

Babu Banarasi Das University, Lucknow
Department of Civil Engineering
School of Engineering
Master of Technology (Transportation Engineering) - Regular
Evaluation Scheme

SEMESTER I									
Course Category	Course Code	Code Title	Contact Hours			Evaluation Scheme			Credits
			L	T	P	CI A	ES E	Course Total	
C	MAS3106	Applied Mathematics	4	0	0	40	60	100	4
C	MTE3101	Analysis of Transportation Systems	4	0	0	40	60	100	4
C	MTE3102	Pavement Materials and Design	4	0	0	40	60	100	4
C	MTE3103	Traffic Flow Theory	4	0	0	40	60	100	4
GE	GE36511/ GE36514	Generic Elective I	4	0	0	40	60	100	4
C	MTE3151	Pavement Materials and Evaluation Laboratory	0	0	2	100	0	100	1
C	MTE3152	Seminar	0	0	2	100	0	100	1
C	MTE3153	Technical Paper Writing	0	0	2	100	0	100	1
Total			20	0	6	500	300	800	23

Legends:

- L** Number of Lecture Hours per week
- T** Number of Tutorial Hours per week
- P** Number of Practical Hours per week
- CIA** Continuous Internal Assessment
- ESE** End Semester Examination

Category of Courses:

- C** Core Course
- GE** Generic Elective

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Evaluation Scheme (w.e.f 2019-20)

SEMESTER II									
Course Category	Course Code	Code Title	Contact Hours			Evaluation Scheme			Credits
			L	T	P	CIA	ESE	Course Total	
C	MTE3201	Advanced Foundation Engineering	4	0	0	40	60	100	4
C	MTE3202	Bridge Engineering	4	0	0	40	60	100	4
C	MTE3203	Pavement Evaluation, Rehabilitation and Maintenance	4	0	0	40	60	100	4
C	MTE3204	Urban Transportation Systems Planning	4	0	0	40	60	100	4
GE	GE36521/ GE36524	Generic Elective II	4	0	0	40	60	100	4
C	MTE3251	Traffic Surveys and Analysis	0	0	2	100	0	100	1
C	MTE3252	Seminar	0	0	2	100	0	100	1
C	MTE3253	Technical Paper Presentation	0	0	2	100	0	100	1
Total			20	0	6	500	300	800	23

Legends:

- L** Number of Lecture Hours per week
- T** Number of Tutorial Hours per week
- P** Number of Practical Hours per week
- CIA** Continuous Internal Assessment
- ESE** End Semester Examination

Category of Courses:

- C** Core Course
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SEMESTER III									
Course Category	Course Code	Code Title	Contact Hours			Evaluation Scheme			Credits
			L	T	P	CIA	ESE	Course Total	
C	MTE3351	State of the art Seminar#	-	-	-	200	0	200	4
C	MTE3352	Thesis - I*	-	-	-	400	0	400	16
Total			-	-	-	600	0	600	20

Student need to perform a literature survey and will give a state of the art presentation and will submit a synopsis clearly mentioning the problem statement. The presentation and synopsis will be evaluated internally within two months of the start of the semester and the result will be intimated to the students so as to proceed for thesis.

* Student will develop the workable model for the problem they have supposed in synopsis.

SEMESTER IV									
Course Category	Course Code	Code Title	Contact Hours			Evaluation Scheme			Credits
			L	T	P	CIA	ESE	Course Total	
C	MTE3451	Thesis - II**	-	-	-	200	800	1000	28
Total			-	-	-	200	800	1000	28

** (a) This is in continuation with Thesis - I.

(b) The required experimental / mathematical verification of the proposed model will be done in this semester.

Legends:

- L** Number of Lecture Hours per week
- T** Number of Tutorial Hours per week
- P** Number of Practical Hours per week
- CIA** Continuous Internal Assessment
- ESE** End Semester Examination

Category of Courses:

- C** Core Course
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Course Code	GenericElective-I
GE36511	Transport and Environment
GE36512	Intelligent Transportation Systems
GE36513	Transport Policy and Financing
GE36514	Ground Improvement Techniques

Course Code	GenericElective-II
GE36521	Airport Infrastructure Planning and Design
GE36522	Modern Highway Construction Practices
GE36523	Traffic Simulation Engineering and Management
GE36524	Finite Element Method

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Credit Summary Chart						
Course Category	Semester				Total Credits	%age
	I	II	III	IV		
C	19	19	20	28	86	91.48
GE	4	4			8	8.52
Total	23	23	20	28	94	100

Discipline wise Credit Summary Chart						
Course Category	Semester				Total Credits	%age
	I	II	III	IV		
Engg. Sciences	4				4	4.26
Professional Subject Core	13	17			30	31.92
Professional Subject - General Elective	4	4			8	8.52
Thesis, Seminar	2	2	20	28	52	55.32
Total	23	23	20	28	94	100

Legends:

- L** Number of Lecture Hours per week
- T** Number of Tutorial Hours per week
- P** Number of Practical Hours per week
- CIA** Continuous Internal Assessment
- ESE** End Semester Examination

Category of Courses:

- C** Core Course
- GE** Generic Elective

MTE3101 ANALYSIS OF TRANSPORTATION SYSTEMS

Course Objective:

1. To know about transportation systems.
2. To know about modeling in transportation technology.
3. To know about the basics Transportation network.
4. To know about the analysis of utility maximizing systems.

Learning Outcome:

1. Exposure on transportation system.
2. Exposure on modeling, prediction and equilibrium flows.
3. Exposure on Analysis of Transportation network.
4. Exposure on Urban transport economic policy.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	Introduction to Transportation systems, Transportation innovations, Social and Economic impacts of Transportation, Decision makers and their options	30 Hours	1
II	Demand modeling and prediction, Supply and equilibrium flows, Modelling and transportation technology	30 Hours	1
III	Analysis of network flows, Transportation network, Network theory, Concepts in transportation models and location models, Models for selecting network investments and operation planning	30 Hours	1
IV	Analysis of utility maximizing systems such as entropy Concepts, Major transportation technologies, Cost functions and estimation, Urban transport economic policy, Case Studies.	30 Hours	1

References:

1. CascettaEnnio, "Transportation Systems Analysis: Models and Applications", Springer.

MTE3102 PAVEMENT MATERIALS AND DESIGN

Course Objective:

1. To know about the importance of subgrade soil properties on pavement.
2. To know about the basics of aggregate and their properties.
3. To know about the properties and test of bitumen.

Learning Outcome:

1. Exposure on the importance of subgrade soil properties on pavement
2. Exposure on basics of aggregate and their properties.
3. Exposure on the properties and different tests of bitumen.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	Subgrade functions, Importance of subgrade soil properties on pavement performance. Identification and significance of soil characteristics, Soil classification, Effect of water on swelling and shrinkage, Cohesion and Plasticity.	30 Hours	1
II	Road making aggregates – Classification, Properties of aggregates, design of aggregate gradation, texture, polishing and skid resistance, IRC codes for various types of mixes.	30 Hours	1
III	Bituminous road binders – Straight-run bitumen, emulsions, Cutback and modified binders. Rheology of bituminous binders, modified binders – adhesion and stripping, penetration index, viscosity, temperature susceptibility of viscosity. Additives and their suitability, Fillers. Design of Bituminous mixes – Marshall method and super paves procedure.	30 Hours	1
IV	Design of emulsified mixes, Visco-elastic and fatigue properties of bituminous mixtures, resilient modulus of pavement materials. Requirements of paving concrete, design of mixes – IRC, absolute volume, Vibrated Concrete mix design, design of DLC and SFRC mixes, Soil stabilization techniques.	30 Hours	1

References:

1. Papagiannakis A. T., Masad Eyad, “Pavement design and materials”, John Wiley & Sons.

2. Athanassios Nikolaides, "Highway Engineering: Pavements, Materials and Control of Quality", CRC Press.

MTE3103 TRAFFIC FLOW THEORY

Course Objective:

1. To know about the Traffic Flow System.
2. To know about the network and capacity of a roadway.
3. To know about the Traffic Flow Theory.
4. To know about the Mathematical modeling.

Learning Outcome:

1. Exposure on Traffic Flow System.
2. Exposure on network and capacity of a roadway.
3. Exposure on Traffic Flow Theory.
4. Exposure on Mathematical modeling.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	Component of Traffic Flow System, Traffic variables and parameters, Driver behaviour modeling, Simulation, Controlled – Access Concept, Freeway Concept, System performances, Measures of effectiveness.	30 Hours	1
II	Flow through transportation networks – various types of graphs, determination of link and chain flows, finding maximum flow values of capacitated networks. Capacity of a roadway, Bottlenecks.	30 Hours	1
III	Approaches to traffic flow theory, Traffic flow relationships – flow at different densities, Shock wave phenomenon, time – Space diagram.	30 Hours	1
IV	Mathematical modeling, Probabilistic and Stochastic models of traffic flow process, Discrete and Continuous modeling headways, Gaps and process of gap acceptance, Macroscopic models, Car – following model, Queuing models, fundamentals & developments of queuing process, Applications, Indices of Level of Service as offered to road users.	30 Hours	1

References:

1. Kerner Boris S., “Introduction to Modern Traffic Flow Theory and Control”, Springer.
2. Kerner, Boris S., “Introduction to Modern Traffic Flow Theory and Control”, Springer.

GE36511/GE36711 TRANSPORT AND ENVIRONMENT

Course Objective:

1. To know about the Modes of Transportation.
2. To know about the air pollution in road transport.
3. To know about the noise pollution in road transport.
4. To know about the basics of EIA.

Learning Outcome:

1. Exposure on Modes of Transportation.
2. Exposure on air pollution in road transport.
3. Exposure on noise pollution in road transport.
4. Exposure on the basics of EIA requirements of highway projects.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	Modes of Transportation, Mixed traffic flow, Transport related pollution.	30 Hours	1
II	Road transport related air pollution, Sources of air pollution, Effects of Weather Conditions, Vehicular emission parameters, Pollution standards, Measurement and analysis of vehicular emission, Mitigative Measures, Emission factors.	30 Hours	1
III	Urban and non-urban traffic noise sources, Noise level factors, Effects of traffic noise, Propagation and measurement of traffic noise, Prediction and control measures, Noise studies, Noise standards.	30 Hours	1
IV	EIA requirements of highway projects, EIA procedures, guidelines, EIA practices in India.	30 Hours	1

References:

1. [Louis Franklin Cohn](#), [Gary Richard McVoy](#), “Environmental analysis of transportation systems”, John Wiley & Sons Australia, Limited,
2. [Cohen](#) L. F., “Environmental Analysis of Transportation Systems”, John Wiley & Sons Inc.

GE36512/GE36712 INTELLIGENT TRANSPORTATION SYSTEMS

Course Objective:

1. To understand the different types of sensors
2. To study the ITS functional areas
3. To have an overview of ITS implementation in developed countries
4. To learn the implantation of ITS in developing countries

Learning Outcome:

1. understand the sensor technologies
2. understand the communication techniques
3. apply the various ITS methodologies
4. understand the user needs
5. define the significance of ITS under Indian conditions

Course Contents:

Module	Course Topics	Total Hours	Credits
I	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.	30 Hours	1
II	Telecommunications in ITS Importance of telecommunications in the ITS system, Information Management, Traffic Management Centres (TMC). Vehicle – Road side communication – Vehicle Positioning System	30 Hours	1
III	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	30 Hours	1

	Travel and Traffic management, Public Transportation Management, Electronic Payment, Commercial Vehicle Operations, Emergency Management, Advanced Vehicle safety systems, Information Management.		
IV	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, Case studies.	30 Hours	1

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.

GE36513/GE36713TRANSPORT POLICY AND FINANCING

Course Objective:

1. To know about the transportation policy and the role of engineers and planners in transportation policy making.
2. To know about the transportation policy for the nation.
3. To know about the objectives of the national transport development policy and the approach the nation.
4. To know about the role of private parties in transportation financing.

Learning Outcome:

1. Understand the issues related to transportation policy and the role of engineers and planners in transportation policy making.
2. Participate in developing the transportation policy for the nation.
3. Understand the objectives of the national transport development policy and the approach the nation should take with regards to different transportation sectors to achieve them.
4. Understand the role of private parties in transportation financing.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	Issues in transport policy:Historical background on transportation policy and financing, Role of transportation engineers and planners in transportation policy making, Issues in transport policy, transportation policy formulation process-Policy making process, Transportation taxes, Equity and fairness in transportation, Policies affecting travel behavior, Environmental issues and sustainability	30 Hours	1
II	National transport development policy: Background: Formation of the NTDP committee, its objective and functions; Approach: Growth projections, specific transport systems, institutional framework for formulation of transport policy, planning and coordination; Railways, roads, ports and airways, Transportation of keycommodities, promotion of integrated transport and logistics systems, Human resource development for the transportation sector, Urban transport; safety policy.	30 Hours	1
III	National Urban Transport Policy:Equitable allocation of road space,Encourage greater use of public transport and non-motorized modes of	30 Hours	1

	transport, Integrated land use and transport planning, Five Year Plans-Transportation Policy: Economically rational inter-modal mix, Consortium approach for financing Urban Transport projects, Institutional arrangements for planning and developing urban transport, Unified Metropolitan Transport Authority in metropolitan cities, Innovations in transportation policy.		
IV	<p>Role of Private Participation: Need for private participation, advantages and disadvantages, Public-private partnership, BOT, BOO etc.; Contracts for services, not procurement of assets, Payments related to service delivery, Whole life approach to design, build and operation Clear legal and institutional framework, Transparent and competitive procurement, implementation, risks for government and private parties.</p> <p>Transportation Financing: Pricing and subsidy issues; Economic and financial dimensions of urban transportation systems, User fees, Toll financing and congestion pricing, Fare and subsidy policies, Social costs of transportation systems</p>	30 Hours	1

References:

1. Highway Investment in Developing Countries, Thomas Telford Ltd., Institute of Civil Engineers, 1983.
2. National Transport Development Policy Documents, Government of India, New Delhi, 2012.
3. National Urban Transport Policy, Ministry of Urban Development, Government of India, New Delhi, 2006.
4. Various National Acts on Transport.

GE36514/GE36714GROUND IMPROVEMENT TECHNIQUES

Course Objective:

1. To know about the basics of ground improvement techniques and its applications.
2. To know about the stabilization of soil.
3. To know about the cohesionless and cohesive soils.
4. To know about the Geotextiles.

Learning Outcome:

1. Illustration on ground improvement techniques and its applications.
2. Illustration on stabilization of soil.
3. Illustration on cohesionless and cohesive soils.
4. Illustration on Geotextiles and its types.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	Introduction:Need for ground improvement, applications, factors affecting, different mechanical, chemical, static and dynamic techniques, mechanical stabilization, blending of aggregate, Rothfuch's, Testing.	30Hours	1
II	Chemical Stabilization:Lime, cement, bitumen, factors influencing, Designapproach, construction procedure, laboratory testing, additives. Suspension and solution grouts, principles, methods, equipment, applications, compaction grouting, jet grouting.	30 Hours	1
III	Cohesionless Soils: In situ densification, vibro techniques, Mechanisms. Factors affecting, suitability number, compacting piles. Vibro replacement process. Cohesive Soils:In situ densification, Pre-loading – Dewatering, sanddrains. Sandwicks, geodrains. ropedrains, banddrains-stone columns, lime piles - thermal and vacuum methods.	30 Hours	1
IV	Geotextiles: Woven and non-woven fabrics. Types, functions and application – Geo-textiles, geo-grades test on geo-textiles. Reinforced earth principles and factors governing design.	30 Hours	1

References:

1. Hansmann, R., "Engineering Principles of GroundModification", McGraw Hill Publishing Co.,

2. Moseley, M.P., "Ground Improvement", Spon Press.
3. Fang-Hsai - Yang, "Foundation Engineering Hand Book", CBS Publication, New Delhi.
4. Raj Purushothama P., "Ground Improvement techniques", Lakshmi Publication.
5. [Sanjay Kumar Shukla](#), [Jian-Hua Yin](#), "Fundamentals of Geosynthetic Engineering", CRC Press.
6. Klaus Kirsch, Alan Bell, "Ground Improvement", CRC Press.

MTE3151 PAVEMENT MATERIALS AND EVALUATION LABORATORY

List of Experiments

- 1.** To determine the Specific Gravity, Penetration value, Softening Point, Ductility value of Bitumen.
- 2.** To determine the flash and fire point of a given bituminous material.
- 3.** To determine the Specific Gravity, Los Angeles Abrasion value, Aggregate Impact value, Sieve Analysis, Flakiness and Elongation Index of road aggregates.
- 4.** To determine optimum binder content of given bituminous mix by Marshall method of Mix Design.
- 5.** To measure the skid resistance of pavements.
- 6.** To study Benkelman Beam Deflection test.

MTE3201 ADVANCED FOUNDATION ENGINEERING

Course Objective:

1. To know about the basics of shallow foundation.
2. To know about the basics of deep foundation.
3. To know about the basics of machine foundation.
4. To know about the basics of Dynamic Soil investigation.

Learning Outcome:

1. Illustration on shallow foundation.
2. Illustration on deep foundation.
3. Illustration on machine foundation.
4. Illustration on Dynamic Soil investigation.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	Shallow Foundation: Bearing capacity, settlement, depth of foundation, depth of soil exploration, footings subjected to moments, footings subjected to Tension. Soil design of footings in clay and sand with settlement calculations Rafts in clay and insand: Floating rafts, buoyancy rafts and basement rafts.	30 Hours	1
II	Deep Foundation:Introduction to various types of deep foundations, cofferdams, diaphragm walls and foundation. Piles: Types, mechanics of load transfer, negative skin friction, determination of ultimate load capacity of individual and group of piles, under reamed piles. Well Foundations: Classification, forces acting and stability construction techniques, tilt and shift, dewatering.	30 Hours	1
III	Machine Foundations:Classification of machine foundations and fundamental principles for the design of machine foundation under static and vibratory systems. Criteria for design.	30 Hours	1
IV	Dynamic Soil investigation: Theoretical and practical determination of elastic properties of soil, Behaviour of soil under dynamic loads, determination of allowable soil stress for dynamic loads.	30 Hours	1

References:

1. Arora, K.R., “Soil Mechanics and Foundation Engineering”, Standard Publishers.
2. Murthy VNS, “[Text book of Soil Mechanics and Foundation Engineering: Geotechnical Engineering](#)”, CBS Publishers & Distributors-New Delhi.
3. Punmia B. C., Jain Ashok Kr. and Jain Arun Kr., “[Soil MechanicsandFoundations](#)”, Laxmi Pub.

GE36521/GE36721 AIRPORT INFRASTRUCTURE PLANNING AND DESIGN

Course Objective:

5. To know about the basics of Aircraft Characteristics.
6. To know about the basics of Air Traffic Management.
7. To know about the basics of Planning, Forecasting and Geometric Design of the Airfield.
8. To know about the basics of Planning and Design of the Terminal Area.

Learning Outcome:

1. Analyze the effects of atmospheric variables on aircraft performance.
2. Fix the orientation of the runways.
3. Design the geometrics of the airport infrastructure.
4. Prepare structural designs of runway, taxiway, and apron-gate area.
5. Prepare a plan of the airport terminal area.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	Aircraft Characteristics: Landing gear configurations, aircraft weight, engine types. Atmospheric conditions Affecting aircraft performance: air pressure, temperature, wind speed and direction. Aircraft performance characteristics: speed, payload and range, runway performance, declared distances, wingtip vortices and other definitions.	30 Hours	1
II	Air Traffic Management: Air traffic separation rules: vertical separation, flight altitudes, longitudinal separation, and lateral separation. Navigational aids: ground based systems, satellite based systems. Airport Planning and Forecasting: Airport planning studies: airport system plan, airport site selection, airport master plan, airport project plan. Forecasting methods: time series method, market share method, econometric modelling. Forecasting requirements and applications: airport system plan, airport master plan.	30 Hours	1
III	Geometric Design of the Airfield: Airport classification: utility airports, transport airports. Runways: runway configurations, runway orientation, wind rose, estimating runway length, sight distance and longitudinal profile, transverse gradient, airfield separation requirements, obstacle clearance requirements.	30 Hours	1

	<p>Taxiways and taxi-lanes: widths and slopes, taxiway and taxi-lane separation requirements, sight distance and longitudinal profile, exit taxiway geometry, location of exit taxiways, design of taxiway curves and intersections, end-around taxiways.</p> <p>Aprons: holding aprons, terminal aprons and ramps, terminal apron surface gradients. Control tower visibility requirements.</p>		
IV	<p>Planning and Design of the Terminal Area: Passenger terminal system and its components. Design considerations: terminal demand parameters, facility classification, level of service criteria.</p> <p>Terminal planning process: overall space requirements, concept development, horizontal distribution concepts, vertical distribution concepts.</p> <p>Apron gate system: number of gates, ramp charts, gate size, aircraft parking type, apron layout, apron circulation, passenger conveyance to aircraft, apron utility requirements, Structural design of runways.</p>	30 Hours	1

References:

1. Ashford, N. J., Mumayiz, S. A., and Wright, P. H. Airport Engineering: Planning, Design and Development of 21st Century Airports, Fourth Edition, John Wiley & Sons, New Jersey, USA.
2. Horonjeff, R., McKelvey, F. X., Sproule, W. J., and Young, S. B. Planning and Design of Airports, Fifth Edition, McGraw-Hill, New York, USA.
3. Kazda, A., and Caves, R. E. Airport Design and Operation, Second Edition, Elsevier, Oxford, U.K.
4. Khanna, S. K., Arora, M. G., and Jain, S. S. Airport planning and Design, Sixth Edition, Nem Chand and Bros, Roorkee, India.
5. Kumar, V., and Chandra, S. Air Transportation Planning and Design, Galgotia Publications Pvt. Ltd., New Delhi, India.
6. Satish Chandra, Railway Engineering, Oxford press.

GE36522/GE36722 MODERNHIGHWAY CONSTRUCTION PRACTICES

Course Objective:

1. To know about the basics of Embankment Construction.
2. To know about the basics of Bituminous Constructions.
3. To know about the basics of Concrete road construction.
4. To know about the basics of Hill Roads Construction.

Learning Outcome:

1. Illustration onEmbankment Construction.
2. Illustration onBituminous Constructions.
3. Illustration onConcrete road construction.
4. Illustration onHill Roads Construction.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	Embankment Construction: Formation cutting in Soil and hard rock, Preparation of Subgrade, Ground improvement, Retaining and Breast walls on hill roads, Granular and Stabilized, Sub-bases/bases, Water Bound Macadam, Wet Mix Macadam, Cement treated bases, Dry Lean Concrete.	30 Hours	1
II	Bituminous Constructions: Types of Bituminous Constructions, Interface Treatments, Bituminous Surfacing and wearing Courses for roads and bridge deck slabs, Selection of wearing Course under different Climatic and Traffic conditions, IRC specifications, Construction techniques and Quality Control.	30 Hours	1
III	Concrete road construction: Test on Concrete mixes, Construction equipments, Method of construction of joints in concrete pavements, Quality Control in Construction of Concrete pavements, Construction of Continuously reinforced, Prestressed, Steel Fibre Reinforced Pavements, IRC, AASHTO Specifications, Recycled pavements, Non-Conventional Pavements, Overlay Construction.	30 Hours	1
IV	Hill Roads Construction: Stability of Slopes, Landslides-Causes and Control measures, Construction of Bituminous and Cement Concrete roads at high altitudes, Hill road drainage.	30 Hours	1

References:

1. Pathak D.R. and Gite H.K., “Highway Engineering”, NiraliPrakashan.
2. Kadyali L R., “[Principles and Practices of Highway Engineering](#)”, Khanna Publishers.
3. Kumar S., “Textbookof Highway Engineering”, Orient Black Swan Pvt Ltd.- New Delhi.
4. EJ Yoder and MW Witzak, “Principles of Pavement Design”, John Wiley & Sons.

GE36723/GE36523 TRAFFIC SIMULATION ENGINEERING AND MANAGEMENT

Course Objective:

1. To know about the basics of Traffic Surveys and Analysis.
2. To know about the basics of Traffic Control.
3. To know about the basics of Geometric Design of Intersections.
4. To know about the basics of Traffic Management.

Learning Outcome:

1. Exposure on Traffic Surveys and Analysis.
2. Illustration on Traffic Control.
3. Exposure on Geometric Design of Intersections.
4. Illustration on Traffic Management.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	Traffic Surveys and Analysis: Surveys and Analysis - Volume, Capacity, Speed and Delays, Origin and Destination, Parking, Pedestrian Studies, Accident Studies and Safety Level of Services- Basic principles of Traffic Flow.	30 Hours	1
II	Traffic Control: Traffic signs, Road markings, Design of Traffic signals and Signal co-ordination (Problems), Traffic control aids and Street furniture, Street Lighting, Computer applications in Signal design	30 Hours	1
III	Geometric Design of Intersections: Conflicts at Intersections, Classification of 'At Grade Intersections, Channelized Intersections- Principles of Intersection Design, Elements of Intersection Design, Rotary design, Grade Separation and interchanges - Design principles.	30 Hours	1
IV	Traffic Management- Transportation System Management-Travel Demand Management, Traffic Forecasting techniques, Restrictions on turning movements, One way Streets, Traffic Segregation, Traffic Calming, Tidal flow operations, Exclusive Bus Lanes, Introduction to Intelligent Transportation System.	30 Hours	1

References:

1. Kadiyali L R, Traffic Engineering and Transport Planning, Khanna Technical Publications, Delhi.
2. Khanna K. and Justo C E G, Highway Engineering, Khanna Publishers, Roorkee.
3. Indian Roads Congress (IRC) specifications: Guidelines and special publications on Traffic Planning and Management.
4. Guidelines of Ministry of Road Transport and Highways, Government of India.
5. Subhash C. Saxena, "A Course in Traffic Planning and Design", DhanpatRai Publications, New Delhi.
6. KhistyJotin C., Lall Kent B., "Transportation Engineering – An Introduction", Prentice Hall of India Pvt Ltd.

GE36524/GE36724FINITE ELEMENT METHOD

Course Objective:

1. To know the basics concept of FEM.
2. To know about the different types of elements in FEM.
3. To know about the formulations of element stiffness and loads.
4. To know about the techniques of nonlinear analysis.

Learning Outcome:

1. Illustration on concept of FEM.
2. Exposure on different types of elements in FEM.
3. Exposure on formulations of element stiffness and loads.
4. Illustration on techniques of nonlinear analysis.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	Introduction and basic concepts. Energy approach and variational principles in Finite Element Method. Various element shapes	30 Hours	1
II	Isoparametric elements, Axisymmetric elements, plate bending elements, introduction to 3-D elements, shell elements, interface elements, boundary elements.	30 Hours	1
III	Direct and variational formulations of element stiffness and loads. Assemblage of elements, Boundary conditions and solution of overall problems.	30 Hours	1
IV	Techniques of nonlinear analysis, Mesh generation, graphic display and software packages, Organization of FEM programs, efficient solutions, input/output, pre and post processors.	30 Hours	1

References:

1. Krishnamoorthy C. S., "Finite Element Analysis", Tata McGraw-Hill
2. David V. Hutton, "Fundamentals of Finite Element Analysis", McGraw Hill
3. Maity D., "Computer Analysis of Framed Structures", I. K. International Pvt. Ltd. New Delhi
4. Erik G. Thompson, "Introduction to the Finite Element Method: Theory, Programming and Applications", John Wiley.

MTE3251 TRAFFIC SURVEYS AND ANALYSIS

List of Experiments

1. Volume count
2. Spot speed
3. Speed and delay studies
4. Parking studies
5. Origin and destination studies
6. Physical inventory using total station survey equipment
7. Environmental impact – Noise studies and vehicular emission measurement
8. Lighting studies

MTE3202 BRIDGE ENGINEERING

Course Objective:

1. Develop an understanding of appreciation for basic concepts in proportioning and design of bridges in terms of aesthetics, geographical location and functionality.
2. To know about the types of bridges.
3. To know about the design of components of bridges.
4. To know about the maintenance of bridges.

Learning Outcome:

1. Illustrates about the basics concepts in proportioning and design of bridges.
2. Illustration on types of bridges.
3. Illustration on design of components of bridges.
4. Illustration on maintenance of bridges.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	History of Bridge Development: Classification of bridges, Selection of bridge sites, Bridge alignment, Sub-surface investigations, Bridge Hydrology, Flood discharge, waterways, scour depth, depth of foundation, standards of loadings, types of loads, impact effect, wind loads, seismic forces, buoyancy, earth pressure, loadings on various bridges, traffic requirements	30Hours	1
II	Bridge Super structure: Superstructure elements, Bridge flooring, design of slab bridges & girder bridges, Theory only for Prestressed concrete bridges, plate girder bridges, Suspension bridges Bridge bearings, joints in bridges, Cable stayed bridges, Truss bridges.	30 Hours	1
III	Bridge Foundation &Substructure:Settlements, Allowable soil pressures, types of foundations, Design of pile foundation, foundation failures, Design of piers and abutments, wing walls and approaches and cofferdams (Concepts only)	30 Hours	1
IV	Bridge Construction & Maintenance:Erection of steel girder bridges, truss bridges, suspension bridges, maintenance of bridges, bridge testing for safe carrying capacity, strengthening of bridges,	30 Hours	1

	aesthetical treatments.		
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References:

1. Johnson Victor D., "Essentials of Bridge Engineering", Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
2. Krishna Raju. N., "Design of Bridges", fourth edition Oxford &IBM Publishing Co, Bombay.
3. Taylor F.W, Thomson S.E. and Smulski. E., "Reinforced Concrete Bridges", John Wiley & Sons, New York.
4. IRC: 3-1983, "Dimensions and Weights of Road Design Vehicles".
5. IRC:5-1998, "Standard Specifications and Code of Practice for Road Bridges, Section I – General Features of Design" (Seventh Revision).
6. IRC:6-2010, "Standard Specifications and Code of Practice for Road Bridges, Section II – Loads and Stresses" (Fifth Revision).
7. Ponnuswamy, S., "Bridge Engineering", Tata McGraw - Hill, New Delhi.
8. Bindra S.P., "Bridge Engineering", DhanpatRai& Sons.

MTE3203 PAVEMENT EVALUATION, REHABILITATION AND MAINTENANCE

Course Objective:

1. To know about the **Pavement Evaluation**.
2. To know about the Pavement Rehabilitation.
3. To know about the highway maintenance and its types.

Learning Outcome:

1. Exposure on **Pavement Evaluation**.
2. Illustration on Pavement Rehabilitation.
3. Illustration on highway maintenance and its types.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	Pavement Evaluation: Functional and Structural Evaluation of pavements, Concept of roughness, International Roughness Index, Measurement of Roughness using different types of equipment, Structural evaluation of in-service pavements using Benkelman beam and Falling Weight Deflectometer methods.	30 Hours	1
II	Pavement Rehabilitation: Engineering concepts and information needed to maintain and rehabilitate pavements. Project evaluation, testing and analysis. Design of rigid and flexible overlays, and other methods of rehabilitation. Selection of rehabilitation alternatives.	30 Hours	1
III	Analysis of the effects of maintenance activities on pavement performance. Initial and life cycle cost analysis of various rehabilitation alternatives.	30 Hours	1
IV	Highway Maintenance: Types of highway maintenance, distresses in flexible and rigid pavements and their remedial measures, maintenance management process, evaluation and performance, analysis and selection, prioritization, resource allocation.	30 Hours	1

References:

1. Kadiyali L.R., "Principles & Practice of Highway Engineering", Khanna Publishers.

2. Khanna S.K., Justo C.E.G., "Highway Engineering", Nem Chand & Bros., Roorkee.
3. Pearson E. Derek, "Deterioration and maintenance of pavements", Ice Publishing.
4. E.J Yoder – TMH publication, Pavement Analysis.

MTE3204 URBAN TRANSPORTATION SYSTEMS PLANNING

Course Objective:

1. To know about the Estimation and Forecasting of travel demand.
2. To know about the basics of Trip Generation modeling.
3. To know about the basics of Modal Split Modeling.
4. To know about the basics of town planning.

Learning Outcome:

1. Illustration on Estimation and Forecasting of travel demand.
2. Illustration on Trip Generation modeling.
3. Illustration on Modal Split Modeling.
4. Illustration on Dynamic Soil investigation.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	Hierarchical levels of planning, Passenger and Good transportation, General concept and planning process, Urban Travel characteristics, Private and Public Travel Behaviour Analysis, Travel Demand Estimation and Forecasting.	30 Hours	1
II	Trip Generation modeling – variables influencing trip generation, Regression Analysis and Category Analysis, Trip distribution Modeling – factors governing trip distribution, Growth factor Method, Gravity Model, Intervening opportunity and Competing opportunity Models.	30 Hours	1
III	Modal Split Modeling – factors influencing Mode choice, Two stage Modal Split Models, Discrete choice Models, Entropy Maximizing and Linear Programming Methods, Transport behavior of Individuals and Households, Network and Route Assignment, Capacity Restrain and Simultaneous Distribution, Direct Demand Models, Land use Models.	30 Hours	1
IV	Lowry derivative models - Quick response techniques - Non-Transport solutions for transport problems. Ekistics- Science of human settlements- Characteristics of urban structure. Town planning concepts - Neighborhood planning.	30 Hours	1

References:

1. Hutchinson B.G., "Principles of urban transportation system planning", McGraw Hill.
2. Bruton M. J., "Introduction to transportation planning", Hutchinson of London.
3. Dickey J. W., "Metropolitan Transportation Planning", Tata McGraw Hill.
4. Michael D. Mayer and Eric J. Miller, "Urban transportation planning A Decision Oriented Approach", McGraw Hill.
5. Papacostas C. S. and Prevedouros P.D., "Transportation Engineering and Planning", Prentice Hall.

