem – Bellman’s optimality principle. Cargo loading problem – Replacement problem – Multistage production planning and allocation problem – Rectangular Games – Two person – zero sum games – Pure and mixed strategies – 2 x n and mix 2 games. Relation between theory of games and linear programming | | | | 10 |
| **IV** | Network Path Models: Tree Networks – Minimal Spanning Tree –Kruskal’s Algorithm ,Prim’s Algorithm- Shortest path problems – Solution methods – Dijkstra’s Method – Floyd’s Algorithm – Network flow Algorithms – Maximal flow algorithm – The method of Ford and Fulkerson | | | | 8 |
| **END SEMESTER EXAM (ALL Modules)** | | | | | |
| **REFERENCES:**  1. Bazarra M. S. Jarvis J. J, H. D. Sherali-Linear programming and Network flows – John Wiley, II edition, 1990.  2. Bazarra M. S. Sherali. H. D, & Shetty. C. M. Nonlinear Programming Theory and Algorithms – John Wiley, II edition, 1993.  3. Hadley. G. Linear Programming, Narosa Publishing House, 1990.  4. Hillier F. S & Liebermann G. T. Introduction to OR. Mc. Grand Hill, VII edition, 2010  5. Taha. H. A. Operations Research – An introduction, Prentice Hall, India, VI edition, 1999. | | | | | |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| COURSE CODE | | COURSE NAME | L-T-P-C | YEAR | |
| **05CE 6326** | | **TRAFFIC FLOW THEORY** | 3-1-0-4 | 2015 | |
| COURSE OBJECTIVES:   * To learn the relationships between the parameters of traffic flow and the types of flow theories. * To study stream characteristics of traffic using distributions. * To learn the concept of design vehicle and design volume to be considered along with the   Concept of roadway capacity and level of service.   * To study the fundamentals of queuing theory relevant to traffic engineering. * Learn the probabilistic aspects of vehicle arrivals, gap acceptance and delays. * Learn the principles of traffic forecasting and simulation in traffic engineering.   **COURSE OUTCOMES:**  **After the completion of the course students should be**   * Able to apply the flow theories to field situations such as toll booths, diversion measures etc. * Able to estimate the capacities of roadways and intersections and the prevailing level of service. * Able to apply the concepts of vehicle arrivals to field situations such as exit ramps, entry ramps etc. * Able to appreciate the process of traffic forecasting and simulation in traffic engineering | | | | | |
| MODULE | COURSE CONTENT (36 hrs) | | | | HRS |
| **I** | **Traffic stream characteristics and Description using distributions:** Measurement, Microscopic and Macroscopic study of Traffic Stream Characteristics Goodness of Fit Tests - Flow, speed and concentration; Use of counting, Interval and Translated Distributions for describing Vehicle Arrivals, Headways, Speeds, Gaps and Lags; Fitting of Distributions  **Traffic Stream Models:** Fundamental Equation of Traffic flow, Speed-Flow-Concentration Relationships, Normalized relationships, Fluid Flow Analogy Approach, shock Wave Theory, Platoon Diffusion and Boltzman like Behaviour of Traffic Flow, Car-Following Theory, Linear and Non linear Car Following Models, Acceleration Noise | | | | 9 |
| **INTERNAL TEST 1(Module 1)** | | | | | |
| **II** | **Queuing Analysis:** Fundamentals of Queuing Theory, Demand Service Characteristics, Deterministic Queuing Models, Stochastic Queuing Models, Multiple Service Channels, Models of Delay at Intersections and Pedestrian Crossings | | | | 9 |

|  |  |  |
| --- | --- | --- |
| **INTERNAL TEST 2(Module 2)** | | |
| **III** | **Highway Capacity and Level- of – Service Studies**: Concepts, Factors affecting Capacity and Level of Service, Capacity Analysis of Different Highway Facilities, Passenger Car Units, Problems in Mixed Traffic Flow | 10 |
| **IV** | **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. | 8 |
| **END SEMESTER EXAM (ALL Modules)** | | |
| **REFERENCES:**   1. TRB-SR No.165-Traffic Flow Theory, Transportation Research Board, Washington-D.C. 2. May, A.D, Traffic Flow Fundamentals, Prentice-Hall, NJ 3. Drew D.R, Traffic Flow Theory and Control, McGraw-Hill, New York. 4. TRB Special Report 209: Highway Capacity Manual, Transportation Research Board, Washington DC,1985. 5. Wohl M. and Martin, B.V., “Traffic System Analysis for Engineers and Planners”, McGraw-Hill, New York. 6. McShane W R & Roess R P, “Traffic Engineering”, Prentice-Hall, NJ 7. Mannering F.L & Kilareski, W.P., “Principles of Highway Engineering and Traffic Analysis”, John Wiley & Sons. Neylor, T. H et al., “Computer Simulation Techniques”, John Wiley. | | |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| COURSE CODE | | COURSE NAME | L-T-P-C | YEAR | |
| **05CE6332** | | **BRIDGE ENGINEERING** | 3-1-0-4 | 2015 | |
| COURSE OBJECTIVES:   * To make students to learn principles of Structural Design, * It provides the foundation for advanced design and bridge analysis and design. * To evaluate performances of the structures.   **COURSE OUTCOMES:**  On completion of this course, students are able to   * Understand and use the basic concepts in proportioning and design of bridges in terms of aesthetics, geographical location and functionality. * Develop an intuitive feeling about the sizing of bridge elements and the conceptual design part * Assess the load flow mechanism and loads on bridges. * Design of bridge and its foundation starting from conceptual design, selecting suitable bridge, geometry to sizing of its elements | | | | | |
| MODULE | COURSE CONTENT (36 hrs) | | | | HRS |
| **I** | **Planning of bridges:**– Investigation for bridges– need for investigation– selection of site– economical span– subsoil exploration– investigation report– importance for proper investigation–Design of RCC bridges**–** IRC loading– types of bridges– components of bridges– analysis and design of slab bridges and box culvert. | | | | 9 |
| **INTERNAL TEST 1(Module 1)** | | | | | |
| **II** | **Design of girder bridges:–** T-beam bridges– Analysis and design of deck slab, longitudinal girders and cross girders–Pigeaud’s method– Courbon’s method– Morice and Little method– Hendry–Jaegar method– prestressed concrete bridges( simply supported case only). | | | | 9 |
| **INTERNAL TEST 2(Module 2)** | | | | | |
| **III** | **Bearings: –** importance of bearings– bearings for slab bridges– bearings for girder bridges–Design of elastomeric bearings –Joints –Appurtenances. Substructure- different types- materials for piers and abutments- substructure design– piers and abutments – shallow footings – well foundation. | | | | 10 |
| **IV** | **Construction methods:** – Inspection and maintenance and construction of bridges–case studies of recently constructed major bridges–critical studies of failure of major bridges.Features of suspension bridges and cable stay bridges. | | | | 8 |
| **END SEMESTER EXAM (ALL Modules)** | | | | | |
| **REFERENCES:**  1. Raina V.K (1991), “Concrete Bridge Practice– Analysis, design & economics”, Tata Mc–GrawHill, publishing company, New Delhi.  2. Raina V.K (1988), “Concrete Bridge Practice– Construction Maintenance & Rehabilitation”, Tata Mc–GrawHill, publishing company, New Delhi.  3. Victor D.J (19991), “Essentials of Bridge Engineering”, Oxford & IBH publishing company, New Delhi.  4. Ponnuswami S (1993), “Bridge Engineering”, Tata Mc–GrawHill, publishing company, New Delhi.  5. Krishna Raju N (1996), “Design of Bridges”, TataMcGrawHill, publishing company, New Delhi.  6. Relevant IS Codes, and IRC Codes. | | | | | |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| COURSE CODE | | COURSE NAME | L-T-P-C | YEAR | |
| **05CE6334** | | **REMOTE SENSING AND GIS IN TRANSPORTATION PLANNING** | 3-1-0-4 | 2015 | |
| COURSE OBJECTIVES:   * To explain the purpose of accurate mapping of all features under different spatial and temporal scales of all kinds of terrain and land under water bodies. * To discuss on the advantages of remote sensing compared to traditional surveying techniques in terms of time, accuracy and output. * To explain the purpose and methods of obtaining abstract data both spatial and temporally. * To illustrate the application of GIS and remote sensing in solving real world transportation problems   **COURSE OUTCOMES:**   * After completion of the course the student should be able to * Choose the remote sensing image from different sensors, resolutions, spatial and temporal scales. * Explain and to comprehend large tracks of earth surface with less time and cost but more accuracy. * Communicate to the common man his analysis of different problems developments, benefits by Preparing different thematic maps. * Apply GIS and remote sensing techniques in solving real world transportation problems | | | | | |
| MODULE | COURSE CONTENT (36 hrs) | | | | HRS |
| **I** | **Introduction to remote sensing:** Definition – Components of Remote Sensing – Energy, Sensor, Interacting Body –Active and Passive Remote Sensing – Platforms – Aerial and Space Platforms –Balloons, Helicopters, Aircraft and Satellites – Electromagnetic Radiation – EMR Spectrum | | | | 9 |
| **INTERNAL TEST 1(Module 1)** | | | | | |
| **II** | **Introduction to GIS:** Basic Concept and Components – Hardware, Software – Data Spatial and non-spatial –Geo-referencing – Map Projection – Types of Projection – Simple Analysis – Data retrieval and querying | | | | 9 |
| **INTERNAL TEST 2(Module 2)** | | | | | |
| **III** | **Data structures and analysis:** Database – Raster and Vector data structures – Data storage – Run length,Chain and Block coding – Vector data storage – Topology – GIS Modeling - Raster and Vector data analysis– Buffering and overlaying techniques – Network Analysis – Spatial Analysi**s** | | | | 10 |
| **IV** | **Applications in transportation:** Highway and Railway Alignment, location of transport terminals and roadside facilities, bus stops – Route optimization – Bus route rationalization – Accident analysis –Applications of Aerial Photography and Satellite Imageries. | | | | 8 |
| **END SEMESTER EXAM (ALL Modules)** | | | | | |
| **REFERENCES:**   1. Burrough P.A, Principles of GIS for Land Resources Assessment, Oxford Publication, 1994. 2. Jeffrey Star and John Ester, Geographical Information System – An Introduction, Prentice Hall Inc., Englewood Cliffe, 1990. 3. Marble, D.F, Calkins, H.W and Penquest, Basic Readings in GIS, Speed System Ltd., New York, 1984 4. Anji Reddy, Remote Sensing and Image Interpretation, John Wiley and Sons Inc. New York, 1987. 5. M.G.Srinivas, Remote Sensing Applications, Narosa Publishing House, 2001 | | | | | |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| COURSE CODE | | COURSE NAME | L-T-P-C | YEAR | |
| **05CE6336** | | **ROAD SAFETY AND ENVIRONMENT** | 3-1-0-4 | 2015 | |
| COURSE OBJECTIVES:  • Explain the causes of accidents, statistical measures of accident data analysis  • Explain road safety audit principle and procedure, various traffic management techniques and their effectiveness  • Explain different transport related pollution  • Explain the concepts of EIA process  **COURSE OUTCOMES:**  After the completion of the course students should be  • Able to acquire knowledge about statistical methods for accident analysis  • Able to remember the process of road safety audit and the measures of improving road safety.  • Capable of analyzing the factors affecting the transport related pollution  • Capable of analyzing the EIA requirements of Highways projects | | | | | |
| MODULE | COURSE CONTENT (36 hrs) | | | | HRS |
| **I** | **Introduction:** Multidisciplinary approach to planning for traffic safety and injury control; Causes of road accidents; Control measures; Roles of vehicle, roadway traffic, driver, and environment, crash and injury causations; Accident analysis, pre crash and post crash models; Conflict points. | | | | 9 |
| **INTERNAL TEST 1(Module 1)** | | | | | |
| **II** | **Road Safety Audit and Traffic Management Techniques:**  Principles- Procedures and Practice, Code of Good Practice and Checklists. Road safety Audit; stages of auditing; methods involved; case studies. Road safety issues and engineering, education, enforcement measures for improving road safety. Local area management. Low cost measures, area traffic control. Various types of medium and long term traffic management measures and their uses. Evaluation of the effectiveness and benefits of different traffic management measures, management and safety practices during road works. | | | | 9 |
| **INTERNAL TEST 2(Module 2)** | | | | | |
| **III** | **Transport related pollution**; Road transport related air pollution, sources of air pollution, effects of weather conditions, Vehicular emission parameters, Urban and non urban traffic noise sources, Noise pollution, noise barriers; pollution standards, measurement and analysis of vehicular emission; Imitative measures. | | | | 10 |
| **IV** | **EIA:** Introduction: Concepts of environmental impact analysis, key features of National environmental policy act and its implementation, screening in the EIA process, utility and scope of EIA process, Environmental protection acts EIA at national level. EIA requirements of Highways projects, EIA practices in India. | | | | 8 |
| **END SEMESTER EXAM (ALL Modules)** | | | | | |
| **REFERENCES:**   1. Evans S.K., Traffic Engineering Handbook, Institute of Traffic Engineers, USA 2. Wohl M., Martin B.V., “Traffic system analysis of Engineers & Planners”, McGraw Hill, New York. 3. Babkov V.F., “Road Conditions & Traffic Safety”, MIR Publishers, Moscow, 1975 4. Kadiyali L.R., “Traffic Engineering & Transport Planning”, Khanna Publishers, 2003 5. Little A.D., “The state of art of Traffic Safety”, Paraeger Publishers, New York, 1970   6. Canter L.W., Environmental impact assessment, McGraw-Hill, 1997  7. Betty Bowers Marriott, Environmental Impact Assessment: A Practical Guide, McGraw-Hill Professional, 1997.  8. Relevant IRC codes. | | | | | |

|  |  |  |  |
| --- | --- | --- | --- |
| COURSE CODE | COURSE NAME | L-T-P-C | YEAR |
| **05CE 6366** | **SEMINAR- I** | 3-1-0-4 | 2015 |
| Each student shall prepare a seminar paper on any topic of interest related to the core/elective courses being undergone in the first semester of the M. Tech programme. He/she shall select paper from reputed journals. They should get the paper approved by the Programme Coordinator/Faculty Members in the concerned area of specialization and shall present it in the class in the presence of Faculty in-charge of seminar class. Every student shall participate in the seminar. Grade will be awarded on the basis of the student’s paper, presentation and his/her participation in the seminar.  **Goals**: This course is designed to improve written and oral presentation skills and to develop confidence in making public presentations, to provide feedback on the quality and appropriateness of the work experience, and to promote discussions on design problems or new developments. | | | |

|  |  |  |  |
| --- | --- | --- | --- |
| COURSE CODE | COURSE NAME | L-T-P-C | YEAR |
| **05CE 6388** | **MINI PROJECT** | 3-1-0-4 | 2015 |
| Mini Project shall be done in an industry/institute approved by the department and under the guidance of a staff member in the concerned field. At the end of the work he/she has to submit a report which is to be evaluated by the internal academic auditing cell. | | | |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| COURSE CODE | | COURSE NAME | L-T-P-C | YEAR | |
| **05CE 7341** | | **GROUND IMPROVEMENT TECHNIQUES** | 3-1-0-4 | 2015 | |
| COURSE OBJECTIVES:   * Explain various ground improvement techniques and the types of compaction and its effect on soil properties * Explain the types of drains and various stabilization techniques * Inform about the types of reinforcement and design principles, grouting techniques * Introduction of various type of geotextiles and functions  COURSE OUTCOMES: After the completion of the course students should be   * Capable of remembering various ground improvement techniques * Capable of selecting different stabilization process of soil using lime, fly ash etc * Able to remember principles and methods of grouting techniques * Understandvarioustypesofgeosynthetics and its applications | | | | | |
| MODULE | COURSE CONTENT (36 hrs) | | | | HRS |
| **I** | Introduction to Ground improvement techniques: Role of ground improvement in foundation engineeringDrainage and Dewatering: Methods of dewatering and pressure relief-deep well drainage vacuum dewatering systems - drainage by electroosmosis – analysis and design of dewatering systems – installation and operation of dewatering systems-well point system, shallow & deep well system, vacuum dewatering, electro osmosis | | | | 9 |
| **INTERNAL TEST 1(Module 1)** | | | | | |
| **II** | In-situ densification methods in granular soils: Introduction-mechanical stabilization-deep dynamic compaction-vibro compaction- blasting.  In-situ densification methods in cohesive soils: Preloading- Concept of three dimensional consolidation –sand drain design and methods of their installation – fabric drains-stone columns & lime piles (installation techniques only)Cement and lime stabilization: cement stabilization-types of soil cement-factors affecting soil cement mixing, Lime stabilization-effect of lime on soil properties. | | | | 9 |
| **INTERNAL TEST 2(Module 2)** | | | | | |
| **III** | Introduction to grouts and grouting- basic functions –permeation grouting, compaction grouting, hydro fracturing- -Grout ability Ratio - Classification of grouts.  Suspension grouts –cement grouts –admixtures used & their role – bentonites grouts –cement and bentonite grouts – lime grouts – asphaltic emulsion grouts – Solution grouts – aqueous solution - non-aqueous solutions – colloidal solutions – advantages and disadvantages of solution grouts over suspension grouts. Properties of grouts: viscosity, fluidity, stability, rigidity, thixotropy, Applications of grouting | | | | 10 |
| **IV** | Earth Reinforcement- Concept of reinforced earth –load transfer mechanism and strength development – Stability analysis of reinforced earth retaining walls-external stability analysis, internal stability analysis (brief mention about the methods only) - application areas.  Geosynthetics: Classification- Functions of geotextiles as separators, reinforcement, filters and in drainage-damage and durability of geotextiles. | | | | 8 |
| **END SEMESTER EXAM (ALL Modules)** | | | | | |
| **REFERENCES:**   1. Robert M. Koerner - Construction and Geotechnical Methods in Foundation Engineering, Mc Graw Hill 2. C.J.F.P Jones - Earth Reinforcement and soil structures,Buuterworths 3. Purushothama Raj.P – Ground Improvement techniques ,Laxmi Publications(P) Ltd.,   New Delhi   1. Shashi.K.Gulhati & Manoj Datta –Geotechnical Engineering , Tata McGraw Hill 2. Shroff AV and Shah. D.L –Grouting technology in tunneling and Dam construction,   Oxford and IBH   1. Robert M. Koerner – “Designing with Geosynthetics”, Prentice Hall Mc Graw Hill 2. G. L. Sivakumar, G. L. Babu, Soil Reinforcement and geosythetics, University Press | | | | | |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| COURSE CODE | | COURSE NAME | L-T-P-C | YEAR | |
| **05CE 7343** | | **PAVEMENT MATERIALS** | 3-1-0-4 | 2015 | |
| COURSE OBJECTIVES:   * To explain the properties of aggregates and different tests * To explain the origin, properties, constituents of bitumen and tar * To explain about cut back bitumen and bitumen emulsions, test procedures and the uses * Make the students aware of the mechanism of stripping, adhesion failures. * To illustrate the bituminous mix design method. * To get an idea of modified binders.  COURSE OUTCOMES: After the completion of the course students should be   * Able to acquire and apply knowledge of properties of road aggregates. * Able to acquire and apply knowledge of properties of binders. * Capable of analyzing adhesion failure and mechanism of stripping.   Able to designs bituminous mixes. | | | | | |
| MODULE | COURSE CONTENT (36 hrs) | | | | HRS |
| **I** | **Subgrade soil:** Soil composition and structure, classification relevant to pavement design.  **Aggregates:** Origin, classification, requirements, properties and tests, concepts of size and gradation. | | | | 9 |
| **INTERNAL TEST 1(Module 1)** | | | | | |
| **II** | **Bitumen and Tar:** Origin, chemical constitution, requirements, properties and tests.  Bituminous Emulsions and Cutbacks:Preparation, characteristics, tests and uses. | | | | 9 |
| **INTERNAL TEST 2(Module 2)** | | | | | |
| **III** | **Modified binders:** HMA, WMA, CMA**.**  **Adhesion of Bituminous Binders to Road Aggregates**: Adhesion failure, mechanism of stripping, tests and methods of improving adhesion. | | | | 10 |
| **IV** | **Bituminous Mixes:** Mechanical properties, dense and open textured mixes, bituminous mix design by Marshal Method.  **Cement concrete for pavement construction**: requirements, mix design for cement concrete pavements, filler and sealer materials. | | | | 8 |

|  |
| --- |
| **END SEMESTER EXAM (ALL Modules)** |
| **REFERENCES:**   1. Khanna, S.K., Justo, C.E.G., and Veeraragavan, A., `Highway Engineering**’**, Nem Chand and Bros, Roorkee, 2014. 2. Partha Chakroborty and Animesh Das, ‘Principles of Transportation Engineering’, Prentice Hall (India), New Delhi, 2011. 3. Relevant IRC and MORTH Publications. 4. RRL, D S I R , ` Bituminous Materials in Road Construction’, HMSO Publication 5. RRL, D S I R , ` Soil Mechanics for Road Engineers’, H M S O Publication |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| COURSE CODE | | COURSE NAME | L-T-P-C | YEAR | |
| **05CE 7345** | | **TRANSPORTATION FACILITY DESIGN** | 3-1-0-4 | 2015 | |
| COURSE OBJECTIVES:   * To get an idea of different types of intersections. * To explain the functional planning and design of terminal buildings. * To make the students aware of geometric design of the highway cross section elements. * To illustrate the design of different types of intersections.   **COURSE OUTCOMES:**  After the completion of the course students should be   * Able to get an idea of different types of intersections. * Able to explain the functional planning and design of terminal buildings. * Able to make the students aware of geometric design of the highway cross section elements. * Capable of designing various intersections. | | | | | |
| MODULE | COURSE CONTENT (36 hrs) | | | | HRS |
| **I** | **Introduction:** Design of highways, design of at-grade intersections, design of signalized intersection, design of grade separated intersection, terminal design, and design of facilities for non-motorized transport. | | | | 9 |
| **INTERNAL TEST 1(Module 1)** | | | | | |
| **II** | **Terminal Planning & Design Terminal Planning & Design:** Terminal functions, analysis of terminals, process flow charts of passenger & goods terminals, terminal processing time, waiting time, capacity & level of service concept, study of typical facilities of highway, transit, airport and waterway terminals, concept of inland port. | | | | 9 |
| **INTERNAL TEST 2(Module 2)** | | | | | |
| **III** | **Design of Highways:** Hierarchy of highway system, functions, design designations, concepts in horizontal & vertical alignment, integration, optical design, geometrical standards for mobility & accessibility components, landscaping and safety considerations, evaluation and design of existing geometrics. | | | | 10 |
| **IV** | **Design of Intersections**: Review of design of at-grade intersections, signal coordination – graphic methods & computer techniques, grade separated intersections – warrants for selection, different types & geometric standards, spacing & space controls, ramps & gore area design. | | | | 8 |
| **END SEMESTER EXAM (ALL Modules)** | | | | | |
| **REFERENCES:**   1. Kadiyali, L.R., “Traffic Engineering and Transport Planning”, Khanna Publishers. 2. IRC-SP41: Guidelines for the Design of At-Grade Intersections in Rural & Urban Areas 3. Salter, R J., Highway Traffic Analysis and Design, ELBS. 4. Edward K. Morlock, “Introduction to Transportation. | | | | | |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| COURSE CODE | | COURSE NAME | L-T-P-C | YEAR | |
| **05CE 7351** | | **PAVEMENT EVALUATION & MANAGEMENT** | 3-1-0-4 | 2015 | |
| COURSE OBJECTIVES:   * Recall the importance of evaluation and strengthening of pavements * Introduce the various methods of structural and functional evaluation of rigid and flexible pavements * Introduce the various methods of overlay design * Discuss the need for pavement management and explain the techniques involved   **COURSE OUTCOMES:**  After completion of the course the student will be able to   * Identify the factors causing deterioration of pavements and propose remedial measures * Carry out structural and functional evaluation of flexible and rigid pavements * Explain the various methods of overlay design * Develop a framework for efficient pavement management system | | | | | |
| MODULE | COURSE CONTENT (36 hrs) | | | | HRS |
| **I** | Structural and functional requirements of flexible and rigid pavements: pavement distress; different types of failures, causes and remedial measures Pavement Surface Condition & Its Evaluation: Methods of Measurement of Skid Resistance, Unevenness, Ruts and Cracks. Pavement Surface Condition Evaluation by Physical Measurements, by Riding Comfort and Other Methods; their Applications. PCI & PSI | | | | 9 |
| **INTERNAL TEST 1(Module 1)** | | | | | |
| **II** | Pavement Structure & Its Evaluation: Factors affecting Structural Condition of Flexible and Rigid Pavements; Effects of Subgrade Soil, Moisture, Pavement Layers, Temperature, Environment and Traffic on Structural Stability, Pavement Deterioration; Evaluation by Non-Destructive Tests such as FWD, Benkelman Beam Rebound Deflection, Plate Load Test, Wave Propagation and other methods of Load Tests; Evaluation by Destructive Test Methods, and Specimen Testing | | | | 9 |
| **INTERNAL TEST 2(Module 2)** | | | | | |
| **III** | Pavement Overlays & Design: Pavement Overlays, Design of Flexible Overlay over Flexible Pavement by Benkelman Beam Deflection and other Methods, Flexible Overlays and Rigid Overlays over Rigid Pavements, Use of Geosynthetics in Pavement Overlays. | | | | 10 |
| **IV** | Pavement Management System: Concepts of pavement management systems, pavement performance prediction – concepts, modeling techniques, structural conditional deterioration models, mechanistic & empirical models, functional condition deterioration models, unevenness deterioration models and other models, ranking and optimization methodologies. | | | | 8 |
| **END SEMESTER EXAM (ALL Modules)** | | | | | |
| **REFERENCES:**  1. Yoder E.J. and Witezak, Principles of Pavement Design, II Ed., John Wiley and Sons, 1975.  2. Woods, K.B., Highway Engineering Hand Book, McGraw Hill Book Co.  3. David Croney, The Design and Performance of Road Pavements, HMSO Publications, 2008.  4. Haas and Hudson, Pavement Management System, McGraw Hill Book Co., New York, 1982.  5. Per Ullidtz, Pavement Analysis, Elsevier, Amsterdam, 1998.  6. HRB/TRB/IRC/International Conference on Structural Design of Asphalt Pavements, 1988.  7. SHAHIN, M Y, Pavement management for airport, roads and parking lots, Chapman and hall 2005.  8. Yang H. Huang, Pavement Analysis and Design, Prentice Hall, 2003. | | | | | |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| COURSE CODE | | COURSE NAME | L-T-P-C | YEAR | |
| **05CE 7353** | | **PUBLIC TRANSPORT PLANNING AND DESIGN** | 3-1-0-4 | 2015 | |
| COURSE OBJECTIVES:   * To make the students aware of the importance of public transport system. * To explain the transit network planning. * To explain transit scheduling procedures * To design public transport facilities   **COURSE OUTCOMES:**  After the completion of the course the students should be able   * To explain the importance of public transport system. * To plan transit network. * To explain transit scheduling and organizational structure. * To plan and design bus terminals and other amenities. | | | | | |
| MODULE | COURSE CONTENT (36 hrs) | | | | HRS |
| **I** | **Public Transport**. Definitions, modes of public transport and comparison, public transport travel characteristics, trip chaining, technology of bus, rail, rapid transit systems, basic operating elements. | | | | 9 |
| **INTERNAL TEST 1(Module 1)** | | | | | |
| **II** | **Transit Network Planning**: Planning Objectives, principles, considerations, transit lines – types, geometry and characteristics, transit routes and their characteristics, timed transfer networks, prediction of transit usage, evaluation of network, accessibility considerations, | | | | 9 |
| **INTERNAL TEST 2(Module 2)** | | | | | |
| **III** | **Transit Scheduling:** Components of scheduling process, determination of service requirements, scheduling procedure, marginal ridership, crew scheduling.  Transit Agency and Economics: Organizational structure of transit agency, management and personnel, transit system statistics, performance and economic measures, operations, fare structure. | | | | 10 |
| **IV** | **Design of Facilities**: Design of bus stops, design of terminals – principles of good layout, types of layout, depot location, twin depot concept, crew facilities and amenities. | | | | 8 |

|  |
| --- |
| **END SEMESTER EXAM (ALL Modules)** |
| **REFERENCES:**  1. Vukan R. Vuchic, Urban Transit : Operations, Planning and Economics, Wiley, 2005.  2. Peter White, Public Transport, UCL Press, 2008.  3. Kadiyali L.R., Traffic Engineering and Transport Planning, Khanna Publishers,1987.  4. Khisty, C J., Transportation Engineering – An Introduction, Prentice-Hall, NJ, 2002.  5. TCRP Report 30, TCRP Report 95, TCRP Report 100  6. Ceder A, Public Transit Planning and Operation, Elsevier, 2007. |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| COURSE CODE | | COURSE NAME | L-T-P-C | YEAR | |
| **05CE 7355** | | **ADVANCED HIGHWAY MATERIALS** | 3-1-0-4 | 2015 | |
| COURSE OBJECTIVES:   * To explain the nature and properties of aggregates. * To illustrate the properties, uses and principles of bituminous construction. * To make the students aware of cement/concrete based materials in pavement construction. * To get an idea of advanced materials in highway construction.   **COURSE OUTCOMES:**  After the completion of the course students should be   * Able to acquire and apply knowledge of properties of road aggregates. * Able to acquire and apply knowledge of properties of binders. * Capable of designing concrete mix. * Able to design pavement using advanced materials. | | | | | |
| MODULE | COURSE CONTENT (36 hrs) | | | | HRS |
| **I** | aggregates for pavement base – aggregate for bituminous mixture – aggregate for Portland Cement Concrete – light weight aggregate – tests on aggregate – specification. | | | | 9 |
| **INTERNAL TEST 1(Module 1)** | | | | | |
| **II** | **Bituminous Materials**: conventional and modified binders – production – types and grade – physical and chemical properties and uses – types of asphalt pavement construction – principles of bituminous pavement construction – tests on bituminous materials. Bituminous Mix design – modified mixtures – temperature susceptibility and performance. | | | | 9 |
| **INTERNAL TEST 2(Module 2)** | | | | | |
| **III** | **Cement /concrete based materials:** Cement – properties – PCC mix design and properties – modified PCC – Mix Design – Behavior – Performance – Tests on Cement and Concrete mixes. High Performance Concrete – low shrinkage – increased strength. | | | | 10 |
| **IV** | **Composites, Plastics and Geosynthetics**: Plastics and polymerization process – properties – durability and chemical composition – Reinforced Polymer Composites – Geosynthetics – Dry Powdered Polymers – Enzymes. Reclaimed / Recycled Waste Products Reclaimed Materials – waste products in civil engineering applications – effect of waste products on materials, structure and properties – self healing and smart materials – locally available materials. | | | | 8 |

|  |
| --- |
| **END SEMESTER EXAM (ALL Modules)** |
| **REFERENCES:**   1. P. T. Sherwood, *Alternative Materials in Road Construction*, Thomas Telford Publication, London, 1997. 2. RRL, DSIR, *Soil Mechanics for Road Engineers,* HMSO, London , 1995 3. Koerner, R. M. *Designing with Geosynthetics,* Prentice Hall, Englewood Cliffs, New Jersey,U.S.A.   Shan Somayaji, *Civil Engineering Materials*, second edition, Prentice Hall Inc., 2001. |

|  |  |  |  |
| --- | --- | --- | --- |
| COURSE CODE | COURSE NAME | L-T-P-C | YEAR |
| **05CE7367** | **SEMINAR - II** | 3-1-0-4 | 2015 |
| Each student is required to present a technical paper on a subject approved by the department. The paper should be on a recent advancement/trend in the field of Transportation engineering. He/she shall submit a report of the paper presented to the department. | | | |

|  |  |  |  |
| --- | --- | --- | --- |
| COURSE CODE | COURSE NAME | L-T-P-C | YEAR |
| **05CE 7387** | **PROJECT (PHASE-I)** | 3-1-0-4 | 2015 |
| The thesis (Phase-I) shall consist of research work done by the candidate or a comprehensive and critical review of any recent development in the subject or a detailed report of project work consisting of experimentation/numerical work, design and or development work that the candidate has executed.  In Phase-I of the thesis, it is expected that the student should decide a topic of thesis, which is useful in the field or practical life. The students should refer national and international journals, proceedings of national and international seminars and conferences. Emphasis should be given to the introduction to the topic, literature review, and scope of the proposed work along with some preliminary work / experimentation carried out on the thesis topic.  Student should submit Phase-I thesis report in two copies covering the content discussed above and highlighting the features of work to be carried out in part-I of the thesis. Student should follow standard practice of thesis writing.  The candidate will deliver a talk on the topic and the assessment will be made on the basis of the term work and talks there on by a panel of internal examiners one of which will be the internal guide. These examiners should give suggestions in writing to the student to be incorporated in thesis work Phase-II. | | | |

|  |  |  |  |
| --- | --- | --- | --- |
| COURSE CODE | COURSE NAME | L-T-P-C | YEAR |
| **05CE 7388** | **PROJECT (PHASE II)** | 3-1-0-4 | 2015 |
| The thesis (Phase-I) shall consist of research work done by the candidate or a comprehensive and critical review of any recent development in the subject or a detailed report of project work consisting of experimentation/numerical work, design and or development work that the candidate has executed.  In Phase-I of the thesis, it is expected that the student should decide a topic of thesis, which is useful in the field or practical life. The students should refer national and international journals, proceedings of national and international seminars and conferences. Emphasis should be given to the introduction to the topic, literature review, and scope of the proposed work along with some preliminary work / experimentation carried out on the thesis topic.  Student should submit Phase-I thesis report in two copies covering the content discussed above and highlighting the features of work to be carried out in part-I of the thesis. Student should follow standard practice of thesis writing. | | | |