PG Program [M.Tech.- Transportation Engineering] Curriculum Structure

List of Abbreviations

Abbreviation	Title	No of courses	Credits	% of Credits
PSMC	Program Specific Mathematics Course	1	4	5.9
PSBC	Program Specific Bridge Course	1	3	4.4
DEC	Department Elective Course	3	9	13.2
MLC	Mandatory Learning Course	2	0	0
PCC	Program Core Course	6	18	26.5
LC	Laboratory Course	4	6	8.8
IOC	Interdisciplinary Open Course	1	3	4.4
LLC	Liberal Learning Course	1	1	1.5
SLC	Self-Learning Course	2	6	8.8
SBC	Skill Based Course	2	18	26.5

Semester I

Sr. No.	Course Type	Course Code	Course Name	Teaching Scheme			Credits
				L	T	P	
1.	PSMC		Statistics and Optimization	3	1	-	4
2.	PSBC		Sensors and Automation	3	-	-	3
3.	DEC		**Elective – I** 1. Pavement Recycling 2. Highway Geo-technology 3. Advances in Docks and Harbour Engineering 4. Intelligent Transportation Systems 5. Disaster Management 6. Any course approved by BOS	3	-	-	3
4.	PCC		Road Safety and Road Safety Audit	3	-	-	3
5.	PCC		Traffic Engineering and Management	3	-	-	3
6.	PCC		Highway Materials	3	-	-	3
7.	LC		Transportation Engineering Lab Practice- I	-	-	3	2
8.	LC		Seminar	-	-	2	1
				Total Credits			**22**

Semester II

Sr. No.	Course Type	Course Code	Course Name	Teaching Scheme			Credits
				L	T	P	
1.	IOC		Interdisciplinary Open Course -Big Data Analytics	2	-	2	3
2.	DEC		**Elective – II** 1.Sustainable Construction Engineering 2.Design of Underground Structure 3.GIS and Remote Sensing 4.Traffic Flow Modelling and Simulation 5.Concrete Pavements for Highways and Airports 6. Rail and Metro Construction 7. Any course approved by BOS	3	-	-	3
3.	DEC		**Elective – III** 1.Artificial Intelligence in Transportation Engineering, 2.Safety in Highways and Airports, 3.Advanced Concrete Technology, 4.Traffic Operations and Control, 5.Surface and Subsurface Drainage to Pavement Structures 6.Freight Transportation Planning and Logistics 7. Any course approved by BOS	3	-	-	3
4.	LLC	LL-19001	Liberal Learning Course	1	-	-	1
5.	MLC	ML-19011	Research Methodology and Intellectual Property Rights	2	-	-	-
6.	MLC	ML-19012	Effective Technical Communication	1	-	-	-
7.	PCC		Highway Structures	3	-	-	3
8.	PCC		Highway Financing and Policy Analysis	3	-	-	3
9.	PCC		Urban Transportation systems planning	3	-	-	3
10.	LC		Transportation Engineering Lab Practice- II	-	-	3	2
11.	LC		Mini Project	-	-	2	1
				Total Credits			**22**

Semester III

Sr. No.	Course Type	Course Code	Course Name	Teaching Scheme			Credits
				L	T	P	
1.	SBC		Dissertation Phase- I	-	-	18	9
2.	SLC		Massive Open Online Course (MOOC)- I	3	-	-	3
				Total Credits			**12**

Semester IV

Sr. No.	Course Type	Course Code	Course Name	Teaching Scheme			Credits
				L	T	P	
1.	SBC		Dissertation Phase- II	-	-	18	9
2.	SLC		Massive Open Online Course (MOOC)- II	3	-	-	3
				Total Credits			**12**

Semester I

Statistics and Optimization

Teaching Scheme
Lectures: 3hrs/ week
Tutorial: 1hr/week

Examination Scheme
Test 1 and 2: 20 marks each
End-Sem Exam: 60 marks

Course Outcomes

At the end of course, Students will be able to

1. use appropriate statistical method in transportation engineering problems.
2. apply the rule of probability and discrete distributions in solving problems.
3. test the goodness of fit by using statistical decision.
4. apply the knowledge of optimization technique and use statistical software in analysis of transportation engineering problems

Course Content

Introduction: Statistical methods, scope and limitations, population and sample, frequency distribution-measure of central tendency-measures of Dispersion- standard deviation, coefficient of variation, skewness. Variables - scatter diagram, Curve fitting methods, correlation linear regression, and multiple linear regressions. Multivariate data analysis.

Probability: Review, Addition & Multiplication Rules, random Variables, Discrete distributions – Binomial, Poisson, Geometric, Hypergeometric Distribution, Continuous Distribution –Exponential, & normal Distributions, applications in Highway engineering problems.

Statistical decisions: hypothesis testing, significance levels – Tests concerning Mean, testing the equality of means of two populations, tests concerning the variance. Chi–square Test for goodness of fit, The Z-Score Test, The T-Test, Confidence Interval. Forecasting and Time Series Analysis Problems

Linear Programming: methods for maximizing, methods for minimizing, etc. Transportation models, assignment model, queuing theory, Applications in Transportation engineering, Use of mathematical and statistical software packages

References

1. Gupta, S.C. and Kapoor V.K. Fundamentals of Mathematical statistics, Sultan Chand and Sons, 1978.
2. Medhi J (1982) Introduction to statistics. New age publications, New Delhi.
3. Walpole R. E. and R. H. Mayers (1982): Probability and statistics for Engineers and Scientists. Wiley Intl. 2002.
4. Johnson R and G. Bhattacharya (1985): Statistics -Principles and methods. John Wiley, NY.
5. Ross S. M. Probability and statistics for Engineers. Wiley Int. Edition.
6. Kadiyali L.R. Traffic Engineering and Transport Planning, Khanna Publishers, 2004

Sensors and Automation

Teaching Scheme

Lectures: 3hrs/ week

Examination Scheme

Test 1 and 2: 20 marks each

End-Sem Exam: 60 marks

Course Outcomes

At the end of course, Students will be able to

1. Recognize the working of commonly used sensors for measurement of temperature, position, accelerometer, vibration sensor, flow and level.
2. Identify the application of machine vision.
3. Conceptualize signal conditioning and data acquisition methods.
4. Comprehend smart sensors and their applications in automation systems.

Course Content:

Sensors and Transducer: Definition, Classification of transducers, Advantages and Disadvantages of Electrical Transducers;

- Measurement of displacement using Potentiometer, LVDT; Measurement of force using strain gauges & load cells;
- Measurement of pressure using LVDT based diaphragm & piezoelectric sensor, earth pressure cell, Humidity Sensor,
- Proximity sensor: Inductive, Capacitive & Photoelectric, Use of proximity sensor as accelerometer and vibration sensor; temperature sensors (RTD,Thermocouple)
- IR sensors, optical sensor, Corrosion Sensors, acoustic emission sensors, inertial sensor, Fuel sensor
- Imaging Sensors: CCD and CMOS; sensing & digitizing function in machine vision, image processing and analysis.
- Smart Sensor : General Structure of smart sensors & its components, Characteristic of smart sensors ,Application of smart sensors
- Signal Conditioning: Introduction, Functions of signal conditioning equipment, need for amplification of signals,
- Data Acquisition Systems and Conversion: Introduction, Objectives & configuration of data acquisition system, Analog & Digital IO, Counters, Timers, need of data conversion

Industrial Automation: Concept, automation components, necessity and working principle, block schematic of Programmable Logic Controller (PLC). Input & Output modules (AI, DI, AO, DO), Introduction to Ladder Programming, introduction to Distributed Control Systems (DCS). Industrial automation leads to Industrial IOT and Industry 4.0.

References

1. DVS Murthy, Transducers and Instrumentation, PHI 2nd Edition 2013
2. D Patranabis, Sensors and Transducers, PHI 2nd Edition 2013.
3. S. Gupta, J.P. Gupta / PC interfacing for Data Acquisition & Process Control, 2nd ED / Instrument Society of America, 1994.
4. Arun K. Ghosh, Introduction to measurements and Instrumentation, PHI, 4th Edition 2012.

5. A.D. Helfrick and W.D. cooper,Modern Electronic Instrumentation & Measurement Techniques,PHI – 2001

Pavement Recycling

Teaching Scheme

Lectures: 3hrs/ week

Examination Scheme

Test 1 and 2: 20 marks each

End-Sem Exam: 60 marks

Course Outcomes

At the end of course, Students will be able to

1. demonstrate the basic terminologies of RAP
2. understand demolition process of concrete pavements
3. carry out mix design
4. apply the concept of RAP for laboratory testings

Course Content

Concept of RAP in bituminous pavements, milling operation, utilizing of RAP in bituminous pavements in appropriate proportion, addition of bitumen, application of RAP in road construction, concrete pavements demolition, process, shredding, segregation, addition of appropriate percentage of cement, mix design, laboratory testing for confirmation, application in field, equipment required.

References
1. J. Paul Guyer, An Introduction to Asphalt Concrete Pavement Recycling, Paperback edition, 2016
2. Sze Wai Pan and Zhang Yifu, Research and Application of Hot in Place Recycling Technology for Asphalt Pavement (Woodhead Publishing Series in Civil and Structural Engineering), 2020.
3. Ministry of Road Transport and Highways: Website portal

Highway Geo-technology

Teaching Scheme

Lectures: 3hrs/ week

Examination Scheme

Test 1 and 2: 20 marks each

End-Sem Exam: 60 marks

Course Outcomes

At the end of course, Students will be able to

1. classify the soil
2. apply the concept of shear strength and earth pressure
3. apply the concept of deep foundations and rock engineering
4. carry out geomechanics classification

Course Content

Classification of Soil. HRB classification. Group Index Method. Subsoil drainage in Highway Engineering, Design of filters, perforated pipe drainage., Methods of sub soil drainage for roads, permeable blankets, longitudinal and transverse under drains, horizontal drains, stabilizing trenches. Sub soil drainage in highways, runways and railways.

Compaction: Mechanics of compaction. Field-compaction equipment; their suitability and choice. Compaction quality control and measurement.

Shear Strength: Terzaghi's effective stress principle, effective shear parameters, measurement of pore pressures. Stability Analysis of slopes: Friction circle method, Taylor's Stability No.

Earth Pressure Theories: Coloumb's Wedge Theory, Culman's method. Sheet pile walls and their analysis.

Deep foundations: Meyorhoff's theory for bearing Capacity. Well foundations, their types, components, well sinking and rectification. Stability analysis.

Rock Engineering: Fundamental of rock Mechanics; Rock Properties; Rock Mass Classification Systems, Rock load classification according to Terzaghi, RQD index as a qualitative description of the rock mass, limitations and advantages,

Geomechanics Classification: General Comments on Application of Rock Mass Classification Schemes, Comparison of Rock Mass Classification Schemes. Practicals: Experiments and design exercises based on above syllabus and also from courses of other subjects where provision of practical is not available

References

1. Soil Mechanics in Highway Engineering, Rodriguez,A,R, Castillo del.h, Trans Tech Publications
2. Essentials of Soil Mechanics and Foundations, David McCarthy,Pearson Education
3. Basic Soil Mechanics, R. Whitlow, Pearson Education
4. Relevant IS and IRC codes

Advances in Docks and Harbour Engineering

Teaching Scheme   **Examination Scheme**

Lectures: 3hrs/ week   Test 1 and 2: 20 marks each

                                                       End-Sem Exam: 60 marks

Course Outcomes: At the end of the course the student will be able to:

- Explain the significance of ports and harbours as a mode of transport.
- Global Trade, GDP impact on EXIM trade and Traffic studies for Ports.
- Demonstrate the basic design of port layout, Multi Modal Transportation
- Demonstrate the fundamental principles of port cargo handling and Equipments used.
- Design, plan and integrate port and harbour infrastructure, Port based SEZ, Dry Ports, Marine Oil Terminals.
- Importance of Inland Water ways, Present development and opportunities in India for Inland transport.
- Case studies.

Introduction : Ports and harbours – an infrastructure layer between two transport media, planning of ports and harbours. Global Trade, GDP impact on EXIM trades, Traffic Studies, Introduction to Micro and Macro analysis

The fundamentals and Design issues: Fundamentals: Tide and current conditions inside harbour, breakwaters, jetties and quay walls; mooring, berthing and ship motion inside the port; model studies, physical and mathematical studies. Design issues: Sea port layout with regards to (1) wave action (2) siltation (3) navigability, berthing facilities.

Design of Port Infrastructures: Design of port infrastructures with regards to (1) cargo handling (2) cargo storage (3)rail road connectivity, planning multipurpose port terminals :-Marine Oil Terminal, Passenger Terminals, Submarine pipe lines, Tank farms, Container Freight Stations, Port based SEZ, Concept of Dry Ports.

Port Operations: Types of Cargo handling and Equipments, shipping lines for cargo operations, **d**redging and navigability, hazard scenarios; VTMS and management of computerized container terminal, safety & environment (handling of fire, oil spill, rescue, etc.)

Inland Waterways and Ports: Maintenance of waterways, construction of environmentally engineered banks, disposal processing and storing of polluted dredged materials, development of river transportation.

Multi Modal Transportation, Ro-Ro vessels Development in India: Custom Formalities, Dedicated freight Corridor, Case Studies.

Site Visits (subject to obtaining of approvals/permissions from concern authorities) :- Mumbai Port/ JNPT , CWPRS, etc.

Text Books

- Muir Wood, A.M., and Fleming. C.A., "Coastal Hydraulics Sea and Inland Port Structures", 1st Edition, Hallstead Press, 2002.
- Ozha & Ozha, "Dock and Harbour Engineering", 1 st Edition, Charotar Books, Anand., 1990

References

- S. Seetharaman, "Construction Engineering and Management", 4 thEdition ,Umesh publications, New Delhi, 1999.
- Richand L. Silister, "Coastal Engineering Volume I & II, Elsevier Publishers, 2000.
- PeraBrunn, "Port Engineering", 1 st Edition, Gulf Publishing Company, 2000

Intelligent Transportation Systems

Teaching Scheme

Lectures: 3hrs/ week

Examination Scheme

Test 1 and 2: 20 marks each

End-Sem Exam: 60 marks

Course Outcomes

At the end of course, Students will be able to

1. demonstrate the fundamentals of ITS
2. understand the ITS functional areas
3. demonstrate the knowledge of vehicle safety
4. carry out ITS implementation in developing countries

Course Content

Introduction to Intelligent Transportation Systems (ITS) – Definition of ITS and Identification of ITS Objectives, Historical Background, Benefits of ITS - ITS Data collection techniques – Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), Geographic Information Systems (GIS), video data collection.

Telecommunications in ITS – Importance of telecommunications in the ITS system, Information Management, Traffic Management Centres (TMC). Vehicle – Road side communication – Vehicle Positioning System

ITS functional areas – Advanced Traffic Management Systems (ATMS), Advanced Traveler Information Systems (ATIS), Commercial Vehicle Operations (CVO), Advanced Vehicle Control Systems (AVCS), Advanced Public Transportation Systems (APTS), Advanced Rural Transportation Systems (ARTS).

ITS User Needs and Services – Travel and Traffic management, Public Transportation Management, Electronic Payment, Commercial Vehicle Operations, Emergency Management, Advanced Vehicle safety systems, Information Management.

Automated Highway Systems - Vehicles in Platoons – Integration of Automated Highway Systems. ITS Programs in the World – Overview of ITS implementations in developed countries, ITS in developing countries.

References

1. Pradip Kumar Sarkar and Amit Kumar Jain; Intelligent Transportation Systems' PHI Learning
2. Mashrur Chowdhury and Adel W. Sadek, Fundamentals of Intelligent Transportation Systems Planning, Artech House Publishers
3. Relevant IRC codes , publisher IRC

Disaster Management

Teaching Scheme

Lectures: 3hrs/ week

Examination Scheme

Test 1 and 2: 20 marks each

End-Sem Exam: 60 marks

Course Outcomes

At the end of course, Students will be able to

1. understand the Basic Concepts of Disaster Management.
2. understand Disaster Management Practices and Disaster Mitigation Measures
3. apply knowledge of Disaster Management Mechanisms in Disaster Risk Mitigation; and Post Disaster Measures.
4. carry out the preventive and mitigation measures

Course Content

Introduction to the Concept: Disaster, hazard, global and Indian scenario, general perspective, importance of study in human life, Direct and indirect effects of disasters, long term effects of disasters. Introduction to global warming and climate change.

Natural Disaster and Manmade disasters: Natural Disasters: nature of natural disaster, drought, cloud burst, Earthquake, Landslides, Cyclone, Storm Surge, climate change, global warming, sea level rise, Manmade Disasters: Chemical, Industrial, Nuclear and Fire Hazards.

Disaster Management, Policy and Administration: Disaster management: concept, importance, objective of disaster management policy, Paradigm shift in disaster management. Policy and administration: study of flowchart showing the entire process.

Institutional Framework for Disaster Management in India: Importance of public awareness, execution of emergency management program. Scope and responsibilities of NIDM and NDMA in India. Methods and measures to avoid disasters, Management of casualties, importance of effective communication amongst different agencies in such situations. Applications of GIS, Remote sensing and GPS in Disaster Management.

Preventive and Mitigation Measures: Pre-disaster, during disaster and post-disaster measures in some events in general , Structural mapping: Risk mapping, assessment and analysis, sea walls and embankments, early warning and communication, Non Structural Mitigation: Community based disaster preparedness, risk transfer, capacity development and training, awareness and education, contingency plans. Do's and don'ts in case of disasters and effective implementation of relief aids. Necessity of Disaster Management study in Transportation Engineering. Case studies.

References

1. Damon P Capolla; Introduction to International Disaster Management; 2007; Butterworth Heinemann Publ.

2. Paritosh Srivastava,"Disaster Management: Disaster Management and Mitigation approaches in India" [Kindle Edition]
3. Natural Hazards and Disaster Management: Vulnerability and Mitigation" by R B Singh.
4. NDMA;Disaster Management Guidelines;2007-11,NDMA.
5. Ministry of Home Affairs; National Policy on Disaster Management (NPDM)2006,MH

Road Safety and Road Safety Audit

Teaching Scheme

Lectures: 3hrs/ week

Examination Scheme

Test 1 and 2: 20 marks each

End-Sem Exam: 60 marks

Course Outcomes: At the end of course, Students will be able to

1. demonstrate the basic concepts of road safety and road safety audit.
2. demonstrate the IRC standards for road safety
3. select stages of road safety audit
4. perform road safety audit

Introduction & need for Road Safety, Global & National Road Safety scenario, Road crash investigation report, Identifying Road crash Characteristics, Human Factors Relating to Crashes/Accidents, Crash/Accident Investigation, Designing for Safety, Introduction to Implementation of forgiving systems approach, Road alignment Design, Junctions, Road Safety Initiatives by iRAP, World Bank & Other development authorities/ NGOs.

IRC standards for road safety, Urban roads safety, pedestrian safety-oriented design, Trauma Care, Importance of golden hour within a road crash, Traffic Signal timing optimization & design with pedestrian signals, Provisions for NMT infrastructure, Safety Provisions for Pedestrians & Cyclists, Night time illumination, Road Signs and Pavement Markings. Safe System Approach- A Global Perspective, Speed Management & safety, Safe System and Speed & Assessing speed limit, Type of speed limit & Speed zone signing Infrastructure to support safe speed feedback and enforcement.

Road Safety Auditing: An Introduction, Concept and need of Road Safety Audit (RSA). Procedures in RSA, design standards, audit tasks, stages of road safety audit, Road Safety Audit Types, key legal aspects, process, audit team and requirements, Checklist, how to use Checklists Road Safety inspection. Road design issues in RSA's. Overview of Road Safety Hazards. Report writing including deficiency identification, corrective actions recommendations, prioritisation. Structuring RSA report. Hazard Identification and Management, Risk Assessment & Prioritization of audit recommendations.

Performing planning & design stage road safety audit, pre-opening & existing stage of safety audit, assessing factors responsible for deciding/ relocating the road alignment, before/ after analysis as a case study

Introduction to Construction Stage Road Safety Audits, Performing Construction Stage Safety Audits on Urban Roads, Safety at Construction Site: Safety provisions for workers at construction site, Construction Zone markings, standard barricading and work zone signage & marking plan.

TEXT/REFERENCE BOOKS:

1. IRC SP 88- 2019 Road Safety Audit Manual (Second Revision)
2. IRC SP 55 2015 Work Zone Traffic Management
3. Highway Safety Manual by Transportation Research Board
4. Kadiyali, L.R., `Traffic Engineering and Transport Planning', Khanna Publications
5. Babkov, V.F. `Road conditions and Traffic Safety', MIR publications, - 1975.

6. K.W. Ogden, `Safer Roads – A Guide to Road Safety Engg.' Averbury Technical, Ashgate Publishing Ltd., Aldershot, England, 1996.
7. Khanna and Justo , 'Highway Engineering', Nem Chand & Brothers, Roorkee.
8. Pignataro, Louis, `Traffic Engineering - Theory and Practice', John Wiley.
9. RRL, DSIR, `Research on Road Safety', HMSO, London.
10. Papacoastas,'Introduction to Transportation Engineering' –Prentice

Traffic Engineering and Management

Teaching Scheme   **Examination Scheme**
Lectures: 3hrs/ week   Test 1 and 2: 20 marks each
                                              End-Sem Exam: 60 marks

Course Outcomes

At the end of course, Students will be able to

1. demonstrate the knowledge of the traffic components
2. assess the traffic characteristics
3. analyse traffic volume
4. design traffic intersections
5. apply traffic management techniques

Course Content

Elements of Traffic Engineering, Issue of Traffic engineering, Traffic stream characteristics. Traffic stream characteristics: Road user and vehicle characteristics, Fundamental parameters and relations, Traffic Stream parameter, Time Space diagram, Fundamental Diagrams. Traffic measurement procedures: Measurement at a Point (Volume data collection and analysis, PCU, PHF etc).Traffic Studies: Traffic Volume studies, Measurement over a Short Section (Speed data collection and analysis), Measurement along a Length of Road (Density and travel time measurement and analysis),Moving Observer Method, Traffic forecasting and growth studies. Specialised traffic studies: Parking Studies, Parking inventory, Statistics, Parking surveys; inout license palate, On-street and off-street parking.

Traffic Analysis and Management, Capacity and Level of Service concepts, Basics of traffic management, Traffic intersection control, Principles of Traffic Control and Traffic Signs, Road Markings and Channelization, Uncontrolled Intersection, Gap acceptance and capacity concepts, Uncontrolled Intersection, Capacity and LOS analysis. Channelization: channelizing devices, geometrical aspects, turning radius. Traffic rotary: Conflict resolution in a rotary, geometric layout, design elements, capacity of rotary. Grade separated intersection: Road over bridges, under pass, overpass, trumpet interchange, diamond interchange, fully and partial clover leaf intersection, Traffic Management: Traffic Management Strategies, Traffic Management Techniques.

References

1. L. R Kadiyali. Traffic Engineering and Transportation Planning. Khanna Publishers, New Delhi, 2008.
2. Highway Capacity Manual. Transportation Research Board. National Research Council, Washington
3. Guidelines on Regulations and Control of Mixed Traffic in Urban Areas by IRC 70-1977

Highway Materials

Teaching Scheme

Lectures: 3hrs/ week

Examination Scheme

Test 1 and 2: 20 marks each

End-Sem Exam: 60 marks

Course Outcomes

At the end of course, Students will be able to

1. describe various pavement materials
2. compare conventional and advanced characterisation of pavement materials
3. design practical solution to Mix design of Pavement Materials
4. interpret recycled waste products

Course Content

Aggregate: Nature and properties, aggregate requirements, Types and processing, Aggregates for pavement base, Aggregate for bituminous mixture, Aggregate for Portland Cement Concrete, Light weight aggregate, Tests on aggregate, Specification.

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. Cement /concrete based materials, Cement properties, PCC mix design and properties, Modified PCC, Mix Design behaviour, Performance, Tests on Cement and Concrete mixes. High Performance Concrete, Low shrinkage, Increased strength. Composites, Plastics and Geosynthetics: Plastics and polymerization process, Properties, Durability and Chemical composition, Reinforced Polymer Composites, Geosynthetics, Dry Powdered Polymers, Enzymes.

Reclamed/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.

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.
4. Shan Somayaji, Civil Engineering Materials, second edition, Prentice Hall Inc., 2001.

Transportation Engineering Lab Practice- I

Teaching Scheme
Practical: 3 hrs/ week

Examination Scheme
End-Sem Exam: 100 marks

Course Outcomes

At the end of course, Students will be able to

1. select relevant national and International codes for performing new experiments in Transportation laboratory
2. develop skills in performing experiments related to Transportation engineering and correlate with the quality standards.
3. exercise hands on experience to develop higher level motor skills
4. prepare practical and site visit report for various assigned activities

Course Content

A. Student will perform various sets of experiments in the Transportation laboratory as decided by the Laboratory In-charge and write a test report as a part of Laboratory work.

Tests on Soils: Density of soil, CBR, Determination of Field CBR using Dynamic Cone Penetrometer
Tests on Aggregate: gradation, shape tests, specific gravity, water absorption, aggregate crushing value, Los Angeles abrasion value, aggregate impact value.
Tests on Bitumen: penetration, viscosity, flash and fire point, ductility and elastic recovery, softening point, specific gravity, Ageing of Bitumen,
Tests on Bituminous Mixes: Marshall mix design, Bitumen content determination using centrifuge extractor.

B. Field visits for studying Transportation Engineering

C. Students will carry out various assignments related to the courses taught in this semester given by the faculty teaching courses

Reference Books:

1. Highway Material Testing Laboratory Manual by Khanna S. K., Justo, C.E.G and Veeraraghavan, A., Nem Chand & Bros.

2. Various IRC, ASTM and AASTHO Codes

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Seminar

Teaching Scheme
Practical: 2 hrs/week

Examination Scheme
End-Sem Exam – 100 marks

Course outcomes:

At the end of the course, students will demonstrate the ability to

1. Identify a topic for study and carry out literature survey
2. Write a technical report related to selected topic
3. Present outcome of the study with the help of ppt.

Course Contents:

Selection of Topic: - Select a topic relevant to the stream of study with content suitable for M. Tech. level presentation. For selection topics refer internationally reputed journals. The primary reference should be published during the last two or three years.

- Some of the journals/publications suitable for reference are: ASCE/Springer/Science Direct journals in the areas of Transportation Engineering and any other related domain

- Get the topic approved by the seminar guide well in advance.

Preparation of Presentation and Report:

- In slides, list out key point only. You may include figures, charts equations tables etc. but not running paragraphs. Font size used should be at least 20.

- Figures should be very clear and possibly drawn by you using suitable software tools.

- A report of the seminar should be prepared which should contain the following.

- Title of the seminar.
- Name and other details of presenter and the guide.
- Abstract of the topic.
- Contents such as Introduction, Theory to elaborate the concept, Implementation if carried out by the presenter, Comparison with other relevant techniques, Conclusion, etc.
- List of references strictly in ASCE format.

Oral Presentation: - Student needs to orally present the topic for 15-20 minutes with good voice projection and with modest pace.

Answering Queries:

Student needs to answer queries raised by the audience and evaluators.

Semester II

Big Data Analytics

Teaching Scheme	**Examination Scheme**
Lectures: 3hrs/ week	Test 1 and 2: 20 marks each
	End-Sem Exam: 60 marks

Course Outcomes

At the end of course, Students will be able to

1. deploy the Data Analytics Lifecycle to address big data analytics projects

2. apply appropriate analytic techniques and tools to analyze big data, create statistical models, and identify insights that can lead to actionable results

3. select appropriate data visualizations to clearly communicate analytic insights to business sponsors and analytic audiences

4. explain how advanced analytics can be leveraged to create competitive advantage

Course Content

Business Intelligence, Decision Support Systems, Data Warehousing; Definition of Big Data, Big data characteristics & considerations, Introduction to Hadoop
Big data analytics, Drivers of Big data analytics, Big Data Stack, Typical analytical architecture, Virtualization & Big Data, Virtualization Approaches, Business Intelligence Vs Data science, Applications of Big data analytics.
Need of Data analytic lifecycle, Key roles for successful analytic projects, various phases of Data analytic lifecycle: Discovery, Data Preparation, Model Planning, Model Building, Communicating Results, Operationalization.
What is Machine Learning?, Applications of Machine Learning; Supervised Learning: Structure of Regression Model, Linear Regression, Logistics Regression, Time series analysis, Support Vector Machine.
Classification: Classification Problem, Classification Models, Classification Trees, Bayesian Method; Association Rule: Structure of Association Rule, Apriori Algorithm, General Association; Clustering: Clustering Methods, Partition Methods, Hierarchical Methods.
Basic features of R, Exploring R GUI, Data Frames & Lists, Handling Data in R Workspace, Reading Data Sets & Exporting Data from R, Manipulating & Processing Data in R.

References

1.Trevor Hastie, Robert Tibshirani, Jerome Friedman, "The Elements of Statistical Learning", Springer, Second Edition, 2011.

2.Business Intelligence – Data Mining and Optimization for Decision Making – Carlo Vercellis – Wiley Publications.

3. Big Data & Analytics – Seema Acharya & Subhashini Chellappan – Wiley Publications

Elective II

Sustainable Construction Engineering

Teaching Scheme

Lectures: 3hrs/ week

Examination Scheme

Test 1 and 2: 20 marks each

End-Sem Exam: 60 marks

Course Outcomes

At the end of course, Students will be able to

1. identify various concepts of sustainable construction

2. apply sustainability to project planning

3. choose appropriate sustainable materials and renewable energy techniques for civil engineering projects

4. highlight the available building codes and standards

Course Content

Sustainability and Sustainable Development. Introduction to course. Introduction to sustainable development Concepts and Theory. Definitions and Prospective on sustainability, Theory and background to sustainable construction planning.The Three E's. Environment, Economics, and Ethics. Ecology of sustainable developments.

Sustainable Construction Planning. Introduction to Sustainable construction. Principles of sustainability. Major Environmental challenges, Global Warming. Introduction to Green Buildings Building energy system. Strategies, Energy conservation in buildings. Energy Efficient projects. HVAC Systems. Water Conservation in buildings. Rainwater harvesting and management, Water Cycle strategies.

Green Buildings Introduction, Green construction, Site selection for Green Construction, Design Considerations, Objectives of Green building movement. Green construction materials and resources. Material Selection Strategies. Eco-friendly Materials, Recyclable and Reusable Materials. Embodied Energy in Materials.

Green Building Codes and Specifications. Introduction. Green building Codes and Standards. LEED Credits, IGBC. International Construction Codes, Carbon accounting, Green building Specifications.

References

1. Green Building Design and Delivery, 2nd Edition, John Wiley, Hoboken -New Jersey.
2. Energy Efficient Buildings in India. Ed. Mujumdar Mili. TERI PRESS.
3. Energy efficient buildings in India. Case Studies by Teri. Video Cassettes, ds.
4. Climate Responsive Architecture. Krishna Arvind.
5. Energy Management Handbook, Steve Doty and Wayne C. Turner, 8th edition.

Design of Underground Structure

Teaching Scheme

Lectures: 3hrs/ week

Examination Scheme

Test 1 and 2: 20 marks each

End-Sem Exam: 60 marks

Course Outcomes

At the end of course, Students will be able to

1. interpret geological data and determine rock strength properties

2. identify various excavation methods for tunnelling, calculate stress-strain analysis and the application to fracture and deformation in rocks

3. apply appropriate support system and HVAC

4. analyse the problems in tunnel construction

Course Content

Tunnel Engineering: Necessity, planning of tunnels, site investigation for tunnels, types of tunnels, tunnel alignment and grade, size and shape of a tunnel, method of constructions, methods of tunnelling in hard rocks - full face method - heading and bench method - drift method - different methods of tunnelling in soft soils including compressed air and shield tunnelling - shafts in tunnels - ventilation of tunnel and various methods - lining of tunnels - drainage and lighting of tunnels, problems in tunnel constructions, boom tunnelling machines, full face tunnel boring machines; support of tunnels; adverse ground conditions; ground treatment and hazards in tunnelling. Study rock mechanics - RMR & Q-system of classification basic concepts, study of joints, sequence of excavation, support systems, Shape optimization, NATM.

References

1. Robert L. Purifoy and Clifford J. Schexnayder Construction Planning, Equipment and Methods, McGrew Hill Publication, Sixth Edition, 2002;
2. Megaw, Thomas M., and John V. Bartlett. Tunnels. Planning, Design, Construction. Volume 1. No. Monograph. 1981.
3. Space, Underground. "Tunnelling and Underground Space Technology."
4. Széchy, Károly. Tunnelbau. Springer-Verlag, 2013.
5. Varma, Mahesh. Construction Equipment and its planning and Application. Metropolitan Book Co., 1975.
6. Tunnels and Tunnelling, London.
7. Bieniawski, Zdzisław Tadeusz. Rock mechanics design in mining and tunnelling. 1984.
8. Desai, Chandrakant S., and John F. Abel. Introduction to the finite element method: a numerical method for engineering analysis. Van Nostrand Reinhold, 1972.
9. Hoek, Evert, and Edwin T. Brown. Underground excavations in rock. 1980Goodman, Richard E. "Introduction to rock mechanics." (1989).

GIS and Remote Sensing

Teaching Scheme

Lectures: 3hrs/ week

Examination Scheme

Test 1 and 2: 20 marks each

End-Sem Exam: 60 marks

Course Outcomes

At the end of course, Students will be able to

1. understand fundamentals of remote sensing and GIS
2. demonstrate the knowledge of electromagnetic specturm
3. understand GIS application in the field of Transportation Engineering
4. formulate models using GIS software

Course Content

Remote Sensing: Introduction to Remote Sensing, Aerial photography, photogrammetry, Definition of Remote sensing, A tool for resource surveys, Application in land use, land cover analysis and town planning. Electromagnetic Energy, Definition, Properties velocity, wavelength, frequency.

Electromagnetic spectrum: definition, wavelength regions, Imaging system, satellite images.

Aerial photography, Types of aerial cameras, Types of photographs, vertical, horizontal, oblique. Geometry of Aerial photographs, Tilt, Swing, Photo nadir, Principle points, principal distance, flying height, air base, overlaps, side laps, methods of scale determination, Image displacement due to relief and tilt, stereoscopic vision, Satellite Imageries, Satellite platforms and orbit patterns, optical, mechanical, scanners, Infrared scanners, earth resource technology satellite, LANDSAT, SPOT, and IRS.

GIS: Introduction, Definition and meaning, Application to town planning.

GIS Vs. Maps, Advantages and disadvantages

Date Modes for GIS, Raster based date, Rasterization using toposheets, isolines maps and urban maps. Nature of remote sensing data, resolution.

Vector based data, Digitization of point, line aerial boundaries using graphs

Components of GIS (1) Input (2) Pre-processing (3) Spatial data base – point, line, polygon (4) Analysis (5) Output

Introduction to GIS software. Application of special functions and compatibility for various types of database.

References

1. Remote Sensing, Principles and Applications by Floyd Sabins; Freeman and Co, New York.

2. Principles of Remote Sensing by P. J. Carran: (ELBS).

3. Remote Sensing and Image Interpretation by Lillesand Thomas M. & Kiefer Ralph W: (John Wiley & Sons Inc. New York)

4. Remote Sensing of environment: An Earth Resource Perspective, by Jensen: Pearson Publ.

Traffic Flow Modelling and Simulation

Teaching Scheme	**Examination Scheme**
Lectures: 3hrs/ week	Test 1 and 2: 20 marks each
Tutorials: 1 hr/week	End-Sem Exam: 60 marks

Course Outcomes

At the end of course, Students will be able to

1. demonstrate different terminologies related to traffic flow
2. carry out macroscopic, mesoscopic, and microscopic simulation of traffic flow
3. demonstrate the knowledge of traffic simulation
4. select the appropriate traffic model in given situation
5. study the car following models

Course Content

Introduction to Traffic Simulation; Simple Probability Concepts; Different Probability Distribution (discrete and continuous distribution); Random Number Generation; Macroscopic Traffic Simulation: concepts of macroscopic models, first order traffic flow models (LWR Model), second order traffic flow models, Macroscopic Traffic Simulator: NETSIM; Mesoscopic Traffic Simulation: Concepts of mesoscopic models, application of mezzo models. Mesoscopic Traffic Simulator: DynaMIT; Microscopic Traffic Simulation: Concepts of microscopic models, Different types of car following models, lane changing and overtaking models, Different types of traffic simulation models; Microscopic Traffic Simulator: MITSIM, VISSIM; Traffic simulation models for mixed traffic conditions.

References

1. J. Barcelo, Fundamentals of Traffic Simulation, Springer, 2010.
2. A. M. Law and W. David Kelton, Simulation Modeling and Analysis, 4th edition, McGraw Hill, 2006
3. T. Toledo, Integrated Model of Driving Behavior, VDM Verlag Dr. Müller, Saarbrucken, Germany, 2008.
4. M. Treiber and A. Kesting, Traffic Flow Dynamics: Data, Models and Simulation, Springer, 2013

Concrete Pavements for Highways and Airports

Teaching Scheme

Lectures: 3hrs/ week

Examination Scheme

Test 1 and 2: 20 marks each

End-Sem Exam: 60 marks

Course Outcomes

At the end of course, Students will be able to

1. identify and select basic construction materials for highway and airport pavements construction based on their characteristics.
2. design aggregate gradation for construction of pavement layers keeping in mind the density and strength parameters.
3. provide mix design procedure and the base layer for a concrete pavement.
4. evaluate the pavements based on the functional and structural characteristics.
5. design airport runways and taxiways

Course Content

Basic road construction materials: Types, source, functions, requirements, properties, tests and specifications for use in various components of road. Soil compaction for use in fill and subgrade of roads, compaction studies in laboratory and field, properties of compacted soils.

Aggregates: Origin, classification, equipments, properties. Tests and specifications on road aggregates for flexible and rigid pavements. Importance of aggregate gradation problems on Rothfutch's and Critical sieve methods and Shape factor in mix design.

Design of concrete pavements for Highways and Airports: Design of cement concrete pavements for highways and airports; PCA and ACI Methods: Design of joints, reinforcements, tie bars, dowel bars and slab thickness as per IRC guidelines. Design features of continuously reinforced concrete pavements, Problems.

References

1. Design & Performance of Road Pavements" Paul Croney, David Croney, Mc Graw hill Professional.
2. IRC Design guides, IRC 37-2012, IRC 81-1997, IRC 58 – 2011, IRC 59 – 1976, IRC 101-1988, MORTH, 5th Edition, New Delhi, 2013
3. Modern Pavement Management" by W.Ronald Hudson, Ralph Haas and Zeniswki, Krieger Publishing Company
4. Huang, Y.H. Pavement Analysis and Design, Second Edition, Pearson Education India

Rail and Metro Construction

Teaching Scheme

Lectures: 3hrs/ week

Examination Scheme

Test 1 and 2: 20 marks each

End-Sem Exam: 60 marks

Course Outcomes

At the end of course, Students will be able to

1. understand functioning of various track elements in Railway and Metros.
2. acquire & understand the necessity of metro system for urban transport and the differences between various urban transport system.
3. understand cost effectiveness of various urban transport systems.
4. understand integrated operation of metro system.

Origin of Railways, Definition/uniqueness of railways, gauge of railway track, over view of railway systems of different countries, Basic track structure Formation, unconventional railways, atmospheric railway, mountain railways, rack railways etc. Basic track structure – Formation, Maintenance and renewal of track – (in brief) manual and mechanical maintenance and renewal.

Turnouts and Crossings – Components constituting turnouts and crossings, Diamond crossings; Slip points, operation of turnouts mechanical & electrical, locking of turnouts, Curved Track – classification of curves, measurement of radius, movement of vehicle on curves, speed on curves, check rails, gauge widening on curves. Gradients / Vertical Curves.

Passenger carrying vehicles (Coaches), development of coaches, 4 wheeled coaches, 6 wheeled coaches, bogie coaches, categories of coaches, Pullman coaches, special coaches in very brief, Goods carrying vehicles, Introduction of maintenance manuals of various types of rolling stock.

Rail Wheel Interaction, Track elements, Flat Bottom Rail, Bull Head Rail, Cast Iron Chair, Rail Screws, Base Plate, Insulating Pad, Modified Loose Jaw, Fish Plated Joint, Insulated Joint Sleepers - Wooden, Steel Trough, Cast Iron Pot, Twin Block and Mono Block Pre-Stressed Concrete Sleepers.

Origin of Metro Rail System, Overview of World Metro Systems, Metro Planning and Selection, Metro Construction Metro Track, Introduction of metro act, Report of Ministry of Urban Development on standardization of metro system.

Metro Operations, Metro Depots, Metro Maintenance, Metro Station Management, Passenger Information System.

References:
1. Indian Railways Permanent Way Manual Published by Indian Railways corrected upto ACS-4, June 2020.
2. Notes on Curves for Railways by Prof V B Sood _ Indian Railways Institute of Civil Engineering Pune.
3. Ponnuswamy, Bridge Engineering, Delhi.

4. Metro Act _ Government of India – 2002
5. Detailed Project Reports of Various Metro Projects in India – By Delhi Metro Rail Corporation.
6. Manual of Specifications And Standards – Hyderabad Metro Government of Andhra

AI in Transportation Engineering

Teaching Scheme
Lectures: 3hrs/ week

Examination Scheme
Test 1 and 2: 20 marks each
End-Sem Exam: 60 marks

Course Outcomes

At the end of course, Students will be able to

6. demonstrate basic terminologies of sensors
7. classify different types of sensors
8. understand the working principles of all types of sensors
9. understand the application of AI in vehicles

Course Content

Basic theory of sensors, types of sensors, sensors for measurement of temperature, static and dynamic load, duration of load, pressure at various points of control on road, friction, permissible limits, application of AI in vehicles.
Above study for bituminous and concrete pavements for surface and intermediate layers.

References
1. ITS Hand Book 2000: Recommendations for World Road Association (PIARC) by Kan Paul Chen, John Miles.
2. Sussman, J. M., Perspective on ITS, Artech House Publishers, 2005.
3. National ITS Architecture Documentation, US Department of Transportation, 2007 (CDROM).
4. Chowdhary, M.A. and A Sadek, Fundamentals of Intelligent Transportation systems planning. Artech House Inc., US, 2003.
5. Williams, B., Intelligent transportation systems standards. Artech House, London,2008.

Safety in Highways and Airports

Teaching Scheme

Lectures: 3hrs/ week

Examination Scheme

Test 1 and 2: 20 marks each

End-Sem Exam: 60 marks

Course Outcomes

At the end of course, Students will be able to

1. assess the factors considered for road safety and airports safety.
2. understand road safety appurtenances and design elements.
3. prepare highways and airports accident investigation reports and database.
4. apply design principles for roadway geometrics improvement with various types of traffic safety purtenances/tools.
5. manage traffic including incident management.

Course Content

Road accidents: Causes, scientific investigations and data collection, Analysis of individual accidents to arrive at real causes, statistical methods of analysis of accident data, Basic concepts of Road accident statistics, Safety performance function: The empirical Bayes method Identification of Hazards road location. Application of computer analysis of accident data.

Safety in Road Design: Operating the road network for safety, highway operation and counter measures, road safety audit, principles-procedures and practice, code of good practice and checklists, vehicle design factors &Driver characteristics influencing road safety.

Road Signs and Traffic Signals: Classification, Location of Signs, measures of sign effectiveness, Types of visual perception, sign regulations, sign visibility, sign variables, Text versus symbols. Road Marking: Role of Road markings, Classification, visibility. Traffic Signals: Need, Signal face. Illumination and location of Signals, Factors affecting signal design, 48 pedestrians' safety, fixed and vehicle actuated signals. Design of signa1s, Area Traffic control. Delineators, Traffic Impact Attenuators, Road side rest areas, Safety Barriers, Traffic Aid Posts.

Traffic Management Techniques: Integrated safety improvement and Traffic Calming Schemes, Speed and load limit, Traffic lights, Safety cameras, Tests on driver and vehicles, pedestrian safety issues, Parking, Parking enforcement and its influence on Accidents. Travel Demand Management; Methods of Traffic management measures: Restriction of Turning Movements, One-way streets, Tidal Flow Operation Methods, Exclusive Bus Lanes and Closing Side-streets; Latest tools and techniques used for Road safety and traffic management. Road safety issues and various measures for road safety; Legislation, Enforcement, Education and Propaganda, Air quality, Noise and Energy Impacts; Cost of Road Accidents.

Incident Management: Introduction, Characteristics of Traffic Incidents, Types of Incidents, Impacts, Incident management process, Incident traffic management; Applications of ITS: Motorist information, Equipment used; Planning effective Incident management program, Best practice in Incident management programs. National importance of survival of Transportation

systems during and after all natural disasters especially cyclones, earthquakes, floods etc. and manmade disasters like sabotage, terrorism etc.

Airport safety and management: Examine various aspects of aviation flight and ground safety program management. Aviation safety program development, aviation human factors issues, aviation accident causation models, Safety Management Systems (SMS) and other areas relevant to aviation safety, Case studies derived from National Transportation Safety Board Aviation Accident Reports.

References

1. Guidelines on Design and Installation of Road Traffic Signals,IRC:93.

2. Specification for Road Traffic Signals, IS: 7537-1974.

3. Principles and Practice of Highway Engineering by L.R. Kadiyali and N.B.Lal, Khanna Publishers.

4. Hand book of Transportation Engineering, Myer Kutz, McGraw-Hill Professional.

Advanced Concrete Technology

Teaching Scheme
Lectures: 3hrs/ week

Examination Scheme
Test 1 and 2: 20 marks each
End-Sem Exam: 60 marks

Course Outcomes

At the end of course, Students will be able to

1. demonstrate the basic terminologies related to concrete
2. analyse the rheological behaviour of concrete
3. apply the concepts of permeability and durability of concrete
4. carry out mix design of concrete
5. select the appropriate concrete in given situation

Course Content

Review of properties of cement, their physical and chemical properties, special purpose cements, Classification and properties of aggregates, soundness of aggregates, alkali aggregate reaction, thermal properties of aggregates, Importance of shape and Surface area and grading, gap graded and aggregates. Admixtures & construction chemicals, Use of Fly Ash, Silica Fumes, Metakaolin& GGBS in concrete.

Rheological behaviour of concrete, requirements of workability of concrete, Effect of environmental conditions, Strength properties of hardened concrete, Impact, Dynamic and fatigue behaviour of concrete, shrinkage and creep of concrete, behaviour of concrete under fire.

Permeability and Durability of concrete, Parameters of durability of concrete, chemical attack on concrete, Production of concrete; batching mixing, transportation, placing, compaction of concrete. Special methods of concreting and curing of concrete, Hot weather and cold weather concreting, Guniting (Shotcreting)/

Concrete mix design, Basic considerations and choice a mix proportions, various methods of mix designs including IS Code method. Quality control and quality assurance of concrete, Acceptance criteria, Quality management in concrete construction, Inspection and testing of concrete. Non-destructive testing of concrete, core test and load test.

Special concrete such as high strength, Lightweight, heavy weight, vacuum processed concrete. Mass concrete, high performance concrete, Pumpable concrete, Self Compacting concrete, Air entrained concrete, Ferro cement, fiber reinforced concrete, Polymer impregnated concrete. Jet concrete. Deterioration and repair technology of concrete, Distress and type of repairs, crack sealing techniques.

References

1. Gambhir M.L: Concrete Technology Tata McGraw Hill (Second Edition) 1995.

2. M.S.Shetty, Concrete Technology S.Chand& Company New Delhi 2005.

3. P.Kumar Mehta and Paulo J.M. Monteiro, Concrete microstructure, properties & materials, McGraw Hill Education

4. Orchard D.F.; Concrete Technology -Vol I. & II Applied Science Publishers (Fourth Edition) 1979.

5. Neville A.M. and J.J.Brook ,Properties of Concrete , Pearson, 2019.

Traffic Operations and Control

Teaching Scheme

Lectures: 3hrs/ week

Examination Scheme

Test 1 and 2: 20 marks each

End-Sem Exam: 60 marks

Course Outcomes

At the end of course, Students will be able to

1. demonstrate the knowledge of traffic characteristics
2. analyse traffic signal
3. design traffic signal
4. identify traffic safety
5. propose pedestrians and bicycles facilities

Course Content

Traffic stream characteristics, Introduction to Road user characteristics, Human and vehicle characteristics, Fundamental parameters, Traffic signal, Definitions and measurement of stopped and control delay, Oversaturated conditions, Evaluation of a Traffic Signal: Delay Models, Capacity and LOS Analysis of a Signalized I/S, Coordinated Traffic Signal, Vehicle Actuated Signals and Area Traffic Control.

Traffic signal design, Elements of traffic signal, Analysis of saturation headway, Saturation flow, Lost time, Critical flows, Derivation of cycle length, Design principles of a traffic signal, Phase design, Cycle time determination, Green splitting, Pedestrian phases, Performance measures, Traffic Signs, Road Markings.

Traffic safety, Accident studies, Accident data analysis, Statistical methods for data analysis, Road safety principles and practice.

Pedestrians and bicycles facilities, Intersection, Roundabout configuration.

References

1. L. R Kadiyali. Traffic Engineering and Transportation Planning. Khanna Publishers, New Delhi, 2008.
2. Highway Capacity Manual. Transportation Research Board. National Research Council, Washington.

Surface and Subsurface Drainage to Pavement Structures

Teaching Scheme

Lectures: 3hrs/ week

Examination Scheme

Test 1 and 2: 20 marks each

End-Sem Exam: 60 marks

Course Outcomes

At the end of course, Students will be able to

1. demonstrate different terminologies of drainage system
2. design surface and subsurface drainage
3. assess cross drainage
4. appraise storm systems

Course Content

Introduction, Importance of drainage, Type of Road Drainage, General Criterion for Road Drainage. Systems of Drainage: Surface and sub-surface drainage systems.

Internal drainage of pavement structure, components of surface drainage system, surface drains, road side drains, catch water drains, geometric drainage with transverse drains, horizontal drains, sub surface drain in heavy clayey soil, sub surface drain at valley curve, change of grade, capillary cut-off.

Design of surface drainage and subsurface drainage system: Hydrologic analysis, hydraulic analysis, data for drainage design, design steps.

Cross Drainage, Sub surface drainage, lowering of water table, control of seepage flow, control of capillary rise, design of filter material, drainage of slopes and erosion control, road construction in water-logged areas. Drainage in hill road. Drainage systems for Airport and Railways.

Urban storm water drainage, Storm water management, Storm Systems- information needs, design criteria, rational method design, hydraulic analysis and designs, Storm water drainage channels- rigid-lined channels, flexible lined channels, street and highway drainage- design considerations, Storm Water Detention- types of surface detention sizing detention, detention basin routing, subsurface disposal of storm water and best management practices (BMP's).

References

1. Highway Engineering by S.K. Khanna & C.E.G Justo, Nem Chand Bros., Roorkee.
2. Principles and Practice of Highway Engineering by L.R. Kadiyali and N. B. lal, Khanna Publishers , Delhi.
3. Rural Road Mannual, IRC SP-20
4. Guide lines of Road Drainage IRC:SP:42-2014, Indian Road Congress -2014

5. Hall , M. J., Urban Hydrology, Elsevier Applied Science Publishers
6. Allen P. Davis and Richard H. Mc Cuen" Stormwater Management for Smart Growth", Springer, ISBN 10: 0-387-26048-X, ISBN-13: 9780387275932

Freight Transportation Planning and Logistics

Teaching Scheme
Lectures: 3hrs/ week

Examination Scheme
Test 1 and 2: 20 marks each
End-Sem Exam: 60 marks

Course Outcomes

At the end of course, Students will be able to

1. Demonstrate the knowledge of various concepts of freight transportation planning.
2. Minimize cost network flow
3. optimize shipment size

Course Content
Introduction to freight models; interregional freight demand models: Gravity model, Input output (IO) model, Spatial general equilibrium model (SGEM); Freight generation and freight trip generation models;
Introduction to network flow: Network flow representation, Shortest path algorithm, Assignment Problem, Transportation Problem, Minimum spanning tree, Minimum cost network flow problem, Network simplex method;
Distribution structure: Micro-level distribution structure, Logistics costs, Drivers of distribution structure, Micro-level normative models, Warehouse location; Inventory theory and freight transport modeling: the economic order quantity (EQQ) model, Optimal shipment size;
Urban freight models: Push models, Pull models; Vehicle routing problem; Fleet size optimization; Urban logistics: parcel delivery, e-commerce, food delivery; Freight consolidation centers; Humanitarian logistics during disasters

Reference Books:

1. L. Tavasszy and G. De Jong, Modeling freight tranport, Elsevier, 2014
2. M. Browne, S. Behrends, Woxenius, G. Giuiano, and J, Holguin-Veras, Urban Logistics, Kogan Page, 2019
3. E. Taniguchi and R. G. Thompson, City Logistics, Emerald Group Publishing, Limited, 2001

LL-19001 Liberal Learning

Teaching Scheme   **Examination Scheme**

Lectures: 1hr/ week   Test 1 and 2: 20 marks each

                                                                End-Sem Exam: 60 marks

Course Outcomes

At the end of course, Students will be able to

1. Develop capacity to understand multidisciplinary sciences in a friendly manner.
2. Create openness to diversity.
3. Acquire ability to lead and examine life and value the need for life learning.

Course Content:

Student will be able to choose and enhance practical learning and application in the subject of his/her choice. One credit course spread over the semester to enhance practical learning and application.

- Agriculture
- Business
- Clay Art & Pottery
- Corporate Culture
- Defense
- French
- Geography
- Holistic Health
- Modern Film Making
- Music (Instrumental)
- Photography
- Political Science
- Music (Vocal)
- Wood and Metal Art
- Japanese
- Painting

(MLC) [ML-19011] - Research Methodology and Intellectual Property Rights

Teaching Scheme

Lectures: 2hrs/ week

Examination Scheme

Test 1 and 2: 20 marks each

End-Sem Exam: 60 marks

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Understand research problem formulation and approaches of investigation of solutions for research problems

2. Learn ethical practices to be followed in research and apply research methodology in case studies and acquire skills required for presentation of research outcomes

3. Discover how IPR is regarded as a source of national wealth and mark of an economic leadership in context of global market scenario

4. Summarize that it is an incentive for further research work and investment in R & D, leading to creation of new and better products and generation of economic and social benefits

Course Contents:

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, necessary instrumentations.

Effective literature studies approaches, analysis, Use Design of Experiments /Taguchi Method to plan a set of experiments or simulations or build prototype, Analyze your results and draw conclusions or Build Prototype, Test and Redesign

Plagiarism, Research ethics, Effective technical writing, how to write report, Paper, Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee Introduction to the concepts Property and Intellectual Property, Nature and Importance of Intellectual Property Rights, Objectives and Importance of understanding Intellectual Property Rights

Understanding the types of Intellectual Property Rights: -Patents-Indian Patent Office and its Administration, Administration of Patent System – Patenting under Indian Patent Act , Patent Rights and its Scope, Licensing and transfer of technology, Patent information and database. Provisional and Non Provisional Patent Application and Specification, Plant Patenting, Idea Patenting, Integrated Circuits, Industrial Designs, Trademarks (Registered and unregistered trademarks), Copyrights, Traditional Knowledge, Geographical Indications, Trade Secrets, Case Studies

New Developments in IPR, Process of Patenting and Development: technological research, innovation, patenting, development, International Scenario: WIPO, TRIPs, Patenting under PCT

Reference Books

1. Aswani Kumar Bansal : Law of Trademarks in India

2. B L Wadehra : Law Relating to Patents, Trademarks, Copyright, Designs and Geographical Indications.

3. G.V.G Krishnamurthy : The Law of Trademarks, Copyright, Patents and Design.

4. Satyawrat Ponkse: The Management of Intellectual Property.

5. S K Roy Chaudhary & H K Saharay : The Law of Trademarks, Copyright, Patents

6. Intellectual Property Rights under WTO by T. Ramappa, S. Chand.

7. Manual of Patent Office Practice and Procedure

8. WIPO : WIPO Guide To Using Patent Information

9. Resisting Intellectual Property by Halbert ,Taylor & Francis
10. Industrial Design by Mayall, Mc Graw Hill
11. Product Design by Niebel, Mc Graw Hill
12. Introduction to Design by Asimov, Prentice Hall
13. Intellectual Property in New Technological Age by Robert P. Merges, Peter S. Menell, Mark A. Lemley
14. Stuart Melville and Wayne Goddard, "Research methodology: An Introduction for Science and Engineering Students", Juta and Company Ltd.
15. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction", Juta and Company Ltd, 2004
16. Ranjit Kumar, "Research Methodology: A Step by Step Guide for Beginners", SAGE Publications, 2 nd edition, 2005

MLC (ML -19011) Effective Technical Communication

Teaching Scheme: **Evaluation Scheme:**
Lectures: 1hr / week   **100M: 4 Assignments (25M each)**
Course Outcomes

After successful completion of the course, students will be able -
1. To produce effective dialogue for business related situations
2. To use listening, speaking, reading and writing skills for communication purposes and attempt tasks by using functional grammar and vocabulary effectively
3. To analyze critically different concepts / principles of communication skills
4. To demonstrate productive skills and have a knack for structured conversations
5. To appreciate, analyze, evaluate business reports and research papers

Course Content
Unit 1: Fundamentals of Communication   **[4 Hrs]**
7 Cs of communication, common errors in English, enriching vocabulary, styles and registers

Unit 2: Aural-Oral Communication   **[4 Hrs]**
The art of listening, stress and intonation, group discussion, oral presentation skills

Unit 3: Reading and Writing   **[4 Hrs]**
Types of reading, effective writing, business correspondence, interpretation of technical reports and research papers

Reference Books

1. Raman Sharma, "Technical Communication", Oxford University Press.
2. Raymond Murphy "Essential English Grammar" (Elementary & Intermediate) Cambridge University Press.
3. Mark Hancock "English Pronunciation in Use" Cambridge University Press.
4. Shirley Taylor, "Model Business Letters, Emails and Other Business Documents" (seventh edition), Prentice Hall
5. Thomas Huckin, Leslie Olsen "Technical writing and Professional Communications for Non-native speakers of English", McGraw Hill.

Highway Structures

Teaching Scheme

Lectures: 3hrs/ week

Examination Scheme

Test 1 and 2: 20 marks each

End-Sem Exam: 60 marks

Course Outcomes

At the end of course, Students will be able to

1. demonstrate the knowledge of highway structures and its various components.
2. demonstrate the knowledge of various techniques in highway structures.
3. select and apply appropriate highway structure.

Course Content

Introduction, Investigation for Bridges and Culverts, Investigations for Important Bridges, Design Flood Discharge for bridges, Linear Waterway of Bridges.

Choice of Foundation for Piers and Abutments, Types of Bridges and Loading Standards, Setting out for Piers and Abutments, Open Foundation, Pile Foundations, Well Foundation- Case Studies.

Piers and Abutments, Superstructure- Design Aspects, Superstructure- Construction, Inspection of Bridges, Maintenance of Bridges- substructure, Maintenance of superstructure – Girders

Rebuilding of Bridges, Construction Management, Grade Separators, River Training and Protection Works, Embankments, Tests on Compaction, Approaches, Layers in Flexible and Rigid pavements, Quality Control Aspects

Retaining walls, small box culverts, large pipe headwalls, high-mast light poles, ITS devices, reinforced soil slopes, sound abutment walls, overhead signs and traffic signals

References

1. S. Ponnuswamy, Bridge Engineering, McGraw Hill Education.

2. Das, P.C., 'Management of highway structures', Thomas Telford Publishing, London

Highway Financing and Policy Analysis

Teaching Scheme

Lectures: 3hrs/ week

Examination Scheme

Test 1 and 2: 20 marks each

End-Sem Exam: 60 marks

Course Outcomes

At the end of course, Students will be able to

1. demonstrate the knowledge of   concepts in transportation economics.
2. Apply demand and supply side concepts to transport policy and planning issues.
3. calculate various transport costs.
4. compare mutually exclusive projects and select the most attractive one
5. Appraise various methods for funding and financing of transportation projects

Course Content

Scope of Transportation Economics, economic development and urban development. Economic theory, demand and supply issues in transportation sector, demand - supply equilibrium, cost and pricing of transport, law of diminishing returns, elasticity and consumer surplus, costs, pricing and subsidy policies, Demand forecasting methods, price elasticity of demand, Main causes of traffic congestion, congestion pricing, road space rationing, and capacity expansion, Supply of transport services, development of systems supply function; Command and control type of regulation, fiscal measures such as road pricing and environmental taxation, safety and economic regulations in the context of transport services provided by public, issues of social, geographical and temporal equity. Direct and external costs of transport, generalized costs, social aspects of transport, joint and common costs of infrastructure, average and marginal cost principle, short-term and long-term costs of supply, congestion costs, external costs, Road User Cost and it's components; Pricing principles efficient pricing, cost complexities and cost recovery, peak load pricing, second-best pricing, Transport subsidies, price discrimination. evaluation of alternatives, analysis techniques, social and financial benefits, Internal Rate of return method for economic and financial viability, valuation of time, measures of land value and consumer benefits from transportation projects, prioritization of projects, multi-criteria decision assessment,   Construction of new infrastructure: investment analysis, Methods for raising funds for maintenance, improvement and expansion of transportation networks, taxation and user fee, financing through loans, bonds, PPPs/PSP and concessions.

References

1. Mccarthy, P.S., "Transportation Economics- Theory and Practice: A Case Study Approach", Blackwell Publishing
2. E. Quinet, R. Vickerman and R.W. Vickerman, "Principles of Transport Economics", Edward Elgare Publishing.
3. Button, K.J., "Transportation Economics", 3rd Ed., Edward Elgare Publishing.

Urban Transportation Systems Planning

Teaching Scheme

Lectures: 3hrs/ week

Examination Scheme

Test 1 and 2: 20 marks each

End-Sem Exam: 60 marks

Course Outcomes

At the end of course, Students will be able to

1. demonstrate the knowledge of fundamentals of transportation systems planning.
2. Apply demand theory and supply theory side of transportation system.
3. compare various models for trip disribution.
4. select and use appropriate land use transport model.

Course Content

Fundamentals of transportation system planning, transportation system planning process, Characteristics of Travel and urban transportation system, Demand theory and supply theory of transportation system, Steps of urban travel demand forecasting- trip generation, trip distribution, modal split and trip assignment, basics of urban transportation network, basics of tour-based or activity-based travel demand model, land use transport model, urban mass transportation, urban goods movement, Basics of activity-based model

References:
1. Ortuzar, J.D. and and Willumsen, L.G., Modelling Transport, John Wiley & Sons, Ltd., 2011.
2. Meyer, M.D. and Miller, E.J., Urban Transportation Planning: A Decision-oriented Approach, Mc Graw Hill, New York, 2001.
3. Hutchinson, B.G., Principles of Urban Transport Systems Planning, McGraw Hill, New York, 1974.
4. Thomas, R., Traffic Assignment Techniques, Avebury Technical, Aldershot, 1991.
5. Yosef Sheffi, Urban transportation networks, Prentice-Hall, Englewood Cliffs, N.J., 1985.
6. Patriksson, M., The traffic assignment problem: models and methods, Dover Publications, New York, 2015.
7. Dickey, J.W., Metropolitan Transportation Planning, Taylor & Francis, 1983.
9. Travel Demand Software for example TransCAD, CUBE.

Transportation Engineering Lab Practice- II

Teaching Scheme   **Examination Scheme**

Practical: 3 hrs/ week   End-Sem Exam: 100 marks

Course Outcomes

At the end of course, Students will be able to

1. demonstrate the knowledge of various software related to Transportation Engineering
2. visit projects, prepare and present technical reports
3. analyze and apply solution for complex problems using advanced software
4. use advance highway design software

Course Content

1. Solving case study problems in travel demand modelling with the help of transportation planning and econometric packages.
2. Developing computer programs for the calibration of travel demand, land-use and land use-transport models
3. Use advance highway design software: Developing sight distance profile for highway alignment, Evaluating existing horizontal and vertical curves, Super elevation development, Intersection design, Interchange design
4. Students will carry out various assignments related to the courses taught in this semester given by the faculty teaching courses.
5. Field visits for studying Transportation Engineering.

(EW-19011)   MINI PROJECT

Teaching Scheme   **Examination Scheme**

Lab hrs: 2 hrs/week   End-Sem Exam – 100 marks

Course outcomes:

At the end of the course, students will demonstrate the ability to

1. Identify a topic for study and carry out literature survey
2. Write a technical report related to selected topic
3. Present outcome of the study with the help of ppt.

Course content:

Mini project presentation is to be performed and reported by the end of the second semester

DISSERTATION I

Teaching Scheme	Examination Scheme
--	Mid-Sem Exam: 40 marks
	End-Sem Exam: 60 marks

Course Outcomes

At the end of course, Students will be able to

1. Identify and carry out research in key areas of Transportation Engineering
2. Analyze data collected and interpret the same
3. demonstrate the evidence of understanding of the chosen topic area, and presentation of technical information.
4. Use and develop written and oral presentation skills.

Course Contents:

The dissertation / project topic should be selected / chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between the academics and the practice.

The student should complete the following:

1. Literature survey
2. Problem Definition
3. Motivation for study and Objectives
4. Data collection / experimental work
5. Report and presentation

References:

1. Various books, research papers, patents and IPRs on the topic selected for the dissertation.

DISSERTATION II

Teaching Scheme   **Examination Scheme**
         --   Mid-Sem Exam: 40 marks
                                                   End-Sem Exam: 60 marks

Course Outcomes

At the end of course, Students will be able to

1. Synthesize knowledge and skills previously gained and applied to in-depth study and execution of new technical problem.
2. Capable to select from different methodologies, methods and forms of analysis suitable to research problem and justify it.
3. Ability to present the findings of their technical solution in a written report.
4. Develop conclusions based on the analysis which are useful to the society at large
4. Write a technical report related to selected topic
6. Present outcome of the study with the help of ppt.

Course Contents:

M. Tech. project is aimed at training the students to analyze independently any problem in the field of Transportation Engineering. The project may be analytical, computational, experimental or a combination of three. The project report is expected to show clarity of thoughts and expression, critical appreciation of the existing literature and analytical, experimental, computational aptitude. The student progress of the dissertation work will be evaluated in stage II by the departmental evaluation committee and final viva voce will be conducted by the external examiner.

References:

1. Various books, research papers, patents and IPRs on the topic selected for the dissertation.