BOS: 2021-2023

For

Master of Technology (M.Tech.)

in

Civil (Transportation Engineering)

Pandit Deendayal Petroleum University

School of Technology

Department of Civil Engineering

Raysan, Gandhinagar-382007

Course Structure for M. Tech. Civil (Transportation Engineering) w.e.f. Academic Year July 2021

Semester I

Sr. No	Course Code	Course Name	Teaching Scheme					Exam Scheme					
			L	T	P	C	Hrs/wk	Theory			Practical		Total Marks
								MS	ES	IA	LW	Viva	
1		Advanced Numerical Techniques and Computer Programming	3	1	0	4	4	25	50	25	--	--	100
		Advanced Numerical Techniques and Computer Programming	0	0	2	1	2	--	--	--	50	50	100
2		Traffic Engineering	3	0	0	3	3	25	50	25	--	--	100
3		Pavement Engineering	3	0	0	3	3	25	50	25	--	--	100
4		Transportation Planning	2	1	0	3	3	25	50	25	--	--	100
5		Elective-1	3	0	0	3	3	25	50	25	--	--	100
6		Elective-2	3	0	0	3	3	25	50	25	--	--	100
7		Traffic Engineering Laboratory	0	0	2	1	2	--	--	--	50	50	100
8		Pavement Engineering Laboratory	0	0	2	1	2	--	--	--	50	50	100
Total			**17**	**2**	**6**	**22**	**25**						**900**

Semester II

Sr. No	Course Code	Course Name	Teaching Scheme					Exam Scheme					
			L	T	P	C	Hrs/wk	Theory			Practical		Total Marks
								MS	ES	IA	LW	Viva	
1		Urban Transportation Systems Planning	3	0	0	3	3	25	50	25	--	--	100
2		Pavement Management Systems	3	0	0	3	3	25	50	25	--	--	100
3		Railway, Airport and Harbour Engineering	3	1	0	4	4	25	50	25	--	--	100
4		Highway Construction Practices	3	0	0	3	3	25	50	25	--	--	100
5		Elective-III	3	0	0	3	3	25	50	25	--	--	100
6		Elective-IV	3	0	0	3	3	25	50	25	--	--	100
7		Project Design Studio	0	0	2	1	2	--	--	--	50	50	100
8		Successful Research Program Development	2	0	0	2	2	25	50	25	--	--	100
Total			**20**	**1**	**2**	**22**	**23**						**800**

Semester III

Sr. No	Course Code	Course Name	Teaching Scheme					Exam Scheme					
								Theory			Practical		Total
			L	T	P	C	Hrs/wk	MS	ES	IA	LW	Viva	Marks
1		Seminar	--	--	--	5	--	--	--	--	50	50	100
2		Project	--	--	--	14	--	--	--	--	50	50	100
3		Industrial Training	--	--	--	--	--	--	--	--	--	--	PP/NP
Total			--	--	--	19	--	--	--	--	--	--	200

Semester IV

Sr. No	Course Code	Course Name	Teaching Scheme					Exam Scheme					
								Theory			Practical		Total
			L	T	P	C	Hrs/wk	MS	ES	IA	LW	Viva	Marks
1		Seminar	--	--	--	5	--	--	--	--	50	50	100
2		Project & Dissertation	--	--	--	24	--	--	--	--	--	100	100
Total			--	--	--	29	--	--	--	--	--	--	200

List of Electives:

Sr. No	Course Name	Teaching Scheme					Exam Scheme					
		L	T	P	C	Hrs/wk	Theory			Practical		Total Marks
							MS	ES	IA	LW	Viva	
1	Pavement Materials	3	0	0	3	3	25	50	25	--	--	100
2	Application of GIS in Transportation	2	1	0	3	3	25	50	25	--	--	100
3	Environmental Analysis of Transportation Systems	3	0	0	3	3	25	50	25	--	--	100
4	Ground Improvement Techniques	3	0	0	3	3	25	50	25	--	--	100
5	Intelligent Transportation Systems	3	0	0	3	3	25	50	25	--	--	100
6	Sustainable Transportation Development	3	0	0	3	3	25	50	25	--	--	100
7	Human Resource Management	3	0	0	3	3	25	50	25	--	--	100
8	Project Management	3	0	0	3	3	25	50	25	--	--	100
9	Design and analysis of experiments	3	0	0	3	3	25	50	25	--	--	100

Course Structure for M. Tech. Civil (Transportation Engineering)
(w.e.f. Academic Year July 2021)

Semester I

Sr. No	Course Code	Course Name	Teaching Scheme					Exam Scheme					
			L	T	P	C	Hrs/wk	Theory			Practical		Total Marks
								MS	ES	IA	LW	Viva	
1		Advanced Numerical Techniques and Computer Programming	3	1	0	4	4	25	50	25	--	--	100
		Advanced Numerical Techniques and Computer Programming	0	0	2	1	2	--	--	--	50	50	100
2		Traffic Engineering	3	0	0	3	3	25	50	25	--	--	100
3		Pavement Engineering	3	0	0	3	3	25	50	25	--	--	100
4		Transportation Planning	2	1	0	3	3	25	50	25	--	--	100
5		Elective-1	3	0	0	3	3	25	50	25	--	--	100
6		Elective-2	3	0	0	3	3	25	50	25	--	--	100
7		Traffic Engineering Laboratory	0	0	2	1	2	--	--	--	50	50	100
8		Pavement Engineering Laboratory	0	0	2	1	2	--	--	--	50	50	100
		Total	**17**	**2**	**6**	**22**	**25**						**900**

MS = Mid Semester, ES = End Semester, IA = Internal assessment (like quiz, assignments etc), LW = Laboratory work, LE = Lab Exam

Elective I:

- Pavement Materials
- Application of GIS in Transportation

Elective II:

- Environmental Analysis of Transportation Systems
- Ground Improvement Techniques

20MA 503T					Advanced Numerical Techniques					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To understand and acquaint the concept of various numerical methods.
- To develop numerical skills in solving problem of engineering interest.
- To enrich the concept of finite element techniques.
- To extract the roots of a polynomial equation.

UNIT 1: EIGEN VALUES EIGEN VECTORS AND INTERPOLATION **10 Hrs**

Eigen values and eigen vectors: Numerical evaluation of largest as well as smallest (numerically) Eigen values and corresponding Eigen vectors.

Interpolation: Introduction, Newton Gregory Forward Interpolation Formula, Newton Gregory Backward Interpolation Formula, Central difference interpolation formula, Lagrange's Interpolation Formula for unevenly spaced Formula, Error in interpolation, Newton's Divided Difference Formula, cubic spline interpolation, surface interpolation.

UNIT 2: NUMERICAL SOLUTION NON-LINEAR EQUATIONS AND POLYNOMIAL **8 HRS**

Introduction, Solution of non-linear simultaneous equations, Descarte's Sign rule, Horner's method, Lin-Bairstow's method, Graeffe's root squaring method, Muller's method, Comparison of various methods.

UNIT 3: NUMERICAL SOLUTION OF ODEs AND PDEs **14 HRS.**

Taylor's method, Euler's method, Runge-Kutta methods of various order, Modified Euler's method, Predictor corrector method: Adam's method, Milne's method. Solution of Boundary value problems using finite differences. Finite difference approximation of partial derivatives, Classification of 2nd order PDEs, different type of boundary conditions, solutions of Elliptic, parabolic and hyperbolic equations of one and two dimensions, Crank- Nicholson method, ADI method.

UNIT 4: FINITE ELEMENT METHOD **8 HRS.**

Introduction, Method of Approximation, The Rayleigh-Ritz Method, The GalerkinMethod,
Application to One dimensional and two-dimensional problems.

Max.40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – **Apply** a suitable numerical technique to extract approximate solution to the problem whose solution cannot be obtained by routine methods.

CO2 - **Estimate** the errors in various numerical methods.

CO3 - **Analyse/ Interpret** the achieved numerical solution of problems by reproducing it in graphical or tabular form.

CO4 - **Approximate** the data generated by performing an experiment or by an empirical formula with a polynomial on which operations like division, differentiation and integration can be done smoothly.

CO5 -**Evaluate** a sufficiently accurate solution of various physical models of science as well as engineering interest whose governing equations can be approximated by nonlinear ODEs or PDEs or system of ODEs or PDEs.

CO6 - **Design/ Create** an appropriate numerical algorithm for various problems of science and engineering.

TEXT/REFERENCE BOOKS

1. B.S. Grewal, Numerical Methods in Engineering and Science with Programs in C & C++, Khanna Publishers (2010).
2. S.S. Sastry, Introductory Methods for Numerical Analysis,4th Ed., Prentice Hall of India (2009).
3. M.K. Jain, S.R.K. Iyenger and R.K. Jain, Numerical Methods for Scientific and Engineering Computation, 5thEd., New Age International (2007).
4. C F Gerald and P O Wheatley, Applied Numerical analysis, Pearson education, 7th edition, 2003.
5. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley publication, 9th edition. 2005
6. R.K. Jain & S.R.K. Iyenger, Advanced Engineering Mathematics, 3rd Ed., Narosa (2002).
7. S C Chapra, Raymond P. Canale, Numerical Methods for Engineers, Tata McGraw Hill Pub. Co. Ltd.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A: 4 questions of 6 marks each	24 Marks (40 min)
Part B: 4 questions of 10 marks each	40 Marks (80 min)
Part C: 3 questions of 12 marks each	36 Marks (60 min)

20MCT501T					Traffic Engineering					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	-	-	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To give an overview about the Traffic engineering and its controlling parameters.
- To know different methods available to conduct traffic survey for various purpose
- To learn design procedure for controlled and uncontrolled intersections.
- To study available methods of traffic control, operation and management.

UNIT 1: INTRODUCTION TO TRAFFIC ENGINEERING **09 Hrs.**

Elements of Traffic Engineering - road user-vehicle and road way and driver characteristics. - Design speed- volume. Passenger Car Units - Static and Dynamic- Highway capacity and level of service - capacity of urban and rural roads - Road user facilities - Parking facilities - Cycle tracks - Pedestrian facilities

UNIT 2: TRAFFIC STUDIES **10 Hrs.**

Traffic volume studies- origin destination studies- speed studies- travel time and delay studies- Parking studies- Accident studies. Elements of design - Alignment - Cross sectional elements - Stopping and passing sight distance. Horizontal curves - Vertical curves. Design problems. Traffic regulation and control - Signs and markings - Traffic System Management.

UNIT 3: TRAFFIC INTESECTION DESIGN **10 Hrs.**

Design of intersections – At-grade intersections- Principles of design – Channelization - Design of rotaries - Traffic signals - pre-timed and traffic actuated. Design of signal setting - phase diagrams, timing diagram – Signal co-ordination – Area traffic Control System. Grade separated interchanges - Geometric elements for divided and access-controlled highways and expressways.

UNIT 4: TRAFFIC MANAGEMENT METHODS AND RSA **10 Hrs.**

Traffic Safety – Principles and Practices – Safety along links - Safety at intersections. Road Safety Audit – Countermeasures, evaluation of effectiveness of counter-measures– Road safety programmes. Introduction to ITS and its application in traffic control and management.

Max. 39 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – **Understand** the concept of Traffic flow parameters and capacity.
CO2 – **Conduct** different types of Traffic Surveys.
CO3 – **Design** at grade and grade separated intersections
CO4 – **Analyze** the critical locations to improve safety of road network
CO5 – **Evaluate** the present traffic and future needs and development
CO6 – **Create** a method/Modal for efficient traffic operation and management.

TEXT/REFERENCE BOOKS

1. Traffic Engineering and Transport Planning by L.R. Kadiyali, Khanna Publishers, Delhi
2. Traffic Engineering by Matson, W.S.Smith& F.W. Hurd
3. G.J. Pingnataro, Principles of Traffic Engineering
4. D.R.Drew, Traffic Flaw Theory
5. W.R. Mchsne and R.P. Roess "Traffic Engineering"
6. Wohl & Martin, Traffic System
7. ITE Hand Book, Highway Engineering Hand Book, Mc Graw - Hill.
8. AASHTO A Policy on Geometric Design of Highway and Streets

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A :10 Questions of 2 marks each-No choice 20 Marks

Part B :2 Questions from each unit with internal choice, each carrying 16 marks 80 Marks

20MCT502T					Pavement Engineering					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To give an overview about the highway engineering with respect to planning and alignment.
- To know the importance of geometric design.
- To learn the procedure and method of pavement design as per IRC.
- To study the various traffic parameters and its estimation and design.

UNIT 1: INTRODUCTION TO PAVEMENT ENGINEERING **10 Hrs.**

Types and component parts of pavements, Factors affecting design and performance of pavements. Highway and airfield pavements, Requirements and desirable properties of soil, aggregates, bitumen, emulsion and modified bitumen, Characterisation of different pavement materials. Pavement Design Factors: Design wheel load, strength characteristics of pavement materials, climatic variations, traffic - load equivalence factors and equivalent wheel loads, aircraft loading, gear configuration and tyre pressure. Drainage – Estimation of flow, surface drainage, sub-surface drainage systems, design of sub-surface drainage structures.

UNIT 2: FLEXIBLE PAVEMENT DESIGN **11 Hrs.**

Empirical, semi-empirical and theoretical approaches, design of highway and airport pavements by IRC, AASHTO Methods, Mechanistic –Empirical design, applications of pavement design software

UNIT 3: RIGID PAVEMENT DESIGN **10 Hrs.**

Types of joints and their functions, joint spacing; design of CC pavement for roads, highways and airports as per IRC, AASHTO, design of joints. Design of continuously reinforced concrete pavements. Reliability; Use of software for rigid pavement design.

UNIT 4: PAVEMENT MANAGEMENT SYSTEM **08 Hrs.**

Distresses in pavements, maintenance of highways, structural and functional condition evaluation of pavements, pavement recycling, performance prediction models, ranking and optimization in pavement management.

Max. 39 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – **Understand** the different pavement layers and its functions.
CO2 – **Understand** different stresses, strains and deflections in flexible and rigid pavements.
CO3 – **Design** Flexible pavement and rigid pavement as per provisions.
CO4 – **Analyse** the critical stress value and location by considering load and temperature stresses.
CO5 – **Evaluate** the condition of pavement and can assess the failure of pavement
CO6 – **Create** a method/Modal for efficient pavement construction and management.

TEXT/REFERENCE BOOKS

1. Yoder and Witczak, Principles of Pavement Design, John Wiley and Sons
2. Yang. H. Huang, Pavement Analysis and Design, Second Edition, Prentice Hall Inc.
3. Rajib B. Mallick and Tahar El-Korchi, Pavement Engineering – Principles and Practice, CRC Press (Taylor and Francis Group)
4. W.RonaldHudson, Ralph Haas and Zeniswki, Modern Pavement Management, Mc Graw Hill and Co
5. IRC – 37 “Guidelines for Design of flexible Pavements”, IRC, New Delhi, 2001.
6. IRC: 58, 2002: “Guidelines for the Design of Plain Jointed Rigid Pavements for Highways”, IRC, N. Delhi, December, 2002.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A :10 Questions of 2 marks each-No choice 20 Marks

Part B :2 Questions from each unit with internal choice, each carrying 16 marks 80 Marks

20MCT503T					Transportation Planning					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To give an overview about importance of transportation planning for development.
- To learn the four-step model of transportation planning.
- To learn different trip generation and efficient distribution methods.
- To study trip scheduling method for transferring people and goods.
- To study land use transportation planning models.

UNIT 1: TRIP GENERATION AND DISTRIBUTION **10 Hrs.**

Trip generation models – Trip classification - productions and attractions – Trip rate analysis - Multiple regression models - Category analysis - Trip distribution models – Growth factor models, Gravity model and Opportunity modes.

UNIT 2: ROUTE CHOICE AND TRIP ASSIGNMENT MODEL **10 Hrs.**

Modal split models – Mode choice behavior – Trip end and trip interchange models - Probabilistic models - Utility functions - Logit models - Two stage model. Traffic assignment – Transportation networks – Minimum Path Algorithms - Assignment methods – All or Nothing assignment, Capacity restrained assignment and Multi path assignment - Route-choice behavior.

10 Hrs.

UNIT 3: TRIP SCHEDULING

Statutory provision for road transport and connected organizations. Route scheduling, Freight transport, Vehicle scheduling, Optimum fleet size, Headway control strategies, Crew scheduling.

UNIT 4: LANDUSE PLANNING **09 Hrs.**

Land use transportation models – Urban forms and structures - Location models - Accessibility – Land use models - Lowry derivative models - Quick response techniques - Non-Transport solutions for transport problems. Preparation of alternative plans - Evaluation techniques - Plan implementation - Monitoring - Financing of Project – urban development planning policy - Case studies.

Max. 39 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – **Understand** the need and importance of proper transportation planning for development of nation.

CO2 – **Understand** base year and horizon year parameters which influencing planning

CO3 – **Apply** the knowledge in developing four step models.

CO4 – **Estimate** the present and future number of trips to distribute.

CO5 – **Analyze** the transportation planning issues.

CO6 – **Create** method/Model to distribute future people and freight transportation.

TEXT/REFERENCE BOOKS

1. Hutchinson, B.G., Principles of Urban Transport Systems Planning, Scripta, McGraw-Hill, NewYork, 1974.
2. Khisty C.J., Transportation Engineering - An Introduction, Prentice Hall, NJ, 2007.
3. Papacostas C.S. and Prevedouros, P.D., Transportation Engineering & Planning, PHI, New Delhi,2002.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A :10 Questions of 2 marks each-No choice 20 Marks

Part B :2 Questions from each unit with internal choice, each carrying 16 marks 80 Marks

20MCT501P					Traffic Engineering Lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
-	-	2	1	2	--	--	--	50	50	100

COURSE OBJECTIVES

- To know different traffic flow parameters and it's relation.
- To Learn procedure to conduct various traffic studies like traffic volume, vehicle Speed, parking study, and congestion etc.
- To learn the design of controlled and uncontrolled intersection based on field data
- To Learn various method to carry out traffic survey to solve traffic related issues through research.

List of Experiments:

1. Volume studies:

Direction, Duration and Classification of Traffic Volume at Mid-Block Section and Intersections, Manual, and Mechanical Methods, Headway Distributions

2. Speed studies:

Spot Speed Studies - Radar Speed Meters

3. Journey time and delay studies:

Travel Time and Delay Studies by Floating Car Method

4. Gap acceptance studies:

Study of Gaps, Lags, Critical Gaps at Intersections

5. Intersection delay studies:

Delay Measurement at Uncontrolled Intersections and Signalised Intersections

6. Parking surveys:

Parking Inventory and Turnover Studies

7. Measurement of driver characteristics:

Reaction Testing, Action Judgement Testing, Driver Vision Testing, Discriminative Reaction Testing, Evaluation of driver Knowledge – Traffic Rules – Road Signs & Markings – Traffic Signs and Motor Vehicle Act Relevant clauses

8. Highway Capacity Estimation:

Videographic method, Dynamic PCU

COURSEOUTCOMES

On completion of the course, student will be able to

CO1 – **Understand** methods to conduct traffic studies for estimating traffic flow characteristics.
CO2 – **Apply** learning to find capacity and level of service of a highway.
CO3 – **Design** the intersection and signal
CO4 – **Analyse** present and future traffic safety and operations issues.
CO5 – **Evaluate** parking requirement and inventory analysis for future need
CO6 – **Create** methods or strategy for efficient and safe traffic operations.

TEXT/REFERENCE BOOKS

1. C. JotinKhisty and, B. Kent Lall, Transportation Engineering: An Introduction, Prentice Hall; 3rd Edition, 2002.
2. Currin, Introduction to Traffic Engineering: Manual F/data Collect & Analysis, CL Engineering, 2nd Edition, 2012. 14
3. L.R. Kadiyali, Traffic Engineering and Transportation Planning, Khanna Publishers, 2011.
4. Pignataro LJ. Traffic Engineering: Theory and Practice; Prentice hall, Inc, 1973
5. Roger P. Roess, Elena S. Prassas and William R. McShane, Traffic Engineering, Prentice Hall, 4th Edition, 2010.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A : Lab Work – Continuous Assessment 50 Marks

Part B : Lab Exam and Viva 50 Marks

20MCT502P					Pavement Engineering Lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
-	-	2	1	2	--	--	--	50	50	100

COURSE OBJECTIVES

- To know different properties of material which influence pavement strength.
- To know procedure to conduct test on soil, aggregate and bitumen.
- To learn bituminous and concrete mix design as per code
- To learn the standard values and related code of practice used in pavement design.

LIST OF EXPERIMENTS:

1. **Tests on Soils:** Liquid limit, plastic limit, soil classification (dry and wet), maximum dry density and moisture content.
2. **Tests on Soils:** CBR.
3. **Tests on Aggregate:** Aggregate gradation, shape tests, specific gravity, water absorption.
4. **Tests on Aggregate:** Los Angeles abrasion value, aggregate impact value, soundness test.
5. **Tests on Bitumen:** Penetration, absolute and kinematic viscosity, flash and fire point, ductility and elastic recovery, softening point, specific gravity.
6. **Field Tests:** Field density using sand replacement method.
7. **Tests on Bituminous Mixes:** Stripping value of aggregate, determination of Gmm of given bituminous mixtures using Marshall mix design.
8. **Field Evaluation:** Pavement condition rating, unevenness.
9. **Field Evaluation:** Dynamic Cone Penetrometer.
10. **Field Evaluation:** Overlay design using Benkelman beam.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Understand engineering properties of pavement material by performing laboratory tests necessary for highway construction

CO2 – Apply learned methods to improve engineering properties of pavement material.

CO3 – Design Bitumen mixes as per required based on provisions

CO4 – Analyse the pavement material quality and field requirement to evaluate the suitability for construction purpose

CO5 – Evaluate the functional response characteristics of in-service pavements.

CO6 – Create smart materials which can be used for cost effective construction of road.

TEXT/REFERENCE BOOKS

1. Khanna, S.K., Justo, C.E.G. and A. Veeraragavan*Highway Materials and Pavement Testing*, 5th Edition, Nem Chand and Bros, Roorkee, India, 2009.
2. Yang H. Huang, *Pavement Analysis and Design*, Second Edition, Pearson Prentice Hall, New Jersey, USA, 2004
3. Relevant IS, IRC, ASTM Codes.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A : Lab Work – Continuous Assessment 50 Marks

Part B : Lab Exam and Viva 50 Marks

<Course Code>					Elective-I: Pavement Materials					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	-	-	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To know the various quality parameters of material, use in pavement construction
- To know the testing procedure of Aggregate, soil, cement and bitumen and composites
- To learn bituminous and concrete mix design for pavement as per code
- To learn the advantage of using waste material in road constrction

UNIT 1: **10 Hrs.**

Aggregate: Nature and properties – aggregate requirements – types and processing – aggregates for pavement base – aggregate for bituminous mixture – aggregate for Portland Cement Concrete – lightweight aggregate – tests on aggregate – specification.

UNIT 2: **10 Hrs.**

Bituminous Materials: conventional and modified binders – production – types and grade – physical and chemical properties and uses – types of asphalt pavement construction – principles of bituminous pavement construction – tests on bituminous materials. Bituminous Mix design – modified mixtures – temperature susceptibility and performance.

UNIT 3: **10 Hrs.**

Cement /concrete based materials: Cement – properties – PCC mix design and properties – modified PCC – Mix Design – Behaviour – Performance – Tests on Cement and Concrete mixes. High Performance Concrete – low shrinkage – increased strength.

Composites, Plastics and Geosynthetics: Plastics and polymerization process – properties – durability and chemical composition – Reinforced Polymer Composites – Geosynthetics – Dry Powdered Polymers – Enzymes.

09 Hrs.

UNIT 4:

Reclaimed / Recycled Waste Products: Reclaimed Materials – waste products in civil engineering applications – effect of waste products on materials, structure and properties – self healing and smart materials – locally available materials.

Max. 39 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – **Understand** the properties and test procedures of aggregate, bituminous materials, composites and recycled waste products

CO2 –**Understand** different types of bituminous pavement construction and its principles

CO3 – **Design** bituminous and PCC mix.

CO4 – **Analyse** the strength characteristics of pavement by using different materials like Composites, Plastics and Geosynthetics.

CO5 –**Evaluate** the amount of waste material canbe added to get maximum strength of pavement economically.

CO6 – **Create** new compound materials by adding any two or more waste material for better strength.

TEXT/REFERENCE BOOKS

1. P. T. Sherwood, Alternative Materials in Road Construction, Thomas Telford Publication, London, 1997.
2. RRL, DSIR, Soil Mechanics for Road Engineers, HMSO, London, 1995
3. Koerner, R. M. Designing with Geosynthetics, Prentice Hall, Englewood Cliffs, New Jersey, U.S.A.
4. Shan Somayaji, Civil Engineering Materials, second edition, Prentice Hall Inc., 2001

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A :10 Questions of 2 marks each-No choice 20 Marks

Part B :2 Questions from each unit with internal choice, each carrying 16 marks 80 Marks

<Course Code>					Open Elective-1: Remote Sensing and Geographical Information System					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	--	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To understand the fundamental of RS and Image processing
- To understand the fundamentals of GIS and Processes.
- To understand the utilization of GPS and UAV for engineering mapping
- To learn the complex engineering application using Geospatial Techniques

UNIT 1 REMOTE SENSING **10 Hrs.**

Basic principles of remote sensing- Electromagnetic energy and spectrum- Spectral characteristics,-Laws of radiation- Interaction with atmosphere and surface- Data and image interpretation- Sensors and platforms- Visible and infrared sensors- IR and MW sensors- Resolutions- visual image analysis and processing- Supervised and unsupervised classifications- LIDAR remote sensing- Passive and active microwave remote sensing- Hyper spectral remote sensing- Improving the utilization of remote sensing data- Emerging issues UAV and Drone techniques

UNIT 2 GEOGRAPHICAL INFORMATION SYSTEM **12 Hrs.**

Introduction - History of GIS- Basic GIS concepts- Representation of earth features- Map basics- Map projections- Raster and vector data models- representation of GIS- GIS data sources- Map and models- Methods of vector and raster inputs- Remote sensing inputs- Surveys and GPS inputs- Field surveys- Data storage and editing- Errors and corrections of errors.

UNIT 3 SPATIAL ANALYSIS TOOLS AND TECHNIQUES **10 Hrs.**

Spatial analysis- Location and identifying spatial objects- Measurements- Surface mapping- Nontopographical surfaces- Terrain analysis- Spatial arrangements- Map overlays- Cartographic modelling- Types of cartographic models- GIS design and applications- Decision support tools for engineers Spatial and Attribute Data Modelling

UNIT 4 CASE STUDY AND APPLICATION **10 Hrs.**

Software tools- ERDAS- ENVI- Q-GIS and ARC GIS- Application and case studies of a RS and GIS techniques in Infrastructure management- Environmental Engineering- Transportation Engineering-Disaster management.

Indian Satellite Missions-Chnadrayaan- 1and 2- NISAR- Vedas- Mars orbiter Mission-ASTROSAT-Gaganyaan-RISAT-1A-Aditya-L1-Shukrayaan-1

Max. 52 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – **Understand** the basic concept of Remote Sensing and GIS techniques
CO2 – **Classify** the advance instrument techniques in surveying
CO3 – **Analyze** a data using a spatial analysis techniques
CO4 – **Illustrate** the application of RS and GIS in decision making activities
CO5 – **Appraise** the use of advance software techniques for map making activities.
CO6 – **Create** an art of map making activities.

TEXT/REFERENCE BOOKS

1. Thomas M. Lillesand, Ralph W. Kiefer, Remote sensing and image interpretation
2. Haywood L, Cornelius S and S Carver (1988) An Introduction to Geographical Information Systems, Addison Wiley Longmont, New York.
3. Burrough PA, McDonnell PA (2000) Principles of Geographical Information systems, London: Oxford University Press.
4. LoCP, Young KW Albert (2002) Concepts And Techniques of Geographic Information Systems, Prentice-Hall of India Pvt ltd, New Delhi

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100	**Exam Duration: 3 Hrs**
Part A: 05 Questions from Unit I-IV, each carrying 10 marks	50 Marks
Part B : 02 Question from Unit II-III, each carrying 10 marks	20 Marks
Part C : 03 Question from Unit III-IV, each carrying 10 marks	30 Marks

<Course Code>					Elective-II: Environmental Analysis of Transportation Systems					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	-	-	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To understand the various environmental impact due to transportation facilities.
- To learn environmental standards, Laws and regulation for any project design
- To learn the process of environmental impact assessment
- To study various environmental policies.

UNIT 1: INTRODUCTION TO ENVIRONMENT **10 Hrs.**

Introduction: Environment and its interaction with human activities – Air and Noise Pollution due to Transportation, Environmental imbalances - Attributes, Impacts, Indicators and Measurements - Concept of Environmental Impact Assessment (EIA), Environmental Impact Statement (EIS)

Environmental Standards, Laws & Regulations: Laws concerned with protection of the environment such as Environmental Protection Act, Air and Noise Pollution Act, Motor Vehicle Act, Town and Country Planning Act, Development Control Regulation.

UNIT 2: PREDICTION OF AIR & NOISE POLLUTION **10 Hrs.**

Factors affecting air pollution from road traffic - Vehicle characteristics, Engine types, Vehicle age and maintenance, Driving conditions, Average speed, Temperature, Meteorological conditions; Emission inventory; Dispersion of pollutants; Inverse air quality models; Emission and dispersion models; Driving cycles; Macroscopic and Microscopic modeling at the microscopic level of air pollution from road traffic; Road traffic noise model (RTNM), Calixto model, Acoustical assessment.

UNIT 3 : ENVIRONMENTAL IMPACT ASSESSMENT AND STATEMENT (EIA & EIS) **10 Hrs.**

Objectives of EIA, Advantages and Limitations of EIA; Overview of Methodologies Adhoc, Checklist, Matrix, Network, Overlays, Benefit Cost Analysis, Choosing a Methodology, Review Criteria; IRC Code.

UNIT 4: MITIGATION MEASURES & POLICIES **09 Hrs.**

Cleaner fuels, Vehicle technology and replacement strategies, improving fuel efficiency, encouraging non-motorised and public transport, Taxation on emissions; Noise barriers, Land use planning, Resurfacing roads with low-noise materials, Managing traffic flows, advanced construction methods. Electric vehicles

Max. 39 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – **Understand** theImpact of transportation infrastructure activities on environment

CO2 – **Understand** Environmental Impact Assessment process

CO3 –**Understand** air and noise pollution due to vehicular traffic

CO4 – **Evaluate** a traffic system with respect to environmental benefits

CO5 –**Conduct** test to assess vehicle pollution level

CO6 – **Formulate** policy through research for environmental benefit

TEXT/REFERENCE BOOKS

1. Canter, L.W., Environmental Impact Assessment, McGraw Hill Pub. Co., New York, 1997
2. David Banister; Transport Policy and Environment, E&FN Spain, 1999
3. Keith W. Little, Environmental Fate and Transport Analysis with Compartment Modeling, CRC Press, Taylor & Francis Group, 2012.
4. Louis Franklin Cohen and Gary Richard McVoy, Environmental Analysis of Transportation Systems, John Wiley & Sons, 1982
5. NCHRP Report 541. Consideration of Environmental Factors in Transportation Systems Planning, TRB, 2005.
6. NCHRP Synthesis 272, Best Management Practices for Environmental Issues Related to Highway and Street Maintenance: A Synthesis of Highway Practice, National Research Council, TRB, 1999.
7. Peter Morris and RikiTherivel, Methods of Environmental Impact Assessment (Natural and Built Environment Series), 3rd Edition, Routledge, 2009
8. TRB Special Report 268. Surface Transportation Environmental Research: A Long-Term Strategy, National Academies Press, 2005 (http://www.nap.edu/catalog/10354.html)
9. World Bank; the Impact of Environmental Assessment – A Review of World Bank Experience, Washington, 1997.
10. World Bank; Road and the Environment, Washington, 1997.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A:10 Questions of 2 marks each-No choice 20 Marks

Part B:2 Questions from each unit with internal choice, each carrying 16 marks 80 Marks

Pandit Deendayal Petroleum University	School of Technology

19MCT505					Department Elective: Ground Improvement Techniques					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To explain the concepts and principles used for physical compaction of soil in laboratory and field; and stabilisation of weak soil using chemical admixtures.
- To explain the principles of advance compaction methods using dynamic loads, stones columns, and different grouting processes.
- To explain and make an awareness about the potential applications of different smart materials like geosynthetics, strips and bars in improving the physical soil properties.
- To explain and make an awareness about different advance techniques of soil improvements like Soil nailing and ground anchors, dewatering techniques, piling techniques etc.

UNIT 1 PHYSICAL AND CHEMICAL STABILIZATION **10 Hrs.**

Introduction: Compaction method used in the laboratory and the field- lab compaction methods-light- heavy- kneading- vibratoryfor soils and with admixtures Shallow stabilization with cement- lime-flyash and other chemical

UNIT 2 DYNAMIC COMPACTION AND GROUTING FOR IN-SITU SOIL **12 Hrs.**

Deep stabilization using vibroflotation- compaction piles- dynamic compaction- blasting- sand drains- stone columns- lime and cement columns- grouting by permeation- displacement and jet methods.

UNIT 3 GEOSYNTHETICS FOR SOIL IMPROVEMENT **10 Hrs.**

Functions and Application of Geosynthetics- Geotextiles- Geogrids- geomembranes- soil reinforcement using strips- bars etc.

UNIT 4 MISCELLANEOUS PHYSICAL METHODS FOR IMPROVING EARTH STRUCTURE **07 Hrs.**

Soil nailing and ground anchors- dewatering techniques- earthmoving machines and earthwork principles-piling and diaphragm wall construction- tunnelling methods in soils etc.

Max. 39 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO 1: Classify different ground improvement methods and their suitability**.**

CO 2: Determine the suitability of physical and chemical soil stabilization techniques**.**

CO 3: Examine the use of dynamic compaction and grouting techniques for soil improvement**.**

CO 4: Select suitable geosynthetic materials for various ground applications**.**

CO 5: Design mechanically stabilized reinforced earth wall systems**.**

CO 6: Evaluate the suitability of ground anchors and dewatering techniques for soil stabilization**.**

TEXT/REFERENCE BOOKS

1. Purushottam Raj, Ground improvement Techniques, Penguin Books Ltd, New Delhi, 1999 2. Gulhati and Manoj Dutta, Geotechnical Engineering, Tata Mc-Graw Hills Manfired R. H., 2003.
2. "Engineering Principles of Ground Modification", McGraw-Hill Pub.Co.1990
3. Koener R M. ,Construction and Geotechnical Methods in Foundation Engineering. McGraw Hill Pub Co New York, 1985.
4. Hausmann M R Engineering Principles of Ground Modifications, McGraw Hill Pub Co New York, 1990.
5. Ingles O G and Metcalf J B. (1972), Soil Stabilisation: Principles and practice, Butterworths, London, 1972.
6. Ell F G. ,Methods of Treatment of Unstable ground, Newness Butterworths, London,1975.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A/Question: <Unit I and Unit II> 55 Marks

Part B/Question: <Unit III and Unit IV> 45 Marks

Course Structure for M. Tech. Civil (Transportation Engineering)
w.e.f. Academic Year July 2021
Semester II

Sr. No	Course Code	Course Name	Teaching Scheme					Exam Scheme					
			L	T	P	C	Hrs/wk	Theory			Practical		Total
								MS	ES	IA	LW	LE/Viva	Marks
1		Urban Transportation Systems Planning	3	0	0	3	3	25	50	25	--	--	100
2		Pavement Management Systems	3	0	0	3	3	25	50	25	--	--	100
3		Railway, Airport and Harbour Engineering	3	1	0	4	4	25	50	25	--	--	100
4		Highway Construction Practices	3	0	0	3	3	25	50	25	--	--	100
5		Elective-III	3	0	0	3	3	25	50	25	--	--	100
6		Elective-IV	3	0	0	3	3	25	50	25	--	--	100
7		Project Design Studio	0	0	2	1	2	--	--	--	50	50	100
8		Successful Research Program Development	2	0	0	2	2	25	50	25	--	--	100
Total			**20**	**1**	**2**	**22**	**23**						**800**

MS = Mid Semester, ES = End Semester, IA = Internal assessment (like quiz, assignments etc), LW = Laboratory work, LE = Laboratory Exam

Elective III:

- Intelligent Transportation Systems
- Sustainable Transportation Development

Elective IV:

- Human Resource Management
- Project Management
- Design and Analysis of Experiments

20MCT511T					Urban Transportation Systems Planning					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	-	-	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To know approaches to study urban activity system and travel pattern
- To learn the urban public transportation facilities.
- To study different economic analysis methods for project development
- To know financial methods for transportation project development.

UNIT 1: URBAN MORPHOLOGY **10 Hrs.**

Urbanization and travel demand – Urban activity systems and travel patterns – Systems approach – Trip based and Activity based approach - Urban Transportation Planning – Goals, Objectives and Constraints - Inventory, Model building, Forecasting and Evaluation - Study area delineation – Zoning - UTP survey

UNIT 2: URBAN PUBLIC TRANSPORTATION **10 Hrs.**

Transit mode classification and characteristics - Depots and Terminals - Crew facilities. Design of terminal facilities – Bus terminal, Freight Terminal Design. Transportation costs - Supply and demand - elasticity of demand; Supply of transport services - Economics of traffic congestion - Pricing policy. Vehicle operating costs: Fuel costs - Maintenance and spares, Depreciation - Crew costs - Value of travel time savings - Accident costs

UNIT 3 : ECONOMIC ANALYSIS OF PROJECTS **10 Hrs.**

Methods of evaluation - Cost-benefit ratio, first year rate of return, net present value, and internal-rate of return methods; Indirect costs and benefits of transport projects

UNIT 4: FINANCING OF ROAD PROJECTS **9 Hrs.**

Methods – Private Public Partnership (PPP) - Toll collection - Economic viability of Design-Build-Operate-Transfer Schemes – Risk Analysis – Value for Money analysis - Case Studies.

Max. 39 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - **Understand** the Motor Vehicle Act and statutory provision for road transport. Also the students will be able to do scheduling of route, vehicle and crew.

CO2 – **Apply** learning to develop energy efficient depots and terminals design

CO3 – **Design** Bus terminal and Freight Terminal

CO4 – **Analyse**schedule for efficient public transportation development in urban area.

CO5 – **Evaluate** the existing public and freight transportation needs in urban area.

CO6 – **Create** energy and cost-effective urban transportation plans.

TEXT/REFERENCE BOOKS

1. Winfrey, Economic analysis for Highways, International Textbook Company, Pennsylvania, 1969.
2. CRRI, Road User Cost Study in India, New Delhi, 1982
3. IRC, Manual on Economic Evaluation of Highway Projects in India, SP-30, 2007

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A :10 Questions of 2 marks each-No choice 20 Marks

Part B :2 Questions from each unit with internal choice, each carrying 16 marks 80 Marks

20MCT512T					Pavement Management Systems					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	-	-	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To know concept of pavement management system
- To learn various pavement performance models
- To learn design strategies of pavement design
- To learn algorithms and other methods can be used for pavement management

UNIT 1 : INTRODUCTION TO PAVEMENT MANAGEMENT **10 Hrs.**

Historical perspectives of PMS- Evolution of PMS concepts- basic components of PMS- system- network and project levels of PMS- data Needs- GIS applications- database design- inventory and monitoring databases- planning pavement investments process- benefits of pavement management.

UNIT 2 :PAVEMENT PERFORMANCE MODELS **11 Hrs.**

General concepts- pavement evaluation with respect to user cost- pavement evaluation technologies, techniques for developing prediction models deterministic- probabilistic- expert system of PMS models- remaining service life- AASHO- CRRI and HDM models- deterioration concepts and modelling, priority programming methods- pavement life cycle cost analysis- decision tree-PMS analysis software.

UNIT 3 :DESIGN ALTERNATIVES **10 Hrs.**

Design Alternatives- evaluation and selection- framework for pavement design- design objectives and constraint- generating alternative pavement design strategies- methods of economic evaluation- economic evaluation of alternative pavement design strategies and selection of optimal design strategies. Perpetual pavements.

UNIT 4 : PAVEMENT PRIORITIZATION TECHNIQUES **8 Hrs.**

General concepts- ranking methods and procedures- prioritization based on befit cost ratio- mathematical optimization for prioritization of M- R&R Work Programs- Markov and heuristic approaches and ANN techniques for Prioritization of M-R&R Work programs.

Implementation of PMS and Technologies-Major steps in Implementation of PMS- operational Issues- system complexity- feedback, other Institutional Issues and PMS case studies

Max. 39 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 –**Understand** the need and select suitable design strategies for a given pavement.

CO2 – **Apply** the basic learning and determine the pavement condition using functional and structural methods.

CO3 – **Design** alternative method of pavement evaluation by considering economic and quality.

CO4 – **Analyse** the type and timing of maintenance required for given pavement.

CO5 - **Evaluate** the life cycle cost of pavements.

CO6 – **Create** strategies for cost effective PMS.

TEXT/REFERENCE BOOKS

1. Hudson, W. R., R. Haas and W. Uddin. Infrastructure Management: Integrating Design, Construction, Maintenance, Rehabilitation, and Renovation. McGraw Hill. New York, 1997.
2. Proceedings of International Conference on Structural Design of Asphalt Pavements NCHRP, TRR and TRB Special Reports.
3. Proceedings of North American Conference on Managing Pavement, 1987, 1994.
4. Ralph C.G. Haas and Ronald W. Hudson, Pavement Management System, McGraw Hill Book Co. 1978.
5. Ralph C.G. Haas, W. Ronald Hudson and Zanieswki, Modern Pavement Management, Kreiger Publications, 1994.
6. Shahin, M.Y. Pavement Management for Airports, Roads and Parking Lots. Chapman & Hall, New York, 1994.
7. Southeast Michigan Council of Governments. Pavement Management System, SEMCOG, 1997.
8. Transportation Association of Canada. Pavement Design and Management Guide. Transportation Association of Canada, Ottawa, 1997.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A :10 Questions of 2 marks each-No choice 20 Marks

Part B :2 Questions from each unit with internal choice, each carrying 16 marks 80 Marks

20MCT513T					Railway, Airport and Harbour Engineering					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	-	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To give an overview about different mode of transportation.
- To know the procedure and influencing factors for Planning of Railway line, Airport and Port.
- To learn ITS application in railways
- To study the various infrastructure development and its requirement in railway,metro, airport and harbour.

UNIT 1: RAILWAY ENGINEERING **12 Hrs.**

Introduction: Role of railways in transportation, Indian Railways, Selection of Routes, Permanent way and its requirements, Gauges and types, coning of wheels, Rails-Functions-requirements- defects-wear-creep-welding-joints, creep of rails. Sleepers And Ballast: Functions, requirements, Types, Track fitting and fasteners, Smart materials and techniques used in railway construction

UNIT 2: RAILWAY GEOMETRIC DESIGN **14 Hrs.**

Geometric Design: Necessity, Safe speed on curves, Cant-cant deficiency-negative cant-safe speed based on various criteria, (both for normal and high speed tracks) Transition curve, Gradient and types, grade compensation, Examples on above. Points And Crossing: Signalling-Objects and types of signals. ITS application in Railways, Metro and mono rail infrastructure development.

UNIT 3: AIRPORT ENGINEERING **13 Hrs.**

Introduction: Layout of an airport with component parts and functions, Site selection for airport, Aircraft characteristics affecting the design and planning of airport, Airport classification, Runway orientation using wind rose with examples.

Runway: Basic runway length-Corrections and examples, Runway geometrics, Taxiway-Factors affecting the layout - geometrics of taxiway-Design of exit taxiway with examples, Visual aids- Airport marking – lighting-Instrumental Landing System. Smart energy saving methods adopted in Airport. Airport connecting with other mode of transportation and Infrastructure development with respect to transportation.

UNIT 4: PORT/HARBOUR ENGINEERING **13 Hrs.**

Harbours: Harbour classifications, Layout with components Natural phenomenon affecting the design of harbours - wind, wave and tide, currents, Breakwater-Types Wharf and Quays, Jetties and Piers, Dry dock and wet docks, Slipways, Navigational aids, warehouse and transit-shed. Infrastructure development with respect to transportation.

Max. 52 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – **Describe** various factors considered for planning of Railway line including metro and monorail, Port and Airport.

CO2 – **Understand** different geometric parameters and its importance in design of Railway, Runway and Taxiway.

CO3 – **Calculate** the geometric parameters of Railway, Runway and Taxiway.

CO4 – **Analyze** wind duration, direction and intensity for orientation of runway

CO5 – **Design** infrastructure requirement at with different facility.

CO6 – **Create** energy efficient model of Airport, Harbour and port.

TEXT/REFERENCE BOOKS

1. Hasmukh P. Oza and Gautam H. Oza, Dock and Harbour Engineering, Sixth Edition, Charotar Publishing House Pvt. Ltd., 2011
2. S.B. Junnarkar and H.J. Shah, Dock and Harbour Engineering, Charotar Publishing House Pvt. Limited
3. Seetharaman, S. Dock and Harbour Engineering, Umesh Publications, New Delhi, India, 1999.
4. Srinivasan, R. Harbour, Dock and Tunnel Engineering, Charotar Publishing House Pvt. Ltd., Anand, India, 2009.
5. Khanna, S. K., Arora, M. G., and Jain, S. S. Airport planning and Design, Sixth Edition, Nem Chand and Bros, Roorkee, India, 2012.
6. Kumar, V., and Chandra, S. Air Transportation Planning and Design, Galgotia Publications Pvt. Ltd., New Delhi, India, 1999.
7. Neufville, R. D., and Odoni, A. Airport Systems: Planning, Design, and Management, McGraw-Hill, New York, USA, 2003.
8. Young, S. B., and Wells, A. T. Airport Planning and Management, Sixth Edition, McGraw-Hill, New York, USA, 2011.
9. Rangwala, S.C. Railway Engineering, Charotar Publishing House, Anand, India, 2008.
10. S.C. Saxena and S.P. Arora, A textbook of Railway engineering, Sixth Edition, DhanpatRai Publications, 2001.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A :10 Questions of 2 marks each-No choice 20 Marks

Part B :2 Questions from each unit with internal choice, each carrying 16 marks 80 Marks

20MCT514T					Highway Construction Practices					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	-	-	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To know the principles of road construction
- To know the different methods in bituminous and cement concrete road construction.
- To learn the guideline for road construction in special location like Desert, Swampy and Hilly Areas
- To learn the procedure for planning and scheduling of material, man and machinery requirement.

UNIT 1: CONSTRUCTION PRINCIPLES **10 Hrs.**

Highway Construction Principles- Developments in road construction- Embankment construction- Formation cutting in ordinary soil and hard rock -Ground improvements

UNIT 2: PAVEMENT CONSTRUCTION **11 Hrs.**

Bituminous Pavement Construction-Seasonal limitations of pavement Construction- Bituminous base and surface courses- prime- tack- seal coats-bituminous- bituminous penetration macadam- surface dressing- premix carpet and bituminous concrete- Recycling of bituminous pavement materials, Construction of earthen- gravel and water bound macadam- wet mix macadam roads

Cement Concrete Pavement Construction-Plants- construction pavement- Types of construction joints-Joints filler and sealer- reinforced- Pre-stressed.

UNIT 3: SPECIAL AREAS ROAD CONSTRUCTION **10 Hrs.**

Desert- Swampy and Hilly Areas Road Construction- Hilly area road- alignment- Geometric design- Design and construction of - hill roads- retaining- revetment walls- Location and design of roads in swampy area- Desert area roads- principles of road location- guidelines for design.

UNIT 4: ROAD CONSTRUCTION MACHINERIES **08 Hrs.**

Road Construction Machineries- Role of labour v/s machinery in road construction- Earthwork machinery- Rock excavation machinery- TransportingEquipment- CompactionEquipment- Bituminous concrete road equipment- Cement Concrete road making Equipment- Equipment Usage charges

Max. 39 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 –**Understand** procedure for embankment construction, different types of pavement constructions and also the process of recycling of pavement materials

CO2 –**Apply** technology of construction for construct earthen, gravel, water bound and wet mix macadam roads.

CO3 –**Design** bitumen mix for special location like Desert, Swampy and Hilly Areas Road Construction

CO4 –**Analyse** the material requirement for special purpose to construct road in hilly, swampy and desert areas

CO5 – **Evaluate** the man and machinery requirement for any road construction project.

CO6 – **Create** road construction schedule for material, man and machinery requirement.

TEXT/REFERENCE BOOKS

1. Principles of Transportation engineering, ParthaChakraborty&Animesh Das.
2. Highway Engineering, Khanna,S.K. and C.E.G.Justo, Nemchand Bros
3. Principles and practice of Highway engineering, Kadiyali, L. R, Khanna Publications Delhi.
4. MOST Standard for Highway constructions

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A :10 Questions of 2 marks each-No choice 20 Marks

Part B :2 Questions from each unit with internal choice, each carrying 16 marks 80 Marks

20MCT517P					Project Design Studio -Lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
-	-	2	1	2	--	--	--	50	50	100

COURSE OBJECTIVES

- To learn transportation planning software
- To learn traffic operation and monitoring software and tools
- To learn pavement design and evaluation software.
- To learn statistical method of analysis and different algorithms

Detailed Syllabus:

Exercises on Usages of the Packages and Mini-Project:

1. TRANSPORTATION PLANNING PACKAGES:

Trip Generation - Multiple Linear Regression Analysis.
Trip Distribution - Growth Factor Methods, Gravity Model.
Mode Choice - Logit Model.
Trip Assignment - All or Nothing Technique.
CUBE
Land use Transportation Planning

2. TRAFFIC ENGINEERING PACKAGES:

MX Road
VISSIM

3. PAVEMENT EVALUATION & ECONOMIC ANALYSIS PACKAGES:

Ken-layer & Ken-slab
HDM – IV

4. STATISTICAL METHOD OF ANALYSIS

5. ALGORITHMS.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – **Understand** different parameters controlling transportation planning, traffic operation and pavement design

CO2 – **Apply** the basic knowledge in developing the model in software.

CO3 – **Design** Flexible and Rigid pavement in software.

CO4 – **Analyze** the different possible condition in planning, traffic operation and pavement management.

CO5 – **Evaluate** the alternative methods to select most possible.

CO6 –**Create** cost effective models using mathematical as well as software approach.

TEXT/REFERENCE BOOKS

1. User Manuals of various packages.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A : Lab Work – Continuous Assessment	50 Marks
Part B : Lab Exam and Viva	50 Marks

20MCT518T					Successful Research Program Development					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
2	-	-	2	2	25	50	25	--	--	100

COURSE OBJECTIVES

- To understand research methods
- To know different funding organisation available for transport research and development
- To understand different process of conduction research
- To know the different process of patent registration

UNIT 1: THE RESEARCH ORGANIZATION **08 Hrs.**

Objectives & Goals of a Research Organization, Indirect Support Activities, Direct Support Activities, Costs & Infrastructure Accounting, General & Administration Activities, Market & Business Development Activities, Profit & Non-Profit Entity Implications, Business Case for R&D, R&D Structures & Costs for Selected Industry Segments, Success stories. Research Staff: Research & Academic Faculty,Scientists& Technologists, Research Associates, Graduate Students, Visiting Researchers, Employment Laws, Contracts, & Implications, Workplace Regulations.

UNIT 2: SPONSORS & FUNDING AGENCIES **06 Hrs.**

Funding Agencies – Types, Types of Interface with Funding & Sponsor Agencies, Call for Proposals & Opportunity Tracking, Types of Proposals & Grants, Contracting Vehicles & Arrangements, Deliverables, Interim & Final Reviews, Cost & Performance Audits, Contract Laws & Enforcement, Ethics & Lobbying, Conflict of Interest & its Management. Proposals for Research Program Funding: Center& Consortia Proposals, Individual Principal Investigator Proposals, Continuation & Renewal Proposals, Prime/Subcontractor Relationships & Contracting, Cost Accounting, Laws and Regulations.

UNIT 3: RESEARCH PROGRAM CONTRACTS **06 Hrs.**

Types of Contracts – IDIQ, Cost-Sharing, Cost-Plus, Intellectual Property & Patent Laws, Export Control & Arms Regulations Compliance, Academic versus Commercial Contracts, Technology Transfer, Overhead & Indirect Costs, Federal & Government Cost & Accounting Regulations (FAR), Case Studies. Writing a Successful Research Proposal: Technical Proposal, Management Proposal, Cost Proposal, Technology Proposal, Statement of Work & Deliverables, Case Studies.

UNIT 4: THE RESEARCH PROCESS **06 Hrs.**

I- Steps in development of successful research program, Quality & Cost consideration, Laboratories and infrastructure setup, Staffing & Support Models, Peer-Review, Independent Verification & Validation, Internal & External Review processes, Ethics & Regulatory Laws & Guidelines, Case Studies. II: Problem Definition, Background Study, Valuation & Current Practice, Proposal Writing, Deliverables & Timelines Development, Results Projection, Staffing, Costs & Progress Tracking, Quality Management, Publication & Patents, Intellectual Property & Licensing, Technology Transfer, Validation & Test. Deliverables & Audits: Technical Reports, Software, Hardware, Systems, Qualification, Cost Reports, Test Reports, Papers & Publications, Patents, Case Studies.

Max. 39 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 –**Understand** the research methodology
CO2 –**Understand** proposal writing for different funding organisation
CO3 –**Understand**the different process of patent registration
CO4 –**Design** own research methodology as per chosen problem.
CO5 – **Analyse** the problem chosen mathematically and various tools
CO6 – **Conduct** individual research on selected topic/ area

TEXT/REFERENCE BOOKS

1. Principles of Transportation engineering, ParthaChakraborty&Animesh Das.
2. Highway Engineering, Khanna,S.K. and C.E.G.Justo, Nemchand Bros
3. Principles and practice of Highway engineering, Kadiyali, L. R, Khanna Publications Delhi.
4. MOST Standard for Highway constructions and related journals.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A :10 Questions of 2 marks each-No choice 20 Marks
Part B :2 Questions from each unit with internal choice, each carrying 16 marks 80 Marks

<Course Code>					Elective III- Intelligent Transportation Systems					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	-	-	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To know the importance and role of ITS in-road transportation
- To study the various sensor and communication technologies used in ITS
- To learn the various functional areas of ITS
- To know the role of ITS in smart city development and sustainable transportation development.

UNIT 1: INTRODUCTION TO INTELLIGENT TRANSPORTATION SYSTEMS (ITS) 10 Hrs.

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.

UNIT 2: TELECOMMUNICATIONS IN ITS 10 Hrs.

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

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

UNIT 3: ITS USER NEEDS AND SERVICES 10 Hrs.

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. ITS in risk management and safety improvement.

UNIT 4: AUTOMATED HIGHWAY SYSTEMS 09 Hrs.

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. Application of ITS in Smart city development. Role of ITS in Sustainable road network development.

Max. 39 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - **Understand** role of ITS in efficient road network operation.

CO2 - **Apply** the various sensor and communication technologies in ITS methodologies

CO3 – **Design** various ITS solution methodologies under Indian conditions.

CO4 – **Analyze** the traffic operation with and without ITS.

CO5 – **Evaluate** the best ITS solution with respect to field traffic issue.

CO6 – **Create** new ITS technology for sustainable transportation development.

TEXT/REFERENCE BOOKS

1. Intelligent Transportation Systems by Pradip kumar Sarkar and Amit Kumar Jain.
2. Permanent International Association of Road Congresses (**PIARC**)-Intelligent Transportation System
3. ITS Hand Book 2000: Recommendations for World Road Association (PIARC) by Kan Paul Chen, John Miles.
4. Sussman, J. M., Perspective on ITS, Artech House Publishers, 2005.
5. National ITS Architecture Documentation, US Department of Transportation, 2007 (CD-ROM)

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A :10 Questions of 2 marks each-No choice 20 Marks

Part B :2 Questions from each unit with internal choice, each carrying 16 marks 80 Marks

<Course Code>					Elective III- Sustainable Transportation Development					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	-	-	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- Know the present and future need of transportation and related issues
- Understanding advantages and disadvantages of NMT
- Study various ways of improving public transportation system
- Study different sustainable technology related to transportation.

UNIT 1: **10 Hrs.**

Problem of Sustainability in Transport: Energy use in transport sector; Transport and climate change; Greenhouse gas emissions, urban air quality, Congestion and sustainability.

Planning for Sustainability: Urban form, Indicator based planning, land use transportation integration, Compact City, Public Transit, TOD, NMT, First and Last Mile Connectivity, Green Highways

UNIT 2: **10 Hrs.**

Evaluation of Non-motorized Transportation: Surveys, Demand Estimation and Analysis; Crash Data, Barrier Effect; Cycling Condition Evaluation Techniques; Pedestrian Condition Evaluation Techniques; Prioritizing Improvements and Selecting Preferred Options.

Planning for Pedestrians: Types of pedestrians and Characteristics; Pedestrian facilities and planning; Pedestrian standards and improvements; Pedestrian facility Design, LOS; Pedestrian safety programs

UNIT 3: **10 Hrs.**

Planning for Bicyclists: Types of cyclists and Bikeways; Integrating cycling into roadway planning; Bicycle network planning; Accommodating cyclists on rural roads; Design of Bicycle boulevards/bike paths; Bicycle Parking/storage Facilities; Roadway maintenance for cyclists.

Sustainable Policies: Continuum of Policies, speed and speed limit policies, national policies, sustainable travel demand management; public awareness; pricing transportation: full cost of transportation, pricing and taxation.

UNIT 4: **09 Hrs.**

Sustainable Technology: Electric vehicle, Telecommuting, Information and Communication technologies, E-commerce, Alternative Cleaner Fuels, vehicle technologies, fuel cells, Intelligent Transport Systems. Nationally Appropriate Mitigation Actions: E-Mobility Management policies, Supporting Bicycling, Creating pedestrian friendly facilities, encouraging Public Transportation.

Max. 39 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - **Understand** sustainable transportation and differentiate sustainable transportation systems from non-sustainable transportation systems

CO2 –**Understand** the complexity in giving priority to NMT and advantages

CO3 – **Consider** sustainability in providing mode choices for the public.

CO4 –**Design** public transport priority traffic network

CO5 – **Develop** a sustainable transportation system

CO6 –**Suggest** policies that improve the sustainability of transportation.

TEXT/REFERENCE BOOKS

1. Black, W.R., Sustainable Transport: Problems and Solutions. Gulford Press, New York, 2010.
2. Henrik Gudmundsson, Ralph P. Hall, Greg Marsden and JosiasZietsman, Sustainable Transportation: Indicators, Frameworks and Performance Management, Springer, 2016
3. Jeffrey Tumlin, Sustainable Transportation Planning: Tools for creating Vibrant, Healthy and Resilient Communities, John Wiley & Sons, Inc, New Jersey, 2012
4. John Forester, Bicycle Transportation: A Handbook for Cycling Transportation Engineers, MIT Press, London, 1994.
5. John J. Fruin, Pedestrian Planning and Design, Elevator World, 1987 (Digitized 2011)
6. Hugh McClintock, Planning for Cycling: Principles, practice and Solutions for urban planners, CRC Press, New York, 2002
7. Preston L. Schiller, Eric C. Brunn and Jeffrey R. Kenworthy. An Introduction to Sustainable Transportation: Policy, Planning and Implementation, earthscan, London, 2010.
8. Rodney Tolley, Editor, Sustainable Transport: Planning for walking and cycling in urban environments; CRC Press, 2003.
9. Transportation Research Board, Integrating Sustainability into the Transportation Planning Process, Conference Proceedings 37, Transportation Research Board, Washington, D.C., 2005.
10. World Bank, Sustainable Transport: Priorities for Policy Reform, The World bank, Washington D.C., 1999.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A :10 Questions of 2 marks each-No choice 20 Marks

Part B :2 Questions from each unit with internal choice, each carrying 16 marks 80 Marks

<Course Code>					Elective IV- Project Management					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	-	-	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To learn about the philosophy, concepts and scope of project management and salient features of the different features of a project life cycle. structures of project organization
- To learn the methodology for development of project organization structures and work breakdown structures
- To learn about the latest project planning and scheduling tools
- To learn methodologies of project management for sustainable development and latest project management tools and techniques including risk management, Building Information Modelling(BIM), Integrated Project Delivery(IPD) and Critical Chain Project Management (CCPM)

UNIT 1: CONCEPT, SCOPE OF PROJECT MANAGEMENT AND PHASES OF PROJECT LIFE CYCLE 8 Hrs

Introduction: Definition & scope of project- Parameters affecting a project- Project planning & implementation cycle- Definition, concept & scope of project management- Role of project manager- Enhancing the probability of success of a project; Phases of a project – Identification, feasibility, development, implementation and operation- Project life cycle.

Project Organization: Factors responsible for organizational revolution; Formal & informal organization structures- Matrix organization structure- Selecting a project organization structure- Criteria to help determine a suitable organizational form in a given project environment.

UNIT 2: PROJECT PLANNING AND SCHEDULING 12 Hrs

Work Break Down Structure (WBS): Typical hierarchy in the WBS of a project- Desirable characteristics of work packages- Project oriented WBS- Functionally oriented WBS- Integration of WBS & organization structure. Project Scheduling & Planning: Scheduling principles- Bar charts (Gantt charts)- Milestones charts- S-curve- Critical path method: Network logic diagram; Arrow diagram; Time estimates; Slack; Total, free & independent floats; Case studies of complex CPM networks- PERT (Project evaluation & review techniques): Three time estimates (optimistic, most likely, pessimistic); Beta distribution; Expected time; Variance in project duration; Standardized normal variable; Case studies. Case studies; Updating the network.

UNIT 3: RESOURCE ALLOCATON & LEVELLING, PROJECT APPRAISAL AND CONTROL 9 Hrs

Resource Allocation and Levelling: Network scheduling with limited resources-Resource allocation; Resource levelling. Project Appraisal: Basics of economic decision- Cash flows-Rate of return-Economic evaluation of project proposals using ROR- Economic appraisal criteria for selection of industrial projects.

Project Control: Concept; Control cycle- Line of Balance- Role of project management on control cycle- Time control- Cost control- Potentiality of cost reduction during different phases of a project- Cost planning- Control curves- Cash flow- Time cost trade-off planning for minimum costs- Controlling cost overrun & time overrun- Quality control: Need of QA/QC programs; Objectives of QA/QC; Quality assurance techniques.

UNIT 4: PROJECT MONITORING, RISK MANAGEMENT AND LATEST PROJECT MANAGEMENT TRENDS 10 Hrs

Project Monitoring: Measurement of performance- Reporting of performance measures for in favourable variations- Major functions of monitoring – Influence of decision-making authority – Case studies. Project Risk Management: Risk identification- Risk analysis –Risk response planning and mitigation measures- Case studies. Latest Trends in Project Management: Project management for sustainable development- Integrated project delivery (IPD)- Lean integrated project delivery (LIPD)- Application of Building Information Modelling (BIM) –Critical chain project management (CCPM).

Max. 39 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – **Understand**basic project management concepts related to transportation

CO2 - **Understand** the method of project planning and scheduling

CO3 – **Prepare** project appraisal and cost planning

CO4 – **Evaluate** transportation projects and can give suggestion in decision making

CO5 – **Estimate** level of risk involved in projects

CO6 –**Create** new project management techniques using research.

TEXT/REFERENCE BOOKS

1. Iyer P Parameshwar (2001) Engineering Project Management with case studies. Wheeler Publishing New Delhi.
2. Nicholas John M (2007) Project Management for Business and Technology: Principles and Practice, 2nd Edition, Pearson Prentice Hall New Delhi
3. Austen AD &Neele RH (1985) Managing Construction Projects: A guide to process and procedures, Dialogue New Delhi
4. Joy PK (1990) Handbook of Construction Management, Macmillan Delhi
5. Harris F &McCaffer R (2003) Modern Construction Management, BSP Professional Books Oxford/ London.
6. Wiest D J. and Leivy K F, (2010) A Management Guide to PERT and CPM: With GERT/ PDM / DCPM, Pearson Prentice Hall Publishers, New Delhi

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A: 10 Questions of 2 marks each-No choice 20 Marks

Part B: 2 Questions from each unit with internal choice, each carrying 16 marks 80 Marks

<Course Code>					Open Elective IV: Human Resource Management					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	-	-	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To understand the importance of human resource management
- To study various concept and selection process can be used in screening
- To learn the method of training an employee or group
- To know the performance evaluation and control

UNIT 1: PERCEPTIVE IN HUMAN RESOURCE MANAGEMENT **10 Hrs.**

Evolution of human resource management – The importance of the human factor – Objectives of human resource management – Inclusive growth and affirmative action -Role of human resource manager – Human resource policies – Computer applications in human resource management – Human resource accounting and audit.

UNIT 2: THE CONCEPT OF BEST FIT EMPLOYEE **10 Hrs.**

Importance of Human Resource Planning – Forecasting human resource requirement – Internal and External sources. Selection process screening – Tests - Validation – Interview - Medical examination – Recruitment introduction – Importance – Practices – Socialization benefits.

UNIT 3: TRAINING AND EXECUTIVE DEVELOPMENT **10 Hrs.**

Types of training methods purpose benefits resistance. Executive development programmes – Common practices -Benefits – Self-development – Knowledge management. SUSTAINING EMPLOYEE INTEREST - Compensation plan – Reward – Motivation – Theories of motivation – Career management – Development of mentor –Protégé relationships.

UNIT 4 : PERFORMANCE EVALUATION AND CONTROL PROCESS **09 Hrs.**

Method of performance evaluation – Feedback – Industry practices. Promotion, Demotion, Transfer and Separation – Implication of job change. The control process – Importance –Methods – Requirement of effective control systems grievances – Causes – Implications– Redressal methods.

Max. 39 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 –**Understand**Recruitment activities

CO2 - **Receive** Better Training and Development programme.

CO3 – **Manage** Motivated Workforce and reduced Employee Grievances

CO4 – **Analyse** the organization needs and manage the human recourse in all division

CO5 – **Evaluate** the performance of organisation as well as employee

CO6 – **Implement** the control process.

TEXT/REFERENCE BOOKS

1. Decenzo and Robbins, Human Resource Management, Wiley, 11th Edition, 2013.
2. Dessler, Human Resource Management, Pearson Education Limited,13th edition, 2007
3. Mamoria C.B. and Mamoria S. Personnel Management, Himalaya PublishingCompany, 5th edition, 2011
4. Bernadin , Human Resource Management ,Tata Mcgraw Hill ,6th edition 2012.
5. EugenceMckenna and Nic Beach, Human Resource Management, Pearson Education Limited,2nd edition, 2008.
6. Wayne Cascio, Managing Human Resource, McGraw Hill, 8th edition, 2009.
7. Ivancevich, Human Resource Management, McGraw Hill, 7th edition, 2010.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A :10 Questions of 2 marks each-No choice 20 Marks

Part B :2 Questions from each unit with internal choice, each carrying 16 marks 80 Marks

<Course Code>					Open Elective IV: Design and Analysis of Experiments					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	-	-	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To know different parameters and its importance in design of any experiments
- To learn the form and method of data collection
- To learn single factor and multifactor 2^k design
- To learn various optimization methods and tools

UNIT 1: **10 Hrs.**

Introduction- Planning of experiments – Steps – Need, Terminology: Factors, levels, variables, experimental error, replication, Randomization, Blocking, Confounding.

UNIT 2: **10 Hrs.**

Single Factor Experiments- ANOVA - Sum of squares – Completely randomized design, Randomized block design, effect of coding, Comparison of treatment means – Newman Kuel's test, Duncan's Multiple Range test, Latin Square Design.

UNIT 3: **10 Hrs.**

Factorial Experiments-Main and interaction effects –Two and three Factor full factorial Designs, 2 k designs with Two and Three factors- Yate's Algorithm Special Experimental Designs- Blocking and Confounding in 2 k design

UNIT 4: **09 Hrs.**

Taguchi Techniques- Fundamentals of Taguchi methods, Quality Loss function, orthogonal designs, application to Process and Parameter design.

Max. 39 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - **Explain** the practical implications of Design of experiments

CO2 - **Adopt** ANOVA techniques to identify sufficient factors

CO3 – **Apply** Taguchi techniques to conduct experiments in research work.

CO4 – **Design** any experiment as per requirement

CO5 – **Evaluat**e the type of test or analysis required based on factors.

CO6 – **Create** method/model to generate optimized solution for transportation problems.

TEXT/REFERENCE BOOKS

1. Montgomery, D.C. Design and Analysis of Experiments, John Wiley and Sons, 5th Edition,2002.
2. Hicks,C.R. Fundamental concepts in the Design of Experiments, Holt, Rinehort and Winston, 2000.
3. Bagchi, T.P. Taguchi Methods explained, PHI, 2002.
4. Ross, P.J. Taguchi Techniques for quality Engineering, Prentice Hall, 2000.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A :10 Questions of 2 marks each-No choice 20 Marks

Part B :2 Questions from each unit with internal choice, each carrying 16 marks 80 Marks

<Course Code>					Open Elective: Financial & Management Accounting for Engineers					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	-	-	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- Equip the students with technical and analytical skills in management of funds
- Develop managerial decision-making with special emphasis on the practical aspects
- Equip the students distinguish the relevant issues from the irrelevant matters
- Grasp the implication of the various factors in a given situation and marshal the thought process logically so as to be able to present information in a meaningful manner.
- Display an understanding of the relative merits of each alterative.

UNIT 1: Management Accounting and Decision making-I **10 Hrs.**

Management & Accounting Functions
Profit Planning
Incremental Analysis
Budgetary Control – Operation

UNIT 2: Management Accounting and Decision making-II **10 Hrs.**

Cost Control Through Variance analysis
Performance Reporting

Management Control System
Decision Models

UNIT 3: Financial Management-I **10 Hrs.**

Analysis and Interpretation of Published Statements
Capital Structuring and sourcing of Long Term Funds
Working Capital
Capital Budget:

UNIT 4 Financial Management-II **10 Hrs.**

Appraisal of Capital Expenditure Proposals
Internal Financing
Investment Management
Forecasting & Planning

Max. 40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – **Identify**the uses and needs of financial statements & their relationship

CO2 – **Identify** how strategic planning determines the path organisation chooses for attaining its long term goal

CO3 – **Explain** the role that budgeting plays in overall planning and evaluation of performance of an organisation

CO4 – **Analyses** the performance against the operational goal using revenues and cost of various centres

CO5 – **Calculate** product line; business line & customer line profitability for overall profit planning of an organisation

CO6 – **Understand** the importance of KPI & its role in evaluating the performance of keys areas of an organisation

TEXT/REFERENCE BOOKS

1. Financial Management by Prasana Chandra TMH
2. Introduction to Management Accounting by Charles Horngren& others –Prentice Hall
3. https://maaw.info/MAAWTextbookMain.htm
4. Reading material of ICAI & ICWA

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A/Question: 4Q X 5marks 20 Marks

Part B/Question: 8 Q X 10 marks 80 Marks

Course Structure for M. Tech. Civil (Transportation Engineering)
(w.e.f. Academic Year July 2021)
Semester III

Sr. No	Course Code	Course Name	Teaching Scheme					Exam Scheme					
			L	T	P	C	Hrs/wk	Theory			Practical		Total
								MS	ES	IA	LW	LE/ Viva	Marks
1		Seminar	--	--	--	5	--	--	--	--	50	50	100
2		Project Phase I	--	--	--	14	--	--	--	--	50	50	100
3		Industrial Training	--	--	--	--	--	--	--	--	--	--	PP/NP
		Total	--	--	--	**19**	--	--	--	--	--	--	**200**

20MCT521T					Seminar					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
			--	--	--	--	--	50	50	100

COURSE OBJECTIVES

- To demonstrate a sound technical knowledge of their selected seminar topic.
- To understand ongoing field work/research work on selected area
- To develop ability to solve complex problems and find engineering solution based on a systematic approach.
- To become updated with all the latest changes in technological world and develop capability and enthusiasm for self-improvement through continuous professional development

Details:

Students need to choose a seminar topic related to the current practices in transportation engineering work can be a planning, design, laboratory of field project on any other related topic. The seminar work can be carried individually and need to prepare seminar report consisting of major learning's. The spiral bound copy of the seminar report will be prepared and submitted to Department through guide. One copy of the report signed by guide and Head of the Department will be submitted to Department library for originality and record. The project work will be reviewed by a committee consisting of minimum 2-faculty members and the guide.

Students in seminar project should give also the novelty of their work.

COURSE OUTCOMES

On completion of the project, student will be able to

CO1 - **Define**the relevance of seminar topic selected for the study with the help of established techniques/principles.

CO2 - **Summarize**the problem statement with the help of literature survey, analytical and documentation skills.

CO3 - **Apply** the data/information gathered for problem.

CO4 - **Analyse** the problems using latest tools/techniques and experimental observations/theoretical modelling through critical investigation.

CO5- **Prepare**a seminar report following all the guidelines set by the institute

CO6- **Present** seminar report properly through accepted tools like PPT.

ASSESSMENT PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A : Mid Semester Review 30 Marks

Part B : End semester Review and thesis submission 50 Marks

(Based on research article submitted in journals/ conference etc.)

Part C: Continuous assessment by guide. 20 Marks

20MCT522P					Project Phase I					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
--	--	--	--	--	--	--	--	50	50	100

COURSE OBJECTIVES

- To demonstrate a sound technical knowledge of their selected project topic.
- To interpret the problems of industry/society and apply engineering knowledge to solve the problem.
- Develop ability to solve complex problems and find engineering solution based on a systematic approach.
- To communicate effectively with industry managers and the community at large in written and oral form.
- Become updated with all the latest changes in technological world and develop capability and enthusiasm for self-improvement through continuous professional development

Details:

Students need to choose a research topic related to the current practices in Transportation Engineering. The broad areas can be urban and rural transport planning, traffic engineering, pavement design and analysis, metro and mono rail construction, airport planning and design.

The student need to choose a guide from the Department and the area / topic of research should be mutually convenient to the student and guide.

The hard bound copy of the thesis will be prepared as per PDPU format and submitted to Department through guide. One copy of the thesis signed by guide and Head of the Department will be submitted to Department library for originality and record. The project & dissertation work will be reviewed by a committee consisting of minimum 2-faculty members for the internal review component and the external review panel would comprise of external examiner, head of department and guide.

COURSE OUTCOMES

On completion of the project, student will be able to

CO1–**Define**the relevance of project topic selected for the study with the help of established techniques/principles.
CO2 –**Summarize**the problem statement with the help of literature survey, analytical and documentation skills.
CO3– **Apply** the data/information gathered for problem to work out the project planning.
CO4–**Analyse** the problems using latest tools/techniques and experimental observations/theoretical modelling through critical investigation.
CO5- **Prepare** a proper project report following all the guidelines set by the institute
CO6- **Present** project report properly through accepted tools like PPT.

ASSESSMENT PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A : Mid Semester Review	30 Marks
Part B : End semester Review and thesis submission (Based on research article submitted in journals/ conference etc.)	50 Marks
Part C: Continuous assessment by guide.	20 Marks

20MCT523P					Industrial Training					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
			--	--	--	--	--	--	--	PP/NP

COURSE OBJECTIVES

- To know the roles and responsibility of a Transportation engineer in construction site/Design company.
- To know the process of contract, tender and selection of project also related government policy and norms.
- To learn the design and analysis of Pavement, Traffic and other components as per field.
- To learn the scheduling of workers, material and equipment requirement for day to day work execution.
- To give exposure to handle different works execution at site and to maintain record.

Details:

The students need to undertake about 6 weeks' project training in any transportation industry organization. The students are expected to learn about the planning, scheduling, construction and maintenance of the transportation engineering projects. The training can be undergone in consulting or contracting organization. At the end of the successful completion of the training, the students need to prepare a comprehensive project training report and have to appear before a panel of jury members comprising of minimum two faculty members.
(Detailed scheme to be provided by Office of the Dean, Faculty of Engineering and Technology)

COURSE OUTCOMES

On completion of the project, student will be able to
CO1–**Define**the relevance of trainingwork area selected for the study.
CO2 –**Understand**the role and responsibility of a transportation engineering at construction site.
CO3–**Analyse** the various transportation engineering components as per site requirement.
CO4– **Apply** the knowledge in execution of work in a systematic manner
CO5- **Prepare**schedule of workers, material and equipment requirement for day to day work execution.
CO6- **Practice** the acquired knowledge, skills and attitudes for becoming a professional engineer

ASSESSMENT PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**
Part A : Training report 50 Marks
Part B : VIVA 50Marks

Course Structure for M. Tech. Civil (Transportation Engineering)
(w.e.f. Academic Year July 2021)
Semester IV

Sr. No	Course Code	Course Name	Teaching Scheme					Exam Scheme					
			L	T	P	C	Hrs/wk	Theory			Practical		Total
								MS	ES	IA	LW	LE/ Viva	Marks
1		Seminar	--	--	--	5	--	--	--	--	50	50	100
2		Project Phase II & Dissertation	--	--	--	24	--	--	--	--	--	100	100
		Total	--	--	--	**29**	--	--	--	--	--	--	**200**

20MCT531T					Seminar					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
			--	--	--	--	--	50	50	100

COURSE OBJECTIVES

- To demonstrate a sound technical knowledge of their selected seminar topic.
- To understand ongoing field work/research work on selected area
- To develop ability to solve complex problems and find engineering solution based on a systematic approach.
- To become updated with all the latest changes in technological world and develop capability and enthusiasm for self-improvement through continuous professional development

Details:

Each student is required to choose a topic of his interest from Transportation Engineering. This topic may be from syllabus or out of syllabus provided faculty has agreed to guide the same. They will prepare a presentation on the chosen topic for about 30-45 minutes and their work will be assessed by a jury consisting of minimum 2-faculty members belonging to the respective areas of research. Internal assessment marks are awarded based on the relevance of the topic, presentation skills, quality of the report, participation of the students, and innovative ideas emerged from the work.

COURSE OUTCOMES

On completion of the project, student will be able to

CO1–**Define**the relevance of seminar topic selected for the study with the help of established techniques/principles.
CO2 –**Summarize**the problem statement with the help of literature survey, analytical and documentation skills.
CO3– **Apply** the data/information gathered for problem.
CO4–**Analyse**the problems using latest tools/techniques and experimental observations/theoretical modelling through critical investigation.
CO5- **Prepare** seminar report following all the guidelines set by the institute
CO6- **Present** seminar report properly through accepted tools like PPT.

ASSESSMENT PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A : Mid Semester Review	30 Marks
Part B : End semester Review and thesis submission (Based on research article submitted in journals/ conference etc.)	50 Marks
Part C: Continuous assessment by guide.	20 Marks

20MCT532T					Project Phase II &Dissertation					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
			--	--	--	--	--	--	--	100

COURSE OBJECTIVES

- To demonstrate a sound technical knowledge of their selected project topic.
- To interpret the problems of industry/society and apply engineering knowledge to solve the problem.
- Develop ability to solve complex problems and find engineering solution based on a systematic approach.
- To communicate effectively with industry managers and the community at large in written and oral form.

Details:

Students need to choose a research topic related to the current practices in Transportation Engineering. The broad areas can be urban and rural transport planning, traffic engineering, pavement design and analysis, metro and mono rail construction, airport planning and design.

The student needs to choose a guide from the Department and the area / topic of research should be mutually convenient to the student and guide.

The hard-bound copy of the thesis will be prepared as per PDPU format and submitted to Department through guide. One copy of the thesis signed by guide and Head of the Department will be submitted to Department library for originality and record. The project & dissertation work will be reviewed by a committee consisting of minimum 2-faculty members for the internal review component and the external review panel would comprise of external examiner, head of department and guide.

COURSE OUTCOMES

On completion of the project, student will be able to
CO1–**Define** the relevance of project topic selected for the study with the help of established techniques/principles.
CO2–**Summarize**the problem statement with the help of literature survey, analytical and documentation skills.
CO3– **Apply** the data/information gathered for problem to work out the project planning.
CO4–**Analyse** and solve the problems using latest tools/techniques and experimental observations/theoretical modelling through critical investigation.
CO5- **Prepare** a proper project report following all the guidelines set by the institute
CO6- **Present** project report properly through accepted tools like PPT.

ASSESSMENT PATTERN

Max. Marks: 100	**Exam Duration: 3 Hrs**
Part A : Mid Semester Review	30 Marks
Part B : End semester Review and thesis submission (Based on research article submitted in journals/ conference etc.)	50 Marks
Part C: Continuous assessment by guide.	20 Marks