Babu Banarasi Das University, Lucknow

Department of Civil Engineering

School of Engineering

Master of Technology (Transportation Engineering) - Regular

Evaluation Scheme (w.e.f. 2021-22)

SEMESTER I									
Course Category	**Course Code**	**Code Title**	**Contact Hours**			**Evaluation Scheme**			**Credits**
			L	**T**	**P**	**CIA**	**ESE**	**Course Total**	
C	MAS4106	Applied Mathematics	4	0	0	40	60	**100**	**4**
C	MTE4101	Analysis of Transportation Systems	4	0	0	40	60	**100**	**4**
C	MTE4102	Pavement Materials and Design	4	0	0	40	60	**100**	**4**
C	MTE4103	Traffic Flow Theory	4	0	0	40	60	**100**	**4**
GE	GE46511/ GE46515	Generic Elective I	4	0	0	40	60	**100**	**4**
C	MTE4151	Pavement Materials and Evaluation Laboratory	0	0	2	100	0	**100**	**1**
C	MTE4152	Seminar	0	0	2	100	0	**100**	**1**
C	MTE4153	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

Babu Banarasi Das University, Lucknow

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SEMESTER II									
Course Category	**Course Code**	**Code Title**	**Contact Hours**			**Evaluation Scheme**			**Credits**
			L	**T**	**P**	**CIA**	**ESE**	**Course Total**	
C	MTE4201	Advanced Foundation Engineering	4	0	0	40	60	**100**	**4**
C	MTE4202	Bridge Engineering	4	0	0	40	60	**100**	**4**
C	MTE4203	Pavement Evaluation, Rehabilitation and Maintenance	4	0	0	40	60	**100**	**4**
C	MTE4204	Urban Transportation Systems Planning	4	0	0	40	60	**100**	**4**
GE	GE46521/ GE46525	Generic Elective II	4	0	0	40	60	**100**	**4**
C	MTE4251	Traffic Surveys and Analysis	0	0	2	100	0	**100**	**1**
C	MTE4252	Seminar	0	0	2	100	0	**100**	**1**
C	MTE4253	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
GE Generic Elective

Babu Banarasi Das University, Lucknow

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School of Engineering

Master of Technology (Transportation Engineering) - Regular

Evaluation Scheme (w.e.f2021-22)

SEMESTER III									
Course Category	Course Code	Code Title	Contact Hours			Evaluation Scheme			Credits
			L	T	P	CIA	ESE	Course Total	
C	MTE4351	State of the art Seminar#	-	-	-	200	0	**200**	**4**
C	MTE4352	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	MTE4451	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

GE Generic Elective

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School of Engineering

Master of Technology (Transportation Engineering) - Regular

Evaluation Scheme (w.e.f. 2021-22)

Course Code	Generic Elective-I
GE46511	Transport and Environment
GE46512	Intelligent Transportation Systems
GE46513	Transport Policy and Financing
GE46514	Ground Improvement Techniques
GE46515	Economic Evaluation of Transportation System

Course Code	Generic Elective-II
GE46521	Airport Infrastructure Planning and Design
GE46522	Modern Highway Construction Practices
GE46523	Traffic Simulation Engineering and Management
GE46524	Finite Element Method
GE46525	Public Transportation System

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Evaluation Scheme (w.e.f. 2021-22)

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

MTE4101 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, Transport models, Model building kit, Mathematical modeling and its calibration, Data collection and application of models.	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. Project evaluation; covering urban passenger transportation, freight, aviation and intelligent transportation systems.	30 Hours	1

References:

1. Cascetta Ennio, “Transportation Systems Analysis: Models and Applications”, Springer.

MTE4102 PAVEMENT MATERIALS AND DESIGN

Course Objective:

1. To know about the importance of subgrade soil properties on pavement.
2. To know about analysis and design of flexible pavement.
3. To know about analysis and design of rigid pavements.
4. To know about alternate materials for durable pavements.

Learning Outcome:

1. Exposure on the importance of subgrade soil properties on pavement
2. Exposure on analysis and design of flexible pavement.
3. Exposure on analysis and design of rigid pavement.
4. Exposure on basics of aggregate and their properties.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	Subgrade functions, Importance of subgrade soil properties on pavement performance. Pavement Materials: Types and Component parts of Pavements - A brief study on aggregates, bitumen and modified bitumen like cutback, emulsion, polymer modified bitumen - Bituminous mix design methods, specifications and testing – Superpave mix design and material testing	30 Hours	1
II	Analysis & Design of Flexible Pavement: Stresses and Deflections in Homogeneous Masses - Burmister's 2- layer, 3- layer Theories - Wheel Load Stresses - Sustained Loads and Pavement behavior under Traffic Loads - Empirical, Semi-empirical, Analytical and Mechanistic-empirical approaches - Development, Principle, Advantages and Applications of different Pavement Design Methods. Guidelines and functions of IRC, NHAI, CRRI, AASTHO, methods of rigid pavement design, conventional and non-conventional materials.	30 Hours	1
III	Analysis & Design of Rigid pavements: Types of Stresses and Causes, Factors influencing the Stresses; General conditions in Rigid Pavement Analysis, ESWL, Wheel Load Stresses, Warping Stresses, Friction Stresses, Combined Stresses - Types of Joints in Cement Concrete Pavements and their Functions, Joint Spacing, Design of Slab Thickness. Drainage failure criteria, Reliability pavement support condition, Properties of components and design tests.	30 Hours	1
IV	Alternate Materials for durable pavements: artificial aggregates – Industrial waste materials – fly ash, pond ash,	30 Hours	1

	marble dust, GGBS, Geo-polymer coated aggregates – waste plastics, fibers. Nanomaterials for pavements: Nano clay, Nano silica, Carbon Nano Tube (CNT) and other nanomaterials – warm mix technologies: additives and modifiers, design guidelines and practices – Cold mix technologies: materials, additives, guidelines and practices		

References:

1. Papagiannakis A. T., MasadEyad, "Pavement design and materials", John Wiley & Sons.
2. Athanassios Nikolaides, "Highway Engineering: Pavements, Materials and Control of Quality", CRC Press.

MTE4103 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 surveys: Speed, volume, delay, origin and destination, parking Traffic variables and parameters, Driver behaviour modeling, Simulation, Controlled – Access Concept, Freeway Concept, System performances, Measures of effectiveness.	30 Hours	1
II	Traffic flow theory: Light hill and Witham's Theory the queuing theory and its application to traffic engineering problems. 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, 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.

MTE4151 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.
7. Falling weight deflection test

MTE4201 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, Terzaghi's, Meyerhoff, Hansens bearing capacity theories, based on SPT, layered soils, eccentric and inclined loads. Soil design of footings in clay and sand with settlement calculations Rafts in clay and in sand: Floating rafts, buoyancy rafts and basement rafts.	30 Hours	1
II	Deep Foundation: Introduction to various types of deep foundations, 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. Drilled Piers and Caissons: Design considerations, bearing capacity equations, Settlements, Lateral loads, Types of caissons, stability analysis.	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: Behavior of soil under	30	1

	dynamic loads, determination of allowable soil stress for dynamic loads. **Subsurface Exploration:** Boring, Sampling, SPT, CPT, Geophysical methods, Bore log and soil report. **Reinforced Earth** : Materials and general considerations, Design and Stability	Hours	

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 Mechanics and Foundations", Laxmi Pub.

MTE4202 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 I.R.C. and other international specifications on live loads for road bridges, Various forces acting on bridges, Load distribution theories- Introduction: Courbon's Method and Pigeaud's curves	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, balanced cantilever bridges	30 Hours	1
III	Substructure: Various parts of substructures, Various types of substructures, Loads acting on substructures, Design of pier and pier cap, Design of different types of foundation – Open, pile & well foundation, its construction aspects & related issues	30 Hours	1
IV	Bridge Construction & Maintenance: Erection of steel girderbridges New technology for design and construction of bridges, Seismic resistant design provisions, load test on bridges	30 Hours	1

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”, Dhanpat Rai & Sons.

MTE4203 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.
4. To know about maintenance activities on pavement performance.

Learning Outcome:

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

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. Evaluation of pavement distress; Design aspects of flexible and rigid overlays.	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.

MTE4204 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 Demand issues: Trends, Overall Planning process, Long term Vs Short term planning, Demand Function, Independent Variables, Travel Attributes, Assumptions in Demand Estimation.Travel Behavior Analysis, Travel Demand Estimation andForecasting.	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. Description of	30 Hours	1

	transportation network ,Route choice behaviour, minimum path, route assignment techniques ,multipath traffic assignment		

References:

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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.

MTE4251 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. Environmental impact – Noise studies and vehicular emission measurement
7. Lighting studies

GE46511 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, Emission factors. Environmental Factors: impacts and mitigation measures of air quality, noise, severance, visual intrusion, impact on water quality, use of limited resources, impact on flora & fauna, vibration, dust ; Transport related pollution	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	Vehicular emission parameters, pollution standards, measurement and analysis of vehicular emission; Imitative measures; EIA requirements of Highways projects, Procedure; MOEF World Bank/EC/UK guidelines ; EIA practices in India.	30 Hours	1

References:

1. Louis Franklin Cohn, Gary Richard Mc Voy, "Environmental analysis of transportation systems", John Wiley & Sons Australia, Limited,
2. CohenL. F.,"Environmental Analysis of Transportation Systems", John Wiley & Sons Inc.

GE46512 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	Sensor technologies and Data requirements of ITS: Importance of telecommunications in the ITS. Information Management, Traffic Management Centers (TMC). Application of sensors to Traffic management; Traffic flow sensor technologies; Transponders and Communication systems; Data fusion at traffic management centers; Sensor plan and specification requirements; Elements of Vehicle Location and Route Navigation and Guidance concepts; ITS Data collection techniques – Detectors, Automatic Vehicle Location	30 Hours	1
III	**ITS functional areas** Advanced Traffic Management Systems (ATMS), Advanced Traveler Information Systems (ATIS),	30 Hours	1

	Commercial Vehicle Operations (CVO), Advanced Vehicle Control Systems (AVCS), Advanced Public Transportation Systems (APTS), Advanced Rural Transportation Systems (ARTS). **ITS User Needs and Services** Travel and Traffic management, Public Transportation Management, Electronic Payment, Commercial Vehicle Operations, Emergency Management, Advanced Vehicle safety systems, Information Management.		
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 on deployment planning and system design and operation; ITS and safety, ITS and security, ITS as a technology deployment program, research, development and business models, ITS planning.	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.

GE46513 TRANSPORT 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 key commodities, 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 transport,	30 Hours	1

	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	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. 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	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.

GE46514 GROUND 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, Emerging trends in ground Improvement.	30Hours	1
II	Chemical Stabilization: Lime, cement, bitumen, factors influencing, Design approach, construction procedure, laboratory testing, additives. Suspension and solution grouts, principles, methods, equipment, applications, compaction grouting, jet grouting. Soil nailing, rock anchoring, micro-piles, design methods, construction techniques.	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-grides test on geo-textiles. Reinforced earth principles and factors governing design. Geosynthetics	30 Hours	1

	Case studies of ground improvement projects.		

References:

1. Hansmann, R., “Engineering Principles of Ground Modification”, 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.

GE46515 ECONOMIC EVALUATION OF TRANSPORTATION SYSTEM

Course Objective:

1. To know about the Demand and Policy.
2. To know about the Economic Evaluation of Transportation.
3. To know about the Behavioural aspect of transportation planning.
4. To know about the choice modelling.

Learning Outcome:

1. Illustration on Demand and Policy.
2. Illustration on Economic Evaluation of Transportation.
3. Illustration on Behavioural aspect of transportation planning.
4. Illustration on choice modelling.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	Concept of demand, Elasticity of demand, Supply of transport, demand-supply interaction, Public Policy, Travel demand and value of time, Willingness-to-pay, valuation of user's benefit and optimal transport pricing policy.	30 Hours	1
II	Appraisal and Economic Evaluation of Transportation Projects, Case Studies, Economic evaluation of highway projects in India, Road-users' cost study in India-Objectives and Methodology, Application of HDM Software	30 Hours	1
III	Behavioural aspect of transportation planning: Basics of travel behaviour analysis, stated and revealed preference data, experimental design, travel behaviour survey	30 Hours	1
IV	Binary, multinomial, nested logit model, maximum likelihood, case studies on choice modelling and estimation of value of travel attribute.	30 Hours	1

References:

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1.Economics of Urban Transport by Kenneth A Small and Erik T Verhoef

2.Principles of Traffic and Highway Engineering by Garber and Hoel

3.Economic Evaluation of highway projects in India-IRC

4.Road Users cost study in India - IRC

GE46521 AIRPORT INFRASTRUCTURE PLANNING AND DESIGN

Course Objective:

1. To know about the basics of Aircraft Characteristics.
2. To know about the basics of Air Traffic Management.
3. To know about the basics of Planning, Forecasting and Geometric Design of the Airfield.
4. 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,	30 Hours	1

	wind rose, estimating runway length, sight distance and longitudinal profile, transverse gradient, airfield separation requirements, obstacle clearance requirements. 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. Aprons: holding aprons, terminal aprons and ramps, terminal apron surface gradients. Control tower visibility requirements.		
IV	Planning and Design of the Terminal Area: Passenger terminal system and its components .Design considerations: terminal demand parameters, facility classification, level of service criteria. Airport landscaping, grading and drainage general aspects; Airport terminal and amenities ; Airport lighting and marking. Terminal planning process: overall space requirements, concept development, horizontal distribution concepts, vertical distribution concepts. 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.	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.

GE46522 MODERN HIGHWAY 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 on Embankment Construction.
2. Illustration on Bituminous Constructions.
3. Illustration on Concrete Road construction.
4. Illustration on Hill 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 walls on hill roads,its construction ,types,advantages and disadvantages of retaining wall, 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 underdifferent 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, Overlay Construction.non conventional pavements; road construction equipments, pavement layers and materials used in different layers.	30 Hours	1
IV	Hill Roads Construction: Stability of Slopes, Landslides-Causes and Control measures, Construction of Bituminous and Cement Concrete	30 Hours	1

	roads at high altitudes, Hill road drainage.		

References:

1. Pathak D.R. and Gite H.K., “Highway Engineering”, Nirali Prakashan.
2. Kadyali L R., “Principles and Practices of Highway Engineering”, Khanna Publishers.
3. Kumar S., “Textbook of Highway Engineering”, Orient Black Swan Pvt Ltd.-New Delhi.
4. EJ Yoder and MW Witczak, “Principles of Pavement Design”, John Wiley & Sons.

GE46523 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	Introduction to systems approach - Typical transportation systems - Mathematical models. Fundamentals of simulation - Monte Carlo method - Analog and digital simulation - Continuous and discrete models - Simulation languages - Introduction to CSMP.	30 Hours	1
II	Probability concepts - Random numbers – Pseudo random generators - Arrival patterns - Service time distributions, Queue discipline – Manual simulation of simple queuing system Creating and moving transactions - Queues and facilities - Event scheduling - Internal logic of GPSS processor - Program control statements.	30 Hours	1
III	Priority - Preemption - Functions – Parameters and save values – Standard numerical attributes - Collection of statistics - Report preparation.	30 Hours	1
IV	Applications of GPSS - Simple queuing problems - Inventory problems - Simulation of ports – Railway platforms and level crossings - Traffic signals. Analysis of simulation results - Model validation - Replication of random conditions - Time series analysis.	30 Hours	1

References:

1. Gordon, G., System Simulation, Prentice-Hall of India, 1992
2. GPSS/PC, User Manual, Minuteman Software, USA, 1985

GE46524 FINITE 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, Mesh, Pre / Post Processor

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 and Mesh Generation.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	Introduction to Finite Element Methods: General Procedure – Engineering Applications – Stress and Equilibrium, Strain – Displacement relations. Stress – strain relations: Finite Elements: 1- Dimensional, 2 – Dimensional, 3-Dimensional & Interpolation Elements	30 Hours	1
II	Iso-parametric 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 generationgraphic display. Techniques using ANSYS, ABAQUS, NASTRAN using Hexahedral and Tetrahedral Elements. graphic display and software packages, Organization of FEM programs, efficient solutions, input/output, Pre and post processors.	30 Hours	1

References:

1. Krishnamoorty 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.

GE46525 PUBLIC TRANSPORTATION SYSTEM

Course Objective:

1. To know about the Urban Passenger Transport Modes.
2. To know about the basics of demand analysis and user's benefited.
3. To know about the basics of Route planning.
4. To know about the Life Cycle cost analysis.

Learning Outcome:

1. Illustration on Urban Passenger Transport Modes.
2. Illustration on demand analysis and user's benefit.
3. Illustration on basics of Route planning.
4. Illustration on Life Cycle cost analysis.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	Urban Passenger Transport Modes Classifications, Role of Mass Transportation System, Transit Modes and Characteristics, System Performance.	30 Hours	1
II	Capacity, Quality of Service, efficiency and utilization, trip makers' perception analysis to various travel attributes, Willingness-to-pay estimation, demand analysis and user's benefit policy issue with reference to public transportation service improvement	30 Hours	1
III	Optimal transport pricing policy, planning Issues, Route Determination, Network Design, Service Policy and Schedule development	30 Hours	1
IV	Life Cycle cost in public transportation, Scheduling, Priority Measures and their Implementations, Issues and Challenges related to development of Mass Transportation System, Para-transits	30 Hours	1

References:

.

1.Public Transit Planning and Operation: Theory, Modelling and Practice by Avishai Ceder.

2.Urban Transit Systems and Technology by Vukan R. Vuchik..

3.Urban Transit: Operations, Planning and Economics by Vukan R. Vuchik.

4.Studies in the economics of transportation by Beckmann et al..

5.Applied choice analysis: A Primer by David Hensher and Willium Greeene.