First Year Curriculum

Admission Year 2026-27

Master of Technology
Transportation Engineering

Faculty of Engineering & Technology

Parul University

Vadodara, Gujarat, India

Semester 1

a. **Course Name:** Research Methodology & IPR
b. **Course Code:** 03020201HM01
c. **Prerequisite:** Knowledge of Electronics and Communication Systems and Technologies. Basic Computer Skills Fundamental Knowledge of Area of Interest in relevant discipline.
d. **Rationale:** students will apply matrix methods
e. **Course Learning Objective:**

CLOBJ 1	To develop skills to idealize, formulate, and analyse determinate and indeterminate structures (beams, trusses, and frames) using classical and matrix structural analysis methods.
CLOBJ 2	To present modern methods to determine the force distribution and deformed shapes of structures
CLOBJ 3	To develop skills in interpreting and predicting solutions from structural analysis
CLOBJ 4	To introduce computer-based applications for the analytical methods as presented

f. **Course Learning Outcomes:**

CLO 1	Analyse the skeleton structures using stiffness analysis code.
CLO 2	Use direct stiffness method understanding its limitations
CLO 3	Applications to Simple Problems
CLO 4	Approximate Solution of Boundary Value Problems
CLO 5	Application of Linear problems
CLO 6	Use of Shape functions

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
2	**0**	**0**	**2**	**60**	**20**	**-**	**20**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	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.	**20%**	**5**
2	Effective literature studies approaches, analysis Plagiarism, Research ethics,	**15%**	**5**
3	Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.	**15%**	**5**
4	Nature of Intellectual Property: Patents, Designs, Trademarks and Copyright. Process of Patenting and Development:technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.	**20%**	**5**
5	Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.	**15%**	**5**
6	New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.	**15%**	**5**

i. Text Book and Reference Book:

1. Intellectual Property Rights Under WTO T. Ramappa; S. Chand, 2008
2. Research methodology: an introduction for science & engineering students Stuart Melville and Wayne Goddard; Juta & Co Ltd
3. Research Methodology: An Introduction Wayne Goddard, Stuart Melville; Juta and Company Ltd, 2004
4. Research Methodology: A Step-by-Step Guide for Beginners Ranjit Kumar; PEARSON; 3rd
5. Resisting Intellectual Property Halbert; Taylor & Francis Ltd., 2007
6. Industrial Design Mayall; McGraw Hill, 1992
7. Product Design Niebel; McGraw Hill, 1974

8. Introduction to Design Asimov; Prentice Hall, 1962
9. Intellectual Property in New Technological Age Robert P. Merges, Peter S. Menell, and Mark A. Lemley; 2016

a. **Course Name:** Traffic Engineering
b. **Course Code:** 03021101PC01
c. **Prerequisite:** Knowledge of Transportation Engineering up to B.E./B.Tech. Level
d. **Rationale:** The objective of the course of Traffic Engineering is to provide safety to the road users and regulating traffic flow on the roads. It is necessary to understand the traffic flow parameters for a Traffic Engineer. Traffic Engineer should understand the basic of design of signals, intersection, capacity and level of service to provide safe, efficient and economic transportation of goods and passengers. It is important to know the methods of traffic survey and various traffic control devices. Accidents in urban area increase rapidly. It is necessary to educate the students about the prevention of accidents. The traffic engineer should know about the Environmental impact of a traffic flow and its remedial measures.
e. **Course Learning Objective:**

CLOBJ 1	To understand traffic characteristics, flow theory, and influencing factors.
CLOBJ 2	To analyze traffic using standard survey and data collection techniques.
CLOBJ 3	To evaluate highway capacity and level of service using HCM methods.
CLOBJ 4	To design traffic control systems and analyze traffic flow conditions.
CLOBJ 5	To assess road safety and environmental impacts of transportation systems.

f. **Course Learning Outcomes:**

CLO 1	Understand the basic characteristics of traffic stream.
CLO 2	Conduct traffic survey and interpretation of the data.
CLO 3	Measure the Highway Capacity and Level of Service
CLO 4	Design traffic signal
CLO 5	Recognize accident and environment related terms.
CLO 6	Understand merging and diverging flow

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	
3	**0**	**4**	**5**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Introduction: Characteristics of road users; Characteristics of vehicles; Characteristics of highways, Fundamental variables of traffic flow and their interrelationship, headway - measurement techniques and analysis	**15**	**7**
2	Traffic Surveys: Volume studies; Speed studies; Travel time and Delay studies; Intersection studies, Pedestrian studies; Parking studies.	**25**	**12**
3	Highway Capacity Analysis: Highway Capacity and Level of Service; Measurement Techniques, HCM Methods, Design hourly volumes and speed, its uses	**13**	**6**
4	Merging & Diverging Flow: Merging & Diverging Flow, Weaving Flow, Length Calculations.	**6**	**3**
5	Traffic control devices: Introduction about the Signs, Markings, Signal and their warrants; Signal Cycle Time Calculations, Fixed and vehicle actuated signals, Rotary	**14**	**7**
6	Road Accidents Analysis: Accident characteristics road, driver, vehicle; Accident recording and analysis; Highway safety improvement program; Safety audit.	**14**	**7**
7	Environmental Considerations: Air pollution; kinds of pollutants, air pollution standards; Measures of air quality and control; Measurement of sound levels, acceptable limits; Prediction of noise levels, traffic noise control	**13**	**6**

i. Text Book and Reference Book:

1. Kadiyali.L.R., Traffic engineering and Transport Planning
2. Introduction to Modern Traffic Flow Theory and Control By Boris S. Kerner | Springer
3. Principles of Highway Engineering and Traffic Analysis By Fred L. Mannering, Scott S. Washburn, Walter P. Kilaresk

a. **Course Name:** Road Safety Engineering
b. **Course Code:** 03021101PC03
c. **Prerequisite: Elective**
d. **Rationale:** Knowledge regarding the road safety and repairing by conducting the audit.
e. **Course Learning Objective:**

CLOBJ 1	To understand road accident characteristics, causes, trends, and the influence of human, vehicle, and roadway factors on highway safety.
CLOBJ 2	To apply road safety management principles, safety data requirements, and strategies for developing effective road safety improvement plans.
CLOBJ 3	To analyze crash data using statistical methods, identify black spots, and conduct road safety audits and crash investigations.
CLOBJ 4	To understand crash reconstruction techniques and recommend appropriate mitigation and accident prevention measures through planning, design, and operational improvements.

f. **Course Learning Outcomes:**

CLO 1	Analyze the effect of driver characteristics, roadway characteristics, climatic factors on highway safety.
CLO 2	Analyze accident data and suggest safety measures
CLO 3	Interpret accident data using statistical analysis.
CLO 4	Plan and design a road safety improvement program
CLO 5	Conduct road safety audit.
CLO 6	Understand the concepts of crash reconstruction

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	**-**	**0**	**3**	**60**	**20**	**-**	**00**	**00**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**-Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Introduction to safety Introduction to safety:: Road accidents, Trends, causes, Collision and Condition diagrams, Highway safety, human factors, Vehicle factors, IRC Road accident forms	**10**	**5**
2	Road Safety Management System Road Safety Management System:: Multi-causal dynamic systems approach to safety, crash vs accident, road safety improvement strategies, elements of a road safety plan, Safety Data Needs.	**25**	**16**
3	Statistical Interpretation and Analysis of Crash Data Statistical Interpretation and Analysis of Crash Data:: Before-after methods in crash analysis, Advanced statistical methods, Black Spot Identification & Investigations.	**20**	**13**
4	Road Safety Audits Road Safety Audits: Key elements of a road safety audit, Road Safety Audits & Investigations, Crash investigation and analysis, Describe methods for identifying hazardous road locations, Case Studies.	**15**	**10**
5	Crash Reconstruction:: Crash Reconstruction:: Describe the basic information that can be obtained from the roadway surface, Understand basic physics related to crash reconstruction, speed for various skid, friction, drag, and acceleration scenarios, variables involved in jump and flip crashes, variables involved in pedestrian crashes, Case Studies.	**15**	**10**
6	Mitigation Measures:: Mitigation Measures:: Accident prevention by better planning, Accident prevention by better design of roads, Crash Countermeasures, Highway operation and accident control measures, Highway Safety Measures during construction, Highway geometry and safety.	**15**	**10**

i. Text Book and Reference Book:

1. Traffic Safety by Leonard Evans Science Serving Society
2. The Traffic Safety Toolbox: A Primer on Traffic Safety By Institute of Transportation Engineers (ITE)

a. **Course Name:** Geometric Design of Highway
b. **Course Code:** 03021101PC03
c. **Prerequisite:** Knowledge of Civil Engineering up to B.E./B.Tech level
d. **Rationale:** Course provides Geometric design transportation facilities, route layout and selection
e. **Course Learning Objective:**

CLOBJ 1	To understand the fundamental principles and standards of geometric design for various transportation facilities based on IRC, AASHTO, and other guidelines.
CLOBJ 2	To analyze and design geometric elements such as sight distance, horizontal and vertical alignment, transition curves, and cross-sectional components for different road conditions.
CLOBJ 3	To apply design principles for at-grade intersections, roundabouts, interchanges, and facilities for pedestrians, cyclists, and parking.
CLOBJ 4	To develop appropriate geometric layouts for highways, urban streets, hill roads, and transportation terminals considering safety, efficiency, and operational requirements.

f. **Course Learning Outcomes:**

CLO 1	Design the longitudinal and cross Sectional elements of a highway.
CLO 2	Design the intersections, interchanges
CLO 3	Design the facilities for bicyclists and pedestrians.
CLO 4	Design parking facilities.
CLO 5	Design street lighting systems.
CLO 6	Design the terminal layout and design

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	**0**	**0**	**3**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. **Course Content:**

Sr. No.	**Content**	**Weightage**	**Teaching Hours**
1	Geometric Design: General: Geometric design provisions for various transportation facilities as per AASHTO, IRC and other guidelines,	**15**	**7**

	Discussion of controls governing geometric design, route layout and selection.		
2	Elements of design: Sight distances, horizontal alignment, transition curves, super ± elevation and side friction.	**20**	**10**
3	Vertical alignment Grades, crest and sag curves. Highway cross ±sectional elements and their design for rural highways, Urban streets and hill roads.	**20**	**10**
4	At grade intersections: Sight distance consideration and principles of design, Channelization, mini roundabouts, layout of roundabouts, Inter ±Changes ±major and minor interchanges, entrance and exit ramps, acceleration and deceleration lanes, Bicycle and pedestrian facility design, Parking layout and design, Terminal layout and design.	**45**	**21**

i. Text Book and Reference Book:

1. Kadiyali.L.R., Traffic engineering and Transport Planning
2. Introduction to Modern Traffic Flow Theory and Control By Boris S. Kerner | Springer
3. Principles of Highway Engineering and Traffic Analysis By Fred L. Mannering, Scott S. Washburn, Walter P. Kilaresk

a. **Course Name:** Intelligent Transportation System.
b. **Course Code:** 03021101PE05
c. **Prerequisite:** Elective
d. **Rationale:** Knowledge regarding ITS System
e. **Course Learning Objective:**

CLOBJ 1	To understand the fundamentals, objectives, and components of Intelligent Transportation Systems (ITS) and data collection techniques used in ITS applications.
CLOBJ 2	To analyze the role of telecommunications, information management, traffic management centers, and vehicle positioning systems in ITS.
CLOBJ 3	To evaluate various ITS functional areas such as ATMS, ATIS, APTS, AVCS, CVO, and rural transportation systems.
CLOBJ 4	To understand ITS user services, automated highway systems, and global ITS implementations for improving transportation efficiency and safety.

f. **Course Learning Outcomes:**

CLO 1	Manage traffic with the help of sophisticated information system.
CLO 2	Plan mass transportation system.
CLO 3	Use information technology to solve traffic related problems.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	**-**	**0**	**3**	**60**	**20**	**-**	**00**	**00**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. **Course Content:**

Sr. No.	**Content**	**Weightage**	**Teaching Hours**
1	Introduction Introduction to Intelligent Transportation Systems (ITS) – Definition of ITS and Identification of ITS	**10**	**5**

	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.		
2	Telecommunications in ITS Telecommunications in ITS – Importance of telecommunications in the ITS system. Information Management, Traffic Management Centres (TMC). Vehicle – Road side communication – Vehicle Positioning System	**20**	**10**
3	ITS functional areas 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).	**30**	**14**
4	ITS User Needs and Services 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.	**25**	**12**
5	Automated Highway Systems 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.	**15**	**7**

i. Text Book and Reference Book:

1. Kadiyali.L.R., Traffic engineering and Transport Planning
2. Highway Capacity Manual By Transportation Research Board | Washington
3. Advanced Technologies for Intelligent Transportation Systems By Picone, M., Busanelli, S., Amoretti, M., Zanichelli, F., Ferrari, G.-L. | Springer, Pub. Year 2014

a. **Course Name:** Transportation System Analysis
b. **Course Code:** 03021101PE09
c. **Prerequisite:** Knowledge of Urban Transportation system up to B.E. Level.
d. **Rationale:** Urban Transportation planning is most important area in the field of transportation. Looking to the present scenario, suitable transportation planning is the backbone of the urbanization. Urbanization is going on at alarming rate in developing countries like India. After studying the subject, the student will be able to understand the importance of the transportation and systematic planning in urban area. The subject covers various types of transportation systems and its characteristics. It is important to carry out thorough study of travel demand and fulfilment. The subject is useful for estimating Trip Generation, Trip Distribution, Modal Split and Trip Assignments. Land use planning models and their suitability should be studied for designing of suitable transportation systems.
e. **Course Learning Objective:**

CLOBJ 1	To understand the concepts of urbanization, urban transport planning process, urban forms, and regional planning principles influencing transportation systems.
CLOBJ 2	To apply demographic, economic, and regional planning models for population and employment forecasting in transportation planning.
CLOBJ 3	To analyze urban travel demand using trip generation, distribution, modal split, and route assignment techniques.
CLOBJ 4	To evaluate mass transit systems, corridor identification, and coordination of public, private, and para-transit modes for efficient urban mobility.

f. **Course Learning Outcomes:**

CLO 1	Explain basics of urban and regional , town, transportation planning and existing system
CLO 2	Collect the data and analyze for travel demand forecasting for horizon year by four stage modeling
CLO 3	Classified types and Suggest mass transportation system in urban area with performance measurement.
CLO 4	Development of regional and urban planning models

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**		
L	**T**	**P**	**C**	**Internal Evaluation**	**ESE**	**Total**

				MSE	CE	P	Theory	P	
3	**0**	**0**	**3**	**60**	**20**	**-**	**00**	**00**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	INTRODUCTION Urban Planning Urbanization, urban class groups, transportation problems and identification, impacts of transportation on urban development, urban transport system planning process. Introduction to Preparation of comprehensive plan and transportation system management planning. Urban forms and structures: point, linear, radial, poly-nuclear Regional planning: Classification of regions - Transport systems functions - Regional delineation - Regional growth - Concepts of GDP and GNP - Regional economic analysis, factors of production, regional income, location quotient, multiplier effects	**20**	**10**
2	Regional Planning Models Demographic and employment forecasting mode: Population forecast, Linear & Exponential models, Logistic models, Cohort – survival models – Employment classification, economic base mechanism, input and output analysis ,Importance & Types – SARC model – Mc-Lynn model - Sketch planning methods – UMOT - Incremental demand models – Abstract model	**30**	**10**
3	Urban Travel demand modeling Trip Generation ,Trip Distribution , Modal Split ,Route Assignment	**30**	**20**
4	Mass transit systems Introduction to routing and scheduling, parameters to measure performance of transit system. Corridor identification and corridor screen line analysis. As per developments suitability of transit system Urban transit problems, travel demand, types of transit systems, public, private, para-transit transport, mass and rapid transit systems, BRTS and Metro rails, capacity, merits and comparison of systems, coordination, types of coordination	**20**	**8**

i. Text Book and Reference Book:

1. Kadiyali.L.R., Traffic engineering and Transport Planning (TextBook)
2. Traffic Engineering and Transport Planning (TextBook) By Dr. L.R. Kadiyali | Khanna Publishers, New Delhi

3. Traffic Engineering Design: Principles and Practice (TextBook) By Mike Slinn, Paul Matthews, Peter Guest, Butterworth Heinemann
4. Traffic Engineering Hand Book by Institute of Transportation Engineers Prentice Hall | 4th Edition
5. Transport Planning and Traffic Engineering By Coleman A. O 'Flaherty, Butterworth-Heinemann
6. Fundamentals of Transportation System Analysis (TextBook) By C. S. Papacostas
7. Principles of Transportation Engineering (TextBook) By Chakroborty Partha, Das Animesh

a. **Course Name:** Dock and Harbour Engineering
b. **Course Code:** 03021101PE11
c. **Prerequisite:**
d. **Rationale:** Get the knowledge about the planning and designing of dock and harbour
e. **Course Learning Objective:**

CLOBJ 1	To understand the fundamentals of water transportation, classification, development, and administrative setup of harbours, docks, and ports.
CLOBJ 2	To analyze harbour planning aspects including ship characteristics, site selection, coastal environment, and survey investigations.
CLOBJ 3	To understand the design and construction features of coastal structures such as breakwaters, piers, wharves, berths, and mooring systems.
CLOBJ 4	To evaluate navigation aids, dredging operations, coastal protection measures, and dock and repair facilities.
CLOBJ 5	To analyze port planning, cargo handling systems, storage facilities, and landside transportation integration.
CLOBJ 6	To understand modern port services including Ro-Ro ferry systems, specialized vessels, and emerging marine transportation technologies.

f. **Course Learning Outcomes:**

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

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	**-**	**0**	**3**	**60**	**20**	**-**	**00**	**00**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**-Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	General: Introduction to water transportation, History, development and policy, classification of Harbours, Docks and Ports, major Ports in India, administrative set up.	**8**	**4**
2	Planning & Design of Harbour: Harbour components & its functions, ship features & ship characteristics, Tonnage relations, Ships for LPG, LNG and other Bulk Cargo, Desirable features of Harbour site, Coastal structures, Coastal Environments, wind, waves, tides & currents observations, principles of Harbour planning & layouts design considerations. Site investigation ± Hydrographic survey, Topographic survey, Geological & Geo-technical studies	**19**	**9**
3	Coastal structures:General design aspects, construction features of Breakwaters, Piers, Wharves, Dolphin, Fender system, Moles, Trestles Mooring accessories, Berth & Slip dimensions, width of Apron, Estimation of required number of Berths, General cargo Berth, Tanker Berth, Explosive Berth & fire protection.	**19**	**9**
4	Navigation Aids: Necessity of Navigational aids, Types of Visual, Lights, Signals, Aural & electronic aids, floating & fixed aids, Range light installation, Light house & Light ship	**15**	**7**
5	Dredging and Coastal Protection: Classification of Dredgers, choice of Dredgers materials, coastal erosion and protection	**8**	**4**
6	Docks and Repair Facilities:: Use of wet docks and design of wet docks, repair docks, lift docks, dry docks, Floating docks, Slipway keel and bilge blocking, construction of dry docks, gates & locks.	**10**	**5**
7	Port Amenities: Primary, secondary & Auxiliary Port-function. Port-planning & Port developments, Terminal building, Cargo handling equipment on land side and within ship, selection of cargo handling equipment for general cargo, container type cargo and bulk cargo, storage facilities & cold storage, Land transportation facilities for collection & distribution of commodities.	**13**	**6**
8	Ro-Ro Ferry Services: Roll on Roll off concept, factors affecting Ro-Ro Ferry service, Evaluation of Ro-Ro Ferry	**8**	**4**

	service, Facilities at Mumbai, Hover craft, Hydrofoil Boats, Multi-hull ship.		

i. Text Book and Reference Book:

1. A Course in Docks and Harbour Engineering By S. P. Bindra | Dhanpat Rai & Sons
2. Harbour, Docks and Tunnel Engineering By R. Srinivasan
3. Dock and Harbour Engineering By S. Seetharaman | Umesh Publications.

Semester 2

a. **Course Name:** Pavement Design and Evaluation
b. **Course Code:** 03021102PC01
c. **Prerequisite:** Core course
d. **Rationale:** Knowledge of Highway Materials and Construction.
e. **Course Learning Objective:** Students will be able to analyse structures using finite element method

CLOBJ 1	To understand the fundamentals of pavement types, components, design factors, and approaches used in flexible and rigid pavement systems.
CLOBJ 2	To analyze stresses and strains in flexible and rigid pavements using theoretical models and IRC-based design methodologies.
CLOBJ 3	To design flexible and rigid pavements, including low-volume roads, using IRC guidelines and software tools, considering drainage and performance criteria.
CLOBJ 4	To evaluate pavement strengthening, overlay design, and maintenance strategies for flexible and rigid pavements based on IRC recommendations.

f. **Course Learning Outcomes:**

CLO 1	Compare Highway & Airport pavement
CLO 2	Compare Flexible and Rigid pavement
CLO 3	Apply various methods of flexible pavement design
CLO 4	Apply various methods of rigid pavement design
CLO 5	Understand concepts of highway pavement maintenance
CLO 6	Learn various concepts of pavement evaluation

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	**-**	**2**	**5**	**60**	**00**	**-**	**60**	**30**	**150**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	FUNDAMENTALS OF PAVEMENT Types of pavement. Pavement composition and the function of each component. Factors governing design and analysis of pavement. Introduction to various approaches to design the pavement	15	5
2	PAVEMENT ANALYSIS Stresses and strains in flexible and rigid pavement. Analysis of flexible pavement. Analysis of rigid pavement.	15	6
3	Design of Highway Pavement : Flexible Pavement: Factors affecting pavement design, ESWL, EWLF, VDF, Stress analysis – Boussinesq's theory, Burmister's two- and three-layer theory, Flexible pavement design as performance criteria- subgrade rutting criteria and fatigue cracking criteria for bituminous layer. Pavement design using IITPAVE software for granular base and granular sub base, cementitious base, cementitious sub base. Overview on Pavement design for low volume road using locally available material as per IRC SP-72. Drainage consideration in pavement design Rigid Pavement: Design factors, Westergaard's stress analysis, load stress, temperature stress, Design based on fatigue behaviour of concrete, IRC-58 design method – Fatigue concept (using IIT RIGID), Design of joints, Friberg's analysis of dowel bar design, Design of tie bar. Overview on Pavement design for low volume road as per IRC SP-62	30	20
4	INTRODUCTION TO OVERLAY DESIGN: Strengthening of flexible pavement by overlay - Flexible overlay, Rigid overlay. Strengthening of rigid pavement by overlay – Flexible overlay over rigid pavement, Rigid overlay over rigid pavement, Unboned rigid overlay, Partially bonded rigid overlay.	25	5
5	Maintenance of pavement Flexible pavement: IRC-82, need of maintenance, types, planning, system approach, types of defects, symptoms, location, cause, severity level	15	6

	and treatment. Preventive and periodical renewals, its warrants and treatments. Rigid pavement- Maintenance and its methodology as per IRC: SP:83, Design of overlay		

i. Text Book and Reference Book

1. Dr S.K Khanna, Dr C.E.G Justo "Highway Engineering"
2. L R Kadiyali and N B Lal, Principles and Practices in Highway Engineering (including Expressway and Airport Engineering), Khanna Publishers, New Delhi, 2017
3. Y H Huang, Pavement Analysis and Design, Pearson Prentice Hall, New Delhi, 2013.
4. E J Yoder and M W Witczak, Principles of Pavement Design, Wiley India Pvt. Ltd., New Delhi, 2012
5. R B Mallick and T El-Korchi, Pavement Engineering – Principles and Practice, CRC Press, Taylor and Francis Group, Boca Raton, Florida, 2013
6. Relevant IRC and AASHTO Codes of Practices

a. **Course Name:** Transportation Planning
b. **Course Code:** 03021102PC03
c. **Prerequisite:** Knowledge of Urban Transportation system up to B.E. Level.
d. **Rationale:** Urban Transportation planning is most important area in the field of transportation. Looking to the present scenario, suitable transportation planning is the backbone of the urbanization. Urbanization is going on at alarming rate in developing countries like India. After studying the subject, the student will be able to understand the importance of the transportation and systematic planning in urban area. The subject covers various types of transportation systems and its characteristics. It is important to carry out thorough study of travel demand and fulfilment. The subject is useful for estimating Trip Generation, Trip Distribution, Modal Split and Trip Assignments. Land use planning models and their suitability should be studied for designing of suitable transportation systems.
e. **Course Learning Objective:**

CLOBJ 1	To understand the concepts of urbanization, urban transport planning process, urban forms, and regional planning principles influencing transportation systems.
CLOBJ 2	To apply demographic, economic, and regional planning models for population and employment forecasting in transportation planning.
CLOBJ 3	To analyze urban travel demand using trip generation, distribution, modal split, and route assignment techniques.
CLOBJ 4	To evaluate mass transit systems, corridor identification, and coordination of public, private, and para-transit modes for efficient urban mobility.

f. **Course Learning Outcomes:**

CLO 1	Explain basics of urban and regional , town, transportation planning and existing system
CLO 2	Collect the data and analyze for travel demand forecasting for horizon year by four stage modeling
CLO 3	Classified types and Suggest mass transportation system in urban area with performance measurement.
CLO 4	Development of regional and urban planning models

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**		
L	**T**	**P**	**C**	**Internal Evaluation**	**ESE**	**Total**

				MSE	CE	P	Theory	P	
3	**0**	**0**	**3**	**60**	**20**	**-**	**00**	**00**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	INTRODUCTION Urban Planning Urbanization, urban class groups, transportation problems and identification, impacts of transportation on urban development, urban transport system planning process. Introduction to Preparation of comprehensive plan and transportation system management planning. Urban forms and structures: point, linear, radial, poly-nuclear Regional planning: Classification of regions - Transport systems functions - Regional delineation - Regional growth - Concepts of GDP and GNP - Regional economic analysis, factors of production, regional income, location quotient, multiplier effects	**20**	**10**
2	Regional Planning Models Demographic and employment forecasting mode: Population forecast, Linear & Exponential models, Logistic models, Cohort – survival models – Employment classification, economic base mechanism, input and output analysis ,Importance & Types – SARC model – Mc-Lynn model - Sketch planning methods – UMOT - Incremental demand models – Abstract model	**30**	**10**
3	Urban Travel demand modeling Trip Generation ,Trip Distribution , Modal Split ,Route Assignment	**30**	**20**
4	Mass transit systems Introduction to routing and scheduling, parameters to measure performance of transit system. Corridor identification and corridor screen line analysis. As per developments suitability of transit system Urban transit problems, travel demand, types of transit systems, public, private, para-transit transport, mass and rapid transit systems, BRTS and Metro rails, capacity, merits and comparison of systems, coordination, types of coordination	**20**	**8**

i. Text Book and Reference Book:

8. Kadiyali.L.R., Traffic engineering and Transport Planning (TextBook)
9. Traffic Engineering and Transport Planning (TextBook) By Dr. L.R. Kadiyali | Khanna Publishers, New Delhi

10. Traffic Engineering Design: Principles and Practice (TextBook) By Mike Slinn, Paul Matthews, Peter Guest, Butterworth Heinemann
11. Traffic Engineering Hand Book by Institute of Transportation Engineers Prentice Hall | 4th Edition
12. Transport Planning and Traffic Engineering By Coleman A. O 'Flaherty, Butterworth-Heinemann
13. Fundamentals of Transportation System Analysis (TextBook) By C. S. Papacostas
14. Principles of Transportation Engineering (TextBook) By Chakroborty Partha, Das Animesh

a. **Course Name:** Railway Infrastructure Planning & Design.
b. **Course Code:** 03021102PC05
c. **Prerequisite:** Elective
d. **Rationale:** Enable to plan and design the different components of railway engineering
e. **Course Learning Objective:**

CLOBJ 1	To understand road accident characteristics, causes, trends, and the influence of human, vehicle, and roadway factors on highway safety.
CLOBJ 2	To apply road safety management principles, safety data requirements, and strategies for developing effective road safety improvement plans.
CLOBJ 3	To analyze crash data using statistical methods, identify black spots, and conduct road safety audits and crash investigations.
CLOBJ 4	To understand crash reconstruction techniques and recommend appropriate mitigation and accident prevention measures through planning, design, and operational improvements.
CLOBJ 5	To evaluate various ITS functional areas such as ATMS, ATIS, APTS, AVCS, CVO, and rural transportation systems.
CLOBJ 6	To understand ITS user services, automated highway systems, and global ITS implementations for improving transportation efficiency and safety.

f. **Course Learning Outcomes:**

CLO 1	Apply track design principles, components and design criteria.
CLO 2	Design and analyse the railway track system and signal system with the available methods.
CLO 3	Maintain the railway track and apply remedial measures.
CLO 4	Execute the minor and major projects related to railway infrastructure.
CLO 5	Design railway network, routes and schedules.
CLO 6	Design of infrastructure required for railways.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	**-**	**0**	**3**	**60**	**20**	**-**	**00**	**00**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Permanent Way: Permanent Way:: Requirements, capacity, cross-sections, forces acting on the track, coning of wheels, tilting of rails, function of rails, types of rails, rail wear, defects in rails, creep of rails, rail fixtures and fastenings, ballast, functions, types, sizes, physical properties, subgrade and formation, slopes of formation, switches, tongue rails, crossing, angle of crossing, turnouts, inspection and maintenance, track junctions and track layouts, symmetrical split, three-throw switch, double turnout, diamond crossing, scissors crossover, gauntleted track, gathering line, triangle, double junctions.	**27**	**13**
2	Geometric Design: Geometric Design: Geometric design, gradients, grade compensation, speeds of trains, curves and super elevation, extra clearance on curves, widening of gauge on curves, cutting rails on curves.	**21**	**10**
3	Railway stations and yards: Railway stations and yards: Purpose, site selection, facilities, requirements, classification, platforms, building areas, types of yards, catch sidings, ship sidings, foot over bridges, subways, cranes, weigh bridge, loading gauge, end loading ramps, locomotive sheds, ash-pits, water columns, turntable, triangles, traverser, carriage washing platforms, buffer stop, scotch block, derailing switch, sand hump, fouling mark.	**16**	**7**
4	Signaling and interlocking Signaling and interlocking: Objectives, classification, fixed signals, stop signals, signaling systems, mechanical signaling system, electrical signaling system, systems for controlling train movement, interlocking, modern signaling installations.	**12**	**6**
5	Track maintenance and Rehabilitation: Track maintenance and Rehabilitation:: Maintenance tools tenance of rail surface, track drainage, maintenance in track circuited lengths, track tolerances, mechanized method of track maintenance, off-track tampers, shovel packing, directed track maintenance, classification of renewal works, through sleeper renewals, mechanized relaying, track renewal trains	**12**	**6**
6	Modernization in Railways: Modernization in Railways:: Modernization of railways, effect of high speed track, vehicle performance on track, high speed ground transportation system, ballastless track, elevated railways, underground and	**12**	**6**

	tube railways, MAGLEV trains.		

i. Text Book and Reference Book:

1. A text book of Railway Engineering (TextBook) By S.C. Saxena and S.P. Arora
2. A textbook of Railway Engineering By S.C. Rangwala
3. Text Book of Railway Engineering By B.L. Gupta

a. **Course Name:** Bridge & Tunnel Engineering
b. **Course Code:** 03021102PE03
c. **Prerequisite:** Knowledge of Transportation Engineering and Mathematics up to B.E./B.Tech level.
d. **Rationale:** The course provides knowledge and practice for GIS software related to Transportation Engineering.
e. **Course Learning Objective:**

CLOBJ 1	To understand the fundamentals of Geographic Information Systems (GIS), data structures, spatial and non-spatial data, and hardware and software requirements.
CLOBJ 2	To apply spatial analysis techniques, GIS modelling, GPS integration, and error analysis for accurate geospatial data processing.
CLOBJ 3	To understand principles of remote sensing, satellite systems, sensors, photogrammetry, and digital image processing for data acquisition and interpretation.
CLOBJ 4	To evaluate applications of GIS and remote sensing in transportation planning, urban development, environmental monitoring, and resource management.

f. **Course Learning Outcomes:**

CLO 1	Use GIS software to solve transportation related problems
CLO 2	Use GIS software for highway.
CLO 3	Use of Remote sensing to solve traffic related problems.
CLO 4	Use RS for highway Engineering.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	**-**	**0**	**3**	**60**	**20**	**-**	**00**	**00**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. **Course Content:**

Sr. No.	**Content**	**Weightage**	**Teaching Hours**

1	GIS Definition GIS Definition – Map and map analysis – Automated cartography – History and development of GIS – Hardware requirement – Type of data – Spatial and non-spatial data – Data structure – Vector and raster – Files and data formats – Data compression	**30**	**14**
2	Spatial analysis Spatial analysis – Data retrieval – Query – Overlay – Vector data analysis – Raster data analysis – Modelling in GIS – Digital Elevation Model – DTM – Types of output data – Output devices – Sources of errors – Types of errors – Elimination – Accuracies - The Global Positioning system and its applications.	**20**	**10**
3	Concepts and foundations of remote sensing Concepts and foundations of remote sensing - electromagnetic spectrum - EMR interaction with atmosphere, water vapour, ozone - Basic principles of photogrammetry – Spectral Signature and Spectral Signature curves - Remote sensing platforms	**25**	**12**
4	Satellite system Satellite system parameters, sensor parameters, earth resources and meteorological satellites, microwave sensors, Data Acquisition and interpretation - Visual Image Interpretation – Visual Image Interpretation Equipment - Digital Image Processing – Classification.	**15**	**7**
5	Applications Applications in Survey, mapping and monitoring of land use/land cover - Transportation planning - Infrastructure development - Natural resources management - Urban Planning, Environment - Coastal Zone Management – Air Quality - Development of Resources Information Systems	**10**	**5**

i. Text Book and Reference Book:

1. Mechani Fundamentals of Geographic Information Systems By Michael N DeMers | Wiley India Education
2. Remote Sensing and Image Interpretation By . Lillesand, T. M., and Keifer, R. W | John Wiley & Sons, N York, 1994
3. Concepts and Techniques of Geographic Information Systems By YEUNG, ALBERT K. W., LO, C. P. | PHI Learning

a. **Course Name:** Sustainable Transportation
b. **Course Code:** 03021102PE05
c. **Prerequisite:** Knowledge of Transportation Engineering and Mathematics up to B.E./B.Tech level.
d. **Rationale:** The course provides knowledge and practice for various software related to Transportation Engineering. It also let the students know about use of MS-excel, origin, MxRoad and MSPSS for various calculation and model making for traffic calculations.
e. **Course Learning Objective:**

CLOBJ 1	To understand methods of data processing, statistical analysis, and graphical presentation for effective interpretation of engineering data.
CLOBJ 2	To apply mathematical and statistical techniques including correlation, regression, and hypothesis testing for data analysis.
CLOBJ 3	To analyze univariate and multivariate data using appropriate statistical distributions and parametric/non-parametric tests.
CLOBJ 4	To develop basic skills in AutoCAD and MX-Road for 2D/3D modelling, network analysis, and shortest path analysis in transportation applications.

f. **Course Learning Outcomes:**

CLO 1	Analyse traffic data and generate plots using MS Excel, and Origin. 2. 34. 5.
CLO 2	Apply curve fitting techniques using tools including MS Excel, Origin, and SPSS.
CLO 3	Develop models using MATLAB, and SPSS.
CLO 4	Prepare longitudinal and cross-sections of highways, highway intersection plans, 2D/3D drawings of interchanges using AutoCAD.
CLO 5	Use of MxRoads for geometric design of highways.
CLO 6	Develop the linear regression models and check its validity

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	**-**	**0**	**3**	**60**	**20**	**-**	**00**	**00**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Data Processing, Graphical Presentation and Interpretation: Data Processing and analysis, Standard functions and tools, Statistical analysis of data, Graphical representation and interpretation of data.	**30**	**14**
2	Mathematical and Statistical Analysis: Data types, measures of central tendancy,dispersion and shapes. Correlation and chi Squre Test, Linear Regression Model, Multiple Linear Regression and Non-linear Regression, Statistical distributions, Parametric and Non-parametric tests, Univariate and Multivariate Analysis.	**40**	**20**
3	Basics of AutoCAD and MX-Road: 2D Drawing and Advance Features, 2D and 3D images modeling, Network analysis, shortest path analysis	**30**	**14**

i. Text Book and Reference Book:

1. Statistical and Econometric Methods for Transportation Data Analysis By Simon P. Washington, Matthew G. Karlaftis, Fred L. Mannering | CRC Press

a. **Course Name:** AI/ML Applications in Transportation Engineering
b. **Course Code:** 03021102PE07
c. **Prerequisite:** Elective
d. **Rationale:** Knowledge regarding ITS System
e. **Course Learning Objective:**

CLOBJ 1	To understand the fundamentals, objectives, and components of Intelligent Transportation Systems (ITS) and data collection techniques used in ITS applications.
CLOBJ 2	To analyze the role of telecommunications, information management, traffic management centers, and vehicle positioning systems in ITS.
CLOBJ 3	To evaluate various ITS functional areas such as ATMS, ATIS, APTS, AVCS, CVO, and rural transportation systems.
CLOBJ 4	To understand ITS user services, automated highway systems, and global ITS implementations for improving transportation efficiency and safety.

f. **Course Learning Outcomes:**

CLO 1	Manage traffic with the help of sophisticated information system.
CLO 2	Plan mass transportation system.
CLO 3	Use information technology to solve traffic related problems.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	**-**	**0**	**3**	**60**	**20**	**-**	**00**	**00**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. **Course Content:**

Sr. No.	**Content**	**Weightage**	**Teaching Hours**
1	Introduction Introduction to Intelligent Transportation Systems (ITS) – Definition of ITS and Identification of ITS	**10**	**5**

	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.		
2	Telecommunications in ITS Telecommunications in ITS – Importance of telecommunications in the ITS system. Information Management, Traffic Management Centres (TMC). Vehicle – Road side communication – Vehicle Positioning System	**20**	**10**
3	ITS functional areas 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).	**30**	**14**
4	ITS User Needs and Services 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.	**25**	**12**
5	Automated Highway Systems 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.	**15**	**7**

i. Text Book and Reference Book:

1. Kadiyali.L.R., Traffic engineering and Transport Planning
2. Highway Capacity Manual By Transportation Research Board | Washington
3. Advanced Technologies for Intelligent Transportation Systems By Picone, M., Busanelli, S., Amoretti, M., Zanichelli, F., Ferrari, G.-L. | Springer, Pub. Year 2014

a. **Course Name:** Operation & Maintenance Management of Pavements
b. **Course Code:** 03021102PE09
c. **Prerequisite:** Knowledge of Civil Engineering up to B.E./B.Tech level
d. **Rationale:** The course provides introductory knowledge about material used in construction of highway, their properties, tests performed and methods for construction of various layers of pavement
e. **Course Learning Objective:**

CLOBJ 1	To understand the properties, classification, testing, and stabilization of soils and aggregates for highway pavement applications.
CLOBJ 2	To evaluate bituminous and cement concrete materials, including their properties, tests, and mix design methods for pavement construction.
CLOBJ 3	To develop appropriate mix designs and apply quality control measures for various pavement layers and construction materials.
CLOBJ 4	To understand highway construction practices, equipment, specifications, and drainage design for durable pavement performance.

f. **Course Learning Outcomes:**

CLO 1	Characterize the pavement materials including soil, aggregate, asphalt, cement, asphalt mixtures.
CLO 2	Choose appropriate stabilization. technique for pavement applications
CLO 3	Determine the proportions of ingredients required for the mix design of bituminous mix.
CLO 4	Understand the importance of Highway drainage.
CLO 5	Distinguish the different techniques used for construction of various pavement layers.
CLO 6	Understand the mix design methods for bituminous concrete and cement concrete.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	**0**	**4**	**5**	**60**	**20**	**-**	**20**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Soil: Properties, Classification, Compaction and Consolidation methods, Application and interpretation of Test Results, use of Geotextile materials.	**9**	**5**
2	Soil Stabilisation: Methods, Principles, Test Significance, Design of Soil and Stabilized Mix, Quality Control tests.	**6**	**3**
3	Aggregate: Aggregates Types, Tests, Desired Properties, Aggregate Blending Methods to meet specification.	**11**	**5**
4	Bituminous Materials: Bituminous Materials ±Types, Laboratory Tests, Properties, interpretation of Test Results	**11**	**5**
5	Cement Concrete: Cement grades, chemical composition, testing, admixtures, fibers, properties and testing of pavement quality concrete, concrete mix design methods, high performance concrete.	**9**	**4**
6	Mix Designs: Various mix designs for Bituminous concrete and Cement concrete	**22**	**9**
7	Highway Construction: Materials and Technical specifications, Plants and equipments, construction procedure and quality control tests and their frequencies for various courses such as WMM, WBM, BM, LBM, DBM, MSS, BC, PMC and Cement concrete pavement.	**27**	**14**
8	Highway Drainage Surface and Subsurface Drainage; design and approaches	**5**	**13**

i. Text Book and Reference Book:

1. Highway Construction and Maintenance by Longman Scientific and Technical By J.P.Watson
2. Highway Engineering By Dr. L.R. Kadiyali | Khanna Publishers, New Delhi
3. Highway Engineering By S. K. Khanna, C.E.G. Justo
4. Highway Capacity Manual By Transportation Research Board | Washington

a. **Course Name:** Cost Management of Engineering Projects
b. **Course Code:** 03021602PE07
c. **Prerequisite:** Knowledge of Transportation Engineering
d. **Rationale:** Students will be able to economically evaluate all types of highway projects
e. **Course Learning Objective:**

CLOBJ 1	To understand the principles and methods of economic evaluation of transportation projects including benefit–cost analysis, NPV, IRR, and rate of return.
CLOBJ 2	To analyze vehicle operating costs, value of travel time savings, accident costs, and their significance in transport project appraisal.
CLOBJ 3	To evaluate the impact of traffic congestion and identify appropriate mitigation measures and pricing strategies.
CLOBJ 4	To understand funding and financing mechanisms for transportation projects and apply economic evaluation techniques through case studies.

f. **Course Learning Outcomes:**

CLO 1	Learn about highway projects
CLO 2	Evaluation of highway constructions
CLO 3	Estimation of highway projects
CLO 4	Economic consideration for highway construction
CLO 5	Programming for project management 6.Apply the concepts for practical highway projects

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	**-**	**0**	**3**	**60**	**20**	**-**	**00**	**00**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**-Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Economic Evaluation of Transport Projects:: Need for economic evaluation, Cost and benefits of transport projects, Time horizon in economic assessment, Basic principles of economic evaluation, interest rate, method of economic evaluation, benefit cost ratio method, first year rate of return, net present value method , internal rate of return method, Comparison of various methods of economic evaluation.	**30**	**14**
2	Vehicle Operating Costs:: Introduction, Road used cost study in India, Components of VOC, and factors affecting VOC, Fuel consumption relationship, Spare parts, Maintenance and repairs, labour cost, tyre life, lubricants, utilization and fixed costs	**20**	**10**
3	Value of Travel Time Savings:: Introduction, Classes of transport users enjoying travel time savings, Methodology for monetary evaluation of passengers, travel time, Review of work in India on passengers travel time. Accidents Costs: Introduction, Relevance of accident costing for a developing country, Review of alternative methodologies for accident costing, Indian studies. Traffic Congestion: Main causes of traffic congestion, mechanisms to deal with traffic congestion congestion pricing, road space rationing, capacity expansion.	**25**	**12**
4	Funding and Financing of Transportation Projects:: Methods for raising funds for maintenance, improvement and expansion of transportation networks, taxation and user fee, financing through loans, bonds, PPPs and concessions, Highway financing in India	**15**	**7**
5	Case Study:A typical case study of economic evaluation of Highway Project	**10**	**5**

i. Text Book and Reference Book:

1. Principles of Transportation Engineering By Partho Chakraborty and Animesh Das
2. Manual on Economic Evaluation of Highways in India By IRC–SP: 30 (2009) | Indian Roads Congress
3. Principles of Transportation and Highway Engineering By G.V.Rao | Tata McGraw-Hill Publishing