DEPARTMENT OF CIVIL ENGINEERING

ANNA UNIVERSITY, CHENNAI

OUR VISION:

Department of Civil Engineering, Anna University, shall strive hard to develop and impart technical knowledge and professional skills required for Civil Engineering practice through excellence in teaching, research and consultancy to address sustainable infrastructure development needs at local, national and International levels.

OUR MISSION:

Department of Civil Engineering, Anna University shall contribute to technological and social development by

1. Providing a firm scientific and technological base in Civil Engineering to achieve self-reliance.
2. Providing quality education through innovation in teaching practices at par with global standards.
3. Nurturing leadership and entrepreneurship qualities with ethical values.
4. Developing and disseminating latest knowledge and technologies in emerging areas of Civil Engineering.
5. Sharing intellectual resources and infrastructure facilities through collaborative partnership.
6. Ensuring supporting conditions for enhancing the employability skills.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

ANNA UNIVERSITY, CHENNAI

UNIVERSITY DEPARTMENTS

REGULATIONS – 2019

CHOICE BASED CREDIT SYSTEM

M. E. TRANSPORTATION ENGINEERING

1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs) :

Graduates of the programme M E Transportation Engineering will

PEO1	Gain knowledge and skills in Traffic, Transportation Planning and Pavement engineering which will enable them to have a career and professional accomplishment in the public or private sector organizations
PEO2	To enable the students to have a strong analytical and practical knowledge of planning, designing and solving transportation problems.
PEO3	To introduce recent advancements in the fields of Sustainable Urban Development, Traffic Engineering and Management, Transport Planning, Highway Design and Construction and Economic and Environmental Evaluation of Transport Projects
PEO4	To inculcate students in professional and effective communication skills, teamwork skills and ethical and societal responsibility in students.
PEO5	To prepare students to excel in research and to succeed in Transportation Engineering profession through rigorous and global post graduate education.

2. PROGRAMME OUTCOMES (POs):

On successful completion of the two year programme, the graduates will exhibit ability to

PO#	Graduate Attribute	Programme Outcome
PO1	Engineering knowledge	Demonstrate knowledge of mathematics, science and engineering
PO2	Problem analysis	Demonstrate an ability to identify, formulate and solve engineering problems.
PO3	Design/development of solutions	Demonstrate an ability to design and conduct experiments, analyze and interpret data.
PO4	Conduct investigations of complex problems	The students will be able to analyze complex problems and investigate Transport and Highway problems by directly assessing the field conditions through surveys and field testing.
PO5	Modern tool usage	Demonstrate and apply appropriate techniques, resources, and modern engineering tools in Transportation and Highway Design such as CAD, GIS and ITS including prediction and modeling with an understanding of the limitations.
PO6	The Engineer and society	Graduate will analyze complex Transportation Engineering problems critically; apply independent judgment for synthesizing information to make intellectual and/or creative advances for conducting research in a wider theoretical, practical and policy context.
PO7	Environment and sustainability	Graduates will gain an in depth knowledge on the environmental issues and socio economic impacts of developing a sustainable Transport, Land use and Highway infrastructure.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

PO8	Ethics	The concept of maintaining the ethics in both planning and design as well as commitment to improve knowledge and competence continuously in the field will be imparted to the graduates.
PO9	Individual and team work	Function in a multi-disciplinary team
PO10	Communication	Proficiency in oral and written Communication.
PO11	Project management and Finance	Implement cost effective and improved system in management of Transportation and Highway related projects.
PO12	Life-long learning	Continue professional development and learning as a life-long activity.

3. PROGRAM SPECIFIC OUTCOMES (PSOs): Minimum Two

By the completion of the Transportation Engineering program the students will have following Program Specific Outcomes.

PSO1	Knowledge in Urban Development, Traffic, Transportation, and Pavement Engineering	Demonstrate in-depth knowledge in the applications of Transportation and Highway Projects dealing with Planning, Design, Evaluation and Modeling
PSO2	Critical analysis of design of various Transport and pavement Infrastructures and Management.	Critically analyze complex transportation problems in developing a sustainable transportation and applying the basic tools of Mathematical modeling that gives a firm grasp of the mathematical theory necessary to understand and build such models.
PSO3	Conceptualization and evaluation of Innovative engineering solutions to Transportation related issues.	Students will be able to design and develop appropriate analytical solutions and strategies for new innovative technologies that incorporate information and Communication Technologies into the transport sector that helps to resolve the problems integrating Transport and Landuse development.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

4. PEO / PO Mapping:

Programme Educational Objectives	Programme Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
I	✓	✓		✓			✓		✓		✓	
II				✓	✓	✓						
III						✓		✓			✓	
IV				✓					✓	✓		✓
V		✓			✓			✓			✓	✓

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

MAPPING OF COURSE OUTCOME AND PROGRAMME OUTCOME

		COURSE NAME	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
YEAR I	SEMESTER I	Probability and Statistical Methods															
		Traffic Engineering Design and Management	H	H	H	H	M	M	L	M	M	M	L	M	H	M	M
		Urban and Regional Planning	M	H	M	M	M	H	H	M	M	M	L	M	H	M	M
		Pavement Materials and Construction	H	H	H	H	M	H	M	M	M	M	L	M	H	M	M
		Program Elective I															
		Traffic Surveys and Analysis Lab	H	H	H	H	H	H	M	M	M	M	M	H	H	H	H
		Pavement Materials Laboratory	H	H	H	H	H	H	M	M	M	M	M	H	H	H	H
		Research Methodology and IPR															
		Audit Course – I															
	SEMESTER II	Transportation System Planning	H	H	H	H	H	M	L	M	M	M	L	M	H	M	M
		Pavement Analysis Design and Evaluation	H	H	H	H	H	M	L	M	M	M	M	M	H	H	M
		Transportation Economics	M	H	M	H	M	M	M	M	M	M	M	M	H	M	M
		Program Elective II															
		Program Elective III															
		Design Studio	H	H	H	H	H	H	M	M	M	M	M	H	H	H	H
		Seminar	H	-	M	M	-	H	H	-	-	M	-	M	H	-	H
		Audit Course –II															
YEAR II	SEMESTER III	Mass Transit System Planning	H	H	H	H	M	M	L	M	M	M	L	M	H	M	M
		Program Elective IV															
		Program Elective V															
		Open Elective															
		Practical Training (4 weeks)	M	H	H	M	M	M	M	L	M	L	M	M	H	M	M
		Project Phase I	M	H	H	H	H	L	M	L	L	L	M	H	M	M	H
	SEMESTER IV	Project Phase II	M	H	H	M	H	M	M	M	L	L	M	M	H	H	M

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

ANNA UNIVERSITY, CHENNAI

UNIVERSITY DEPARTMENTS

M.E. TRANSPORTATION ENGINEERING
REGULATIONS – 2019
CHOICE BASED CREDIT SYSTEM
CURRICULA AND SYLLABI FOR I TO IV SEMESTERS

SEMESTER I

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	MA5156	Probability and Statistical Methods	FC	3	1	0	4	4
2.	TE5101	Traffic Engineering Design and Management	PCC	3	0	0	3	3
3.	TE5102	Pavement Materials and Construction	PCC	3	0	0	3	3
4.	TE5103	Urban and Regional Planning	PCC	3	0	0	3	3
5.		Program Elective I	PEC	3	0	0	3	3
6.	RM5151	Research Methodology and IPR	RMC	2	0	0	2	2
7.		Audit Course I*	AC	2	0	0	2	0
PRACTICALS								
8.	TE5111	Pavement Materials Laboratory	PCC	0	0	4	4	2
9.	TE5112	Traffic Survey and Analysis Laboratory	PCC	0	0	4	4	2
			TOTAL	**19**	**1**	**8**	**28**	**22**

***Audit Course is Optional

SEMESTER II

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	TE5201	Transportation System Planning	PCC	3	0	0	3	3
2.	TE5202	Transportation Economics	PCC	3	0	0	3	3
3.	TE5203	Pavement Analysis Design and Evaluation	PCC	3	0	0	3	3
4.		Program Elective II	PEC	3	0	0	3	3
5.		Program Elective III	PEC	3	0	0	3	3
6.		Audit Course II*	AC	2	0	0	2	0
PRACTICALS								
7.	TE5211	Design Studio	PCC	0	0	4	4	2
8.	TE5212	Seminar	EEC	0	0	2	2	1
			TOTAL	**17**	**0**	**6**	**23**	**18**

* Audit Course is Optional

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

SEMESTER III

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	TE5301	Mass Transit System Planning	PCC	3	0	0	3	3
2.		Program Elective IV	PEC	3	0	0	3	3
3.		Program Elective V	PEC	3	0	0	3	3
4.		Open Elective	OEC	3	0	0	3	3
PRACTICALS								
5.	TE5311	Practical Training (4 Weeks)	EEC	0	0	0	0	2
6.	TE5312	Project Phase I	EEC	0	0	12	12	6
			TOTAL	**12**	**0**	**12**	**24**	**20**

SEMESTER IV

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
PRACTICALS								
1.	TE5411	Project Phase II	EEC	0	0	24	24	12
			TOTAL	**0**	**0**	**24**	**24**	**12**

TOTAL CREDITS TO BE EARNED FOR AWARD OF THE DEGREE: 72

FOUNDATION COURSES (FC)

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	SEMESTER
				L	T	P			
1.	MA5156	Probability and Statistical Methods	FC	3	1	0	4	4	1
							TOTAL CREDITS	**4**	

PROFESSIONAL CORE COURSES (PCC)

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	SEMESTER
				L	T	P			
1.	TE5101	Traffic Engineering Design and Management	PCC	3	0	0	3	3	1
2.	TE5102	Pavement Materials and Construction	PCC	3	0	0	3	3	1
3.	TE5103	Urban and Regional Planning	PCC	3	0	0	3	3	1
4.	TE5111	Pavement Materials Laboratory	PCC	0	0	4	4	2	1

5.	TE5112	Traffic Surveys and Analysis Laboratory	PCC	0	0	4	4	2	1
6.	TE5211	Design Studio	PCC	0	0	4	4	2	2
7.	TE5201	Transportation System Planning	PCC	3	0	0	3	3	2
8.	TE5202	Transportation Economics	PCC	3	0	0	3	3	2
9.	TE5203	Pavement Analysis Design and Evaluation	PCC	3	0	0	3	3	2
10.	TE5301	Mass Transit System Planning	PCC	3	0	0	3	3	3
							TOTAL CREDITS	**27**	

PROGRAM ELECTIVE COURSES (PEC)

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	GROUP
				L	T	P			
1.	TE5001	Basic Transport Infrastructure Design	PEC	3	0	0	3	3	1
2.	TE5002	Waterways Transportation System– Planning and Design	PEC	3	0	0	3	3	1
3.	TE5003	Rail Transportation Systems – Planning and Design	PEC	3	0	0	3	3	1
4.	TE5004	Airport System Planning and Design	PEC	3	0	0	3	3	1
5.	TE5005	Geospatial Techniques	PEC	3	0	0	3	3	1
6.	TE5006	Dynamic Simulation Modeling for Sustainable Transportation and Management	PEC	3	0	0	3	3	2
7.	TE5007	Computational Techniques in Transportation Engineering	PEC	3	0	0	3	3	2
8.	TE5008	Sustainable Urban and Transport Planning	PEC	3	0	0	3	3	2
9.	TE5009	Analytical Techniques in Transportation Engineering	PEC	3	0	0	3	3	2
10.	TE5010	Road Safety System	PEC	3	0	0	3	3	2
11.	TE5011	Traffic Flow Theory	PEC	3	0	0	3	3	2
12.	TE5012	Intelligent Transportation Systems	PEC	3	0	0	3	3	3
13.	TE5013	Advanced System Dynamics Modeling in Transportation Engineering	PEC	3	0	0	3	3	3

14.	TE5014	Pavement Management System	PEC	3	0	0	3	3	3
15.	TE5015	Environmental Impact Assessment of Transportation Projects	PEC	3	0	0	3	3	3
16.	TE5016	Urban Infrastructure and Asset Management.	PEC	3	0	0	3	3	3
17.	TE5017	Logistics in Transportation Engineering	PEC	3	0	0	3	3	3

RESEARCH METHODOLOGY AND IPR COURSES (RMC)

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.	RM5151	Research Methodology and IPR	2	0	0	2	1
					TOTAL CREDITS	**2**	

OPEN ELECTIVE COURSES [OEC]

*(Out of 6 Courses one Course must be selected)

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.	OE5091	Business Data Analytics	3	0	0	3	3
2.	OE5092	Industrial Safety	3	0	0	3	3
3.	OE5093	Operations Research	3	0	0	3	3
4.	OE5094	Cost Management of Engineering Projects	3	0	0	3	3
5.	OE5095	Composite Materials	3	0	0	3	3
6.	OE5096	Waste to Energy	3	0	0	3	3

AUDIT COURSES (AC)

Registration for any of these courses is optional to students

SL. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.	AX5091	English for Research Paper Writing	2	0	0	0	1/2
2.	AX5092	Disaster Management	2	0	0	0	
3.	AX5093	Sanskrit for Technical Knowledge	2	0	0	0	
4.	AX5094	Value Education	2	0	0	0	
5.	AX5095	Constitution of India	2	0	0	0	
6.	AX5096	Pedagogy Studies	2	0	0	0	
7.	AX5097	Stress Management by Yoga	2	0	0	0	
8.	AX5098	Personality Development Through Life Enlightenment Skills	2	0	0	0	
9.	AX5099	Unnat Bharat Abhiyan	2	0	0	0	
					TOTAL CREDITS	**0**	

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.	TE5212	Seminar	EEC	0	0	2	2
2.	TE5311	Practical Training (4 weeks)	EEC	0	0	0	0
3.	TE5312	Project Phase I	EEC	0	0	12	12
4.	TE5411	Project Phase II	EEC	0	0	24	24
					TOTAL CREDITS	**21**	

SUMMARY

	Name of the Programme: M. E. TRANSPORTATION ENGINEERING					
	SUBJECT AREA	CREDITS PER SEMESTER				CREDITS TOTAL
		I	II	III	IV	
1.	FC	04	00	00	00	04
2.	PCC	13	11	03	00	27
3.	PEC	03	06	06	00	15
4.	RMC	02	00	00	00	02
5.	OEC	00	00	03	00	03
6.	EEC	00	01	08	12	21
7.	Non Credit / Audit Course	✓	✓	00	00	
8.	**TOTAL CREDIT**	**22**	**18**	**20**	**12**	**72**

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

MA5156 PROBABILITY AND STATISTICAL METHODS L T P C
3 1 0 4

OBJECTIVES:

- This course provides a sound and rigorous treatment of the basic principles for a proper understanding of the subject matter and for confidence in applying these principles to practical problem solving
- This course provides a solid undergraduate foundation in both probability theory and mathematical statistics and at the same time provides an indication of the relevance and importance of the theory in solving problems in the real world
- To introduce the basic concepts of one dimensional and two dimensional Random Variables
- To provide information about Estimation theory, Correlation, Regression and Testing of hypothesis
- To enable the students to use the concepts of multivariate normal distribution and principal components analysis

UNIT I ONE DIMENSIONAL RANDOM VARIABLES 12

Random variables - Probability function – Moments – Moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Functions of a Random Variable.

UNIT II TWO DIMENSIONAL RANDOM VARIABLES 12

Joint distributions – Marginal and Conditional distributions – Functions of two dimensional random variables – Regression Curve – Correlation.

UNIT III ESTIMATION THEORY 12

Unbiased Estimators – Method of Moments – Maximum Likelihood Estimation - Curve fitting by Principle of least squares – Regression Lines.

UNIT IV TESTING OF HYPOTHESES 12

Sampling distributions - Type I and Type II errors - Tests based on Normal, t, Chi-Square and F distributions for testing of mean, variance and proportions – Tests for Independence of attributes and Goodness of fit.

UNIT V MULTIVARIATE ANALYSIS 12

Random Vectors and Matrices - Mean vectors and Covariance matrices - Multivariate Normal density and its properties - Principal components: Population principal components – Principal components from standardized variables.

TOTAL: 60 PERIODS

OUTCOMES:

At the end of the course, students will be able to

- Use the appropriate and relevant, fundamental and applied mathematical and statistics knowledge and methodologies in solving practical problem.
- Bring together and flexibly apply knowledge to characterize, analyse and solve a wide range of problems.
- Understand the balance between the complexity/accuracy of the mathematical/statistical models used and the timeliness of the delivery of the solution.
- Steeped in research methods and rigor.
- Develop critical thinking based on empirical evidence and the scientific approach to knowledge development.

REFERENCES:

1. Dallas E Johnson , “Applied multivariate methods for data analysis”, Thomson and Duxbury press, Singapore, 1998.
2. Gupta S.C. and Kapoor V.K. “Fundamentals of Mathematical Statistics”, Sultan and Sons, 11th Edition, Reprint, New Delhi, 2019.

3. Jay L. Devore, “Probability and statistics for Engineering and Sciences”, Thomson and Duxbury, 9th Edition, Singapore, Boston, 2016.
4. Krishnaiah K. and Shahabudeen P, “Applied Design of Experiments and Taguchi Methods”, PHI, New Delhi, 2012.
5. Richard A. Johnson and Dean W. Wichern, “Applied Multivariate Statistical Analysis”, Pearson Education, Fifth Edition, 6th Edition, New Delhi, 2013.
6. Richard Johnson. ”Miller & Freund‟s Probability and Statistics for Engineer”, Prentice Hall of India Private Ltd., 8th Edition, New Delhi, 2011.

TE5101 TRAFFIC ENGINEERING DESIGN AND MANAGEMENT L T P C
3 0 0 3

OBJECTIVE:

- To be aware of various methods of collecting traffic data.
- To understand the basics of highway planning and design, and workout problems in design of road geometrics.
- Provides a basic understanding on Traffic Engineering – Planning, Design, Operation and Management

UNIT I TRAFFIC CHARACTERISTICS 9

Road User Characteristics- Physical, Physiological, Psychological, Environmental Characteristics, Traffic Stream Characteristics, Vehicle Characteristics – Static and Dynamic, Urban Road and Road Characteristics – Geometric Design- Overview.

UNIT II SURVEYS AND STUDIES IN TRAFFIC ENGINEERING 9

Conventional and Modern Methods of Traffic Survey and Studies – Volume and Capacity – LOS for uninterrupted traffic flow – Headway concepts and applications – Speed and Delay – Origin and Destination, Parking, Accidents.

UNIT III DESIGN OF TRANSPORT INFRASTRUCTURE 9

Design of roads – Design Speed, Terrain, Gradient curves – Horizontal and Vertical, Superelevation, Sight Distance – Stopping Sight Distance, Overtaking Sight Distance, Curves Horizontal and Vertical, Superelevation - Gradients - Traffic Signs Traffic Signs, Road Markings, Traffic Control Aids, Street furniture, Road Arboriculture. Road Safety Audit

UNIT IV INTERSECTION DESIGN AND ANALYSIS 9

Design of Intersections – At grade intersection – Uncontrolled, Channelization, Rotary, Traffic Signal Control, Signal Co-ordination, Grade Separated Interchanges - Types , Design and Analysis.

UNIT V TRAFFIC OPERATION AND MANAGEMENT 9

Traffic Regulation, Cost Effective Management Measures – Traffic System Management and Travel Demand Management - Congestion Management, Traffic Calming and Pricing-Design of Cycle Tracks, Pedestrian Facilities, Parking Facilities – On Street and Off Street Multi level car Parking - Street Lighting.

TOTAL: 45 PERIODS

OUTCOME:

CO1	Interpret the fundamentals of traffic characteristics
CO2	Construct the various applications of traffic survey and studies
CO3	Design the geometric elements and infrastructure features
CO4	Design & analyse different types of intersections & interchanges
CO5	Perceive diverse Traffic system management techniques and operations

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

REFERENCES:

1. Kadiyali, L.R., „Traffic Engineering and Transport Planning, Khanna Publishers, Delhi, 2006.
2. Roger.P.Roess, Elena S..Prassas and Willim R.McShane,"Traffic Engineer".Pearson Educayion India, 2013.
3. Wolfgang S. Homburger et.al., „Fundamentals of Traffic Engineering 15th Edition, Institute of Transportation Studies, University of California, Berkely, 2001
4. James L. Pline (Edr)„Traffic Engineering Hand Book, Institute of Transportation Engineers.
5. Nicholas T.Garber, Lester A Hoel, Traffic and Highway Engineering, Revised Second Edition, ITP, California, USA, 1999
6. Thomas Curinan, „An Introduction to Traffic Engineering – A Manual for Data Collection and Analysis, Books Cole, UK, 2001
7. Washington DC, USA, 1999Pignataro, L.J., Traffic Engineering – Theory & Practice, John Wiley, 1985.
8. AASHTO A Policy on Geometric Design of Highway and Streets

CO – PO Mapping - TRAFFIC ENGINEERING DESIGN AND MANAGEMENT							
PO/ PSO		**Course Outcome**					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PROGRAM OUTCOMES (PO)							
PO1	Knowledge of Engineering Sciences	H	M	L	L	L	L
PO2	Problem analysis	L	M	H	H	L	M
PO3	Design / development of solutions	L	L	H	H	H	H
PO4	Investigation	L	L	L	L	M	L
PO5	Modern Tool Usage	L	L	M	M	M	M
PO6	Individual and Team work	L	L	L	M	M	L
PO7	Communication	L	M	L	L	L	L
PO8	Engineer and Society	M	M	M	M	H	M
PO9	Ethics	L	M	M	M	H	H
PO10	Environment and Sustainability	L	L	M	M	M	M
PO11	Project Management and Finance	L	L	L	M	M	M
PO12	Life Long Learning	L	L	M	M	M	M
PROGRAM SPECIFIC OBJECTIVES (PSO)							
PSO1	Knowledge in Urban Development, Traffic, Transportation, and Pavement Engineering	L	L	-	-	-	L
PSO2	Critical analysis of design of various Transport and pavement Infrastructures and Management.	L	L	M	M	M	M
PSO3	Conceptualization and evaluation of Innovative engineering solutions to Transportation related issues.	L	-	M	M	H	M

TE5102 PAVEMENT MATERIALS AND CONSTRUCTION L T P C
3 0 0 3

OBJECTIVE:

- To enable the students to understand the properties and use of various materials and construction
- To focus on the design, and analysis of pavement.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT I SUBGRADE SOIL CHARACTERIZATION 9

Properties of Subgrade soil characterization- Soil Classification– Laboratory and In situ soil testing- Index properties of soils, determination of strength properties of soil for flexible and rigid pavements, suitability of different types of soil for construction of embankment and other pavement layers, Laboratory and field compaction of soil, Soil stabilization- different methods- Use of geosynthetics.

UNIT II MATERIALS FOR FLEXIBLE PAVEMENT 10

Types of aggregates; Sampling of aggregates; testing the properties of aggregates; Bitumen sources and manufacturing ,bituminous binders- emulsion and modified bitumen- Properties,and testing of Binders - Rheological properties of bitumen, Ageing, PAV, RTFOT, SEM, TGA,FTIR;. Use of Alternate Materials in Pavement.

UNIT III MATERIALS FOR RIGID PAVEMENT 9

Cement – grades – chemical composition – hydration of cement – testing – admixtures – fibres - properties and testing of pavement quality concrete – mix design – acceptance criteria

UNIT IV PAVEMENT CONSTRUCTION 10

Earthwork and construction– roadway excavation, embankment construction- Subbase – Construction of gravel and stabilized bases; Base – WBM base, wet mix macadam; Bituminous pavements – preparation & laying of tack coat, bituminous macadam, mixed seal surfacing, bituminous concrete;–Drainage – Estimation of flow, surface drainage, sub-surface drainage systems--different types of drains- Pavement Recycling.

UNIT V HIGHWAY CONSTRUCTION EQUIPMENTS 7

Excavators, graders, vibratory rollers, sensor pavers, computerized asphalt mix plant, plants and trucks for ready mix concrete, slip form paver – working principle, advantages and limitations

TOTAL : 45 PERIODS

OUTCOME

CO1	Knowledge on the Soil characteristics, testing and stabilization Techniques
CO2	Understand the different types of materials used for construction of flexible pavement.
CO3	Understand the different types of materials used for construction of rigid pavement
CO4	Select and apply appropriate design and techniques for construction of pavement layers.
CO5	Understand the types and working principles of equipments used for the construction of pavements

REFERENCES:

1. Khanna, S.K. and Justo C.E.G.and Veeraragavan, A, “Highway Engineering”, New Chand and Brothers, Revised 10th Edition, 2014
2. Yoder and Witczak, Priniciples of Pavement Design, John Wiley and Sons.
3. Prithvi Singh Kandhal, Bituminous Road Construction in India, Prentice Hall of India Publications,2018
4. Alkins and Harold, "Highway Material" , Prentice Hall, Pearson,2003.
5. Kerbs and Walkes, "Highway Materials", McGraw Hill BookCo.2007.
6. Specifications for" Road and Bridge works", Fourth Revision, MoSRT & H (India), 2001.
7. Peurify.R.L., "Construction Planning, Equipment and Methods", McGraw Hill Publishers, New York, 2000.
8. S.C.Sharma., "Construction Equipment and its Management", Khanna Publishers, New Delhi, 1988.
9. Yang H. Huang, "Pavement Analysis and Design", Prentice Hall, NewJersy,1993
10. Concrete Pavement Design, Construction and Performance by Delatte
11. Ralph Haos, "Ronald Hudson and Zaniesuki, Modern Pavement Management", Kneigr Publications, 1994
12. Concrete Pavements, AF Stock, Elsevier, Applied Science Publishers
13. Read, J. And Whiteoak, D., “The Shell Bitumen Handbook”, Fifth edition, Shell Bitumen, Thomas Telford Publishing, London, 2003.
14. Relevant IRC and IS codes and ASTM Standards

CO – PO Mapping - PAVEMENT MATERIALS AND CONSTRUCTION							
PO/PSO		**Course Outcome**					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PROGRAM OUTCOMES (PO)							
PO1	Knowledge of Engineering Sciences	H	H	H		L	H
PO2	Problem analysis		M	M			M
PO3	Design / development of solutions	M	M	M	M	L	M
PO4	Investigation	H	H	H			H
PO5	Modern Tool Usage	M	M	H	H	H	H
PO6	Individual and Team work	L			L	L	L
PO7	Communication					L	L
PO8	Engineer and Society		M	M	M		M
PO9	Ethics	H	H	H	H		H
PO10	Environment and Sustainability	H	H	H			H
PO11	Project Management and Finance				M	M	M
PO12	Life Long Learning		M	M	M		M
PROGRAM SPECIFIC OBJECTIVES (PSO)							
PSO1	Knowledge in Urban Development, Traffic, Transportation , and Pavement Engineering	H	H	H	H	M	H
PSO2	Critical analysis of design of various Transport and pavement Infrastructures and Management.	H	H	H	M	L	H
PSO3	Conceptualization and evaluation of Innovative engineering solutions to Transportation related issues.	H	M	M	M	H	M

TE5103 URBAN AND REGIONAL PLANNING L T P C
3 0 0 3

OBJECTIVES:

- Provides a basic knowledge on Urbanization and its trend.
- Deals with different types of plan, its implementation, regional development and management for sustainable Urban growth.

UNIT I BASIC CONCEPTS POLICIES AND PROGRAMMES 8

Definitions and Concept- Urbanization, Towns, Cities, Metropolis, Megalopolis, Satellite and New towns, CBD, Peri urban areas, Suburban areas, Census Definition, Classification of urban settlements, TOD, National policies, National Urban Transport Policy 2006, National Policy for Urban street vendors 2009- Programme objectives and salient features of Jawaharlal Nehru National Urban Renewal Mission (JNNURM), Urban infrastructure development scheme for small and medium towns (UIDSSMT), Rajiv Awas Yojana (RAY).

UNIT II PLANNING PROCESS 8

Steps in Planning Process- Plans; levels; objectives, content, and data requirement-regional plan, master plan, detail development plan, city development plan, development control regulation, Zoning Regulation, Layout and Building Regulations.

UNIT III SOCIO ECNOMIC AND SPATIAL PLANNING 10

Economic and social concepts in urban and regional planning and their relevance, Economic principals of zoning, Components of sustainable development, Planning for Inclusive development, Compact cities, Quality of life-Form of cities, issues related to inner city fringe areas, and suburban areas, Application of Remote sensing and GIS in Urban and Regional planning.

UNIT IV PROJECT FORMULATION AND EVALUATION 10

Constraints for plan implementation – Industrial, Financial and Legal Constraints, Institutional Arrangements for Urban Development – Financing of Urban Developments - Legislation related to Urban Development. Urban infrastructure projects planning, appraisal, formulation, feasibility and preparation of detailed project report, site planning, layout, road network, and service ducts under the road,

UNIT V URBAN GOVERNANCE AND MANAGEMENT 9

Planning laws; Town and Country planning act: Urban Development authorities Act, Constitutional (74^{th} Amendment) Act 1992- Local bodies, Functions, powers and Interfaces-development of small town and smart cities-case studies

TOTAL: 45 PERIODS

OUTCOMES:

CO1	Basic definitions and knowledge on various Government Policies.
CO2	Understand different types of Plans and Planning process.
CO3	Knowledge on various development strategies.
CO4	Students will be in a position to formulate, appraise and conduct feasibility studies on urban projects.
CO5	Knowledge on various Government Acts.

REFERENCES:

1. CMDA, Second Master Plan for Chennai, Chennai 2008
2. CMDA 2018, “Combined Development Regulation of Building Rules 2018”, CMDA, Chennai.
3. Charles Montgomery, 2013, Happy City – Transforming our lives through Urban Design, British Columbia Arts Council Press, USA.
4. Goel, S.L Urban Development and Management, Deep and Deep publications, New Delhi
5. 2002
6. George Chadwick, "A Systems view of planning", Pergamon press, Oxford 1978
7. Singh V.B, "Revitalised Urban Administration" in India, Kalpaz publication, Delhi 2001
8. Edwin S.Mills and Charles M.Becker, "Studies In Urban Development", A World Bank Publication, 1986
9. Thooyavan. K.R, "Human Settlements – A Planning Guide to Beginners. M.A Publications, Chennai 2005.
10. Tumlin Jeffrey, "Sustainable Transportation Planning Tools for Creating Vibrant Healthy and Resilient Communities", John Wiley And Sons, 2012.

CO – PO Mapping - URBAN AND REGIONAL PLANNING							
PO/ PSO		**Course Outcome**					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PROGRAM OUTCOMES (PO)							
PO1	Knowledge of Engineering Sciences	M		M			M
PO2	Problem analysis	L		H	M	H	M
PO3	Design / development of solutions	H	M	L	H	H	H
PO4	Investigation	M	H	H	H	M	H
PO5	Modern Tool Usage			H	M		M
PO6	Individual and Team work	M	H	M	H		M
PO7	Communication					M	M

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

PO8	Engineer and Society	M	H	H	M	L	M
PO9	Ethics	L	H	H	H	M	H
PO10	Environment and Sustainability	H	M	H	M	H	H
PO11	Project Management and Finance	M		M	H		H
PO12	Life Long Learning	M	M	M	M	M	M
PROGRAM SPECIFIC OBJECTIVES (PSO)							
PSO1	Knowledge in Urban Development, Traffic, Transportation, and Pavement Engineering	H	M	H	H	H	H
PSO2	Critical analysis of design of various Transport and pavement Infrastructures and Management.	H				H	H
PSO3	Conceptualization and evaluation of Innovative engineering solutions to Transportation related issues.	M		M	H		M

RM5151 RESEARCH METHODOLOGY AND IPR L T P C
2 0 0 2

OBJECTIVES:

To impart knowledge and skills required for research and IPR:

- Problem formulation, analysis and solutions.
- Technical paper writing / presentation without violating professional ethics
- Patent drafting and filing patents.

UNIT I RESEARCH PROBLEM FORMULATION 6

Meaning of research problem- Sources of research problem, criteria characteristics of a good research problem, errors in selecting a research problem, scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, necessary instrumentations

UNIT II LITERATURE REVIEW 6

Effective literature studies approaches, analysis, plagiarism, and research ethics.

UNIT III TECHNICALWRITING /PRESENTATION 6

Effective technical writing, how to write report, paper, developing a research proposal, format of research proposal, a presentation and assessment by a review committee.

UNIT IV INTRODUCTION TO INTELLECTUAL PROPERTY RIGHTS (IPR) 6

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT V INTELLECTUAL PROPERTY RIGHTS (IPR) 6

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System, IPR of Biological Systems, Computer Software etc.

Traditional knowledge Case Studies, IPR and IITs.

TOTAL : 30 PERIODS

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

OUTCOMES:

1. Ability to formulate research problem
2. Ability to carry out research analysis
3. Ability to follow research ethics
4. Ability to understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity
5. Ability to understand about IPR and filing patents in R & D.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓										
CO2	✓											
CO3	✓							✓				
CO4	✓				✓							
CO5	✓					✓						✓

REFERENCES:

1. Asimov, "Introduction to Design", Prentice Hall, 1962.
2. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
3. Mayall, "Industrial Design", McGraw Hill, 1992.
4. Niebel, "Product Design", McGraw Hill, 1974.
5. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners" 2010

TE5111 **PAVEMENT MATERIALS LABORATORY** **L T P C**
0 0 4 2

OBJECTIVE:

- To give the students hands on experience on the various testing procedures of pavement materials as per the IRC standards.

I PAVEMENT MATERIAL TESTING

a. **Tests on Aggregates** -.Shape tests- Aggregate Impact Test- Los Angeles Abrasion Test –- Specific Gravity Test and Water Absorption Test-Soundness Test

b. **Tests on Bitumen -** Penetration Test- Ductility Test- Softening point Test- Specific Gravity of Bitumen-Viscosity test. Elastic Recovery Test for Modified Binders.

II BITUMINOUS MIXES- DESIGN AND TESTING

- Marshall Stability Mix Design-Analysis.
- Bitumen Extraction -Centrifuge Extractor

III PAVEMENT EVALUATION – ROUGHNESS AND DISTRESS EVALUATION

- Visual pavement condition survey -, potholes, raveling, edge breaking , cracking, etc.
- Skid resistance measurements.
- Texture Depth.
- MERLIN

TOTAL : 60 PERIODS

OUTCOME:

CO1	Understand the types of materials used in pavement construction and to carry out various laboratory test to investigate their properties in accordance to the specified standards.
CO2	Carry out hands on experience in designing Bituminous mixes and testing.
CO3	Understand the types of distresses, equipments used to measure and evaluating the quality of road surfaces.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

REFERENCES:

1. Highway Material Testing – S K Khanna- C.E.G. Justo , and Veeraraghavan A Nemchand Bros- Rookee, 2010.
2. Relevant IS Codes

CO – PO Mapping - PAVEMENT MATERIALS LABORATORY					
		Course Outcome			
PO / PSO		CO1	CO2	CO3	Overall Correlation of COs to POs
PROGRAM OUTCOMES (PO)					
PO1	Knowledge of Engineering Sciences	H	H	H	H
PO2	Problem analysis	H	H	H	H
PO3	Design / development of solutions	H	H	H	H
PO4	Investigation	H	H	H	H
PO5	Modern Tool Usage	M	M	H	M
PO6	Individual and Team work	M	M	H	M
PO7	Communication	L	L	L	L
PO8	Engineer and Society	H	H	H	H
PO9	Ethics	H	H	H	H
PO10	Environment and Sustainability	H	H	H	H
PO11	Project Management and Finance	M	M	M	M
PO12	Life Long Learning	H	H	H	H
PROGRAM SPECIFIC OBJECTIVES (PSO)					
PSO1	Knowledge in Urban Development, Traffic, Transportation , and Pavement Engineering	H	H	H	H
PSO2	Critical analysis of design of various Transport and pavement Infrastructures and Management.	H	H	H	H
PSO3	Conceptualization and evaluation of Innovative engineering solutions to Transportation related issues.	H	M	M	M

TE5112 **TRAFFIC SURVEYS AND ANALYSIS LABORATORY** **L T P C**
0 0 4 2

OBJECTIVE:

- Provides clear understanding on conducting various types of traffic surveys data collection, analysis, inference and presentation

LIST OF EXERCISES:

Conduct of the following surveys related to Transport Development, Analysis, Inferences and Proposals.

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

TOTAL : 60 PERIODS

OUTCOME:

CO1	Construct survey to measure traffic volume, speed and delay characteristics
CO2	Estimate the parking index & turnover, Inter & intra zone trips, and physical inventory analysis
CO3	Examine the environmental impact of noise level, vehicular emission & Street lighting studies

CO – PO Mapping - TRAFFIC SURVEYS AND ANALYSIS LABORATORY					
		Course Outcome			
PO / PSO		CO1	CO2	CO3	Overall Correlation of COs to POs
PROGRAM OUTCOMES (PO)					
PO1	Knowledge of Engineering Sciences	M	M	M	M
PO2	Problem analysis	M	M	M	M
PO3	Design / development of solutions	L	M	L	L
PO4	Investigation	L	L	L	L
PO5	Modern Tool Usage	H	M	H	H
PO6	Individual and Team work	H	H	H	H
PO7	Communication	M	M	M	M
PO8	Engineer and Society	M	M	H	M
PO9	Ethics	M	M	M	M
PO10	Environment and Sustainability	L	M	H	M
PO11	Project Management and Finance	L	L	L	L
PO12	Life Long Learning	M	M	M	M
PROGRAM SPECIFIC OBJECTIVES (PSO)					
PSO1	Knowledge in Urban Development, Traffic, Transportation, and Pavement Engineering	L	L	L	L
PSO2	Critical analysis of design of various Transport and pavement Infrastructures and Management.	M	M	M	M
PSO3	Conceptualization and evaluation of Innovative engineering solutions to Transportation related issues.	M	M	M	M

TE5201 TRANSPORTATION SYSTEMS PLANNING L T P C
3 0 0 3

OBJECTIVE:

- To impart knowledge in the rudiments and advancements in Transportation Planning and Travel Demand Forecasting

UNIT I TRANSPORTATION SYSTEM STATUS 10

Status of existing Transportation System – Significance in Urban & Rural planning- Systems Approach to Transport Planning – Stages in Transportation Planning – Transport Systems and Planning Considerations -Concepts of Zoning – Inventory of Transport and other activities – Surveys -Planning Policies at National and other levels.

UNIT II TRIP END & TRIP INTERCHANGE MODELS 9

Travel Behavior- Travel Demand Estimation and Modeling-- Trip Generation Models - Category analysis –Different Types of Trip End and trip Interchange models- Sequential Modeling Process.

UNIT III MODE CHOICE MODELS 8

Modal Split and Types of Mode Choice Models – Probabilistic models – Utility Functions – Logit Probit and Nested Models..

UNIT IV TRIP ASSIGNMENT MODELS 8

Traffic Assignment model types – Dynamic Traffic Assignment - Multimodal Transportation Planning -Advancement in four stage modeling - Non-Transportation and Sustainable Solutions to Transportation Problems.

UNIT V LAND USE TRANSPORT(LUT) MODELS 10

Urban Forms - Land Use Effect on Travel Demand – Soil Suitability in Land Use Allocation – Types of Land Use Modeling – Lowery & Garin model and Applications –LUT Conception with Dynamic Simulation Modeling - Case Studies.

TOTAL: 45 PERIODS

OUTCOME:

CO1	Knowledge on basics of Urban Transport Planning with Status of Existing Situations
CO2	Understand the first two stages of conventional transportation modelling
CO3	Modelling methodologies of third stages of conventional transportation planning
CO4	Study on methodologies of the last stage of conventional transportation modelling
CO5	Know the rudiments of land use transport (LUT) modelling & models of developed world & to conduct research pertinent to LUT modelling and to communicate effectively to different stakeholders as well as engage in independent life-long learning

REFERENCES

1. Milan janic (2016), “Transport Systems: Modelling, Planning, and Evaluation”-1st Edition**,** CRC Press Publication, USA.
2. John Black (2018), “Urban Transport Planning: Theory and Practice”- 1st Edition, Routledge Publication, USA.
3. Agostino Nuzzolo & William H. K. Lam (2016), “Modelling Intelligent Multi-Modal Transit Systems”- 1st Edition, CRC Press Publication, USA.
4. Reid Ewing, Keith Bartholomew (2018), “Best Practices in Metropolitan Transportation Planning ”- 1st Edition,Routledge Publication, USA
5. Papacostas C.S., Prevedouros (2015), "Transportation Engineering and Planning, 3rd Edition, Pearson Education India, New Delhi, India.
6. John D.Edwards (Edr.) (1999), "Transportation Planning Hand Book", 2nd Edition, Institute of Transportation Engineers, Prentice Hall Inc., Washington DC, USA.

CO – PO Mapping TRANSPORTATION SYSTEMS PLANNING

PO/ PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PROGRAM OUTCOMES (PO)							
PO1	Knowledge of Engineering Sciences	H	H	H	M	H	H
PO2	Problem analysis		H	M	M	H	H
PO3	Design / development of solutions		H	H	H		H
PO4	Investigation			M	H	M	M
PO5	Modern Tool Usage	H	M	M	H	H	H
PO6	Individual and Team work	H			H	H	H
PO7	Communication	H	M	M	L	H	H
PO8	Engineer and Society	M	M		H	H	H
PO9	Ethics	H	M	H	H	H	H
PO10	Environment and Sustainability	H	M		M	H	M
PO11	Project Management and Finance	M		M	M	H	M
PO12	Life Long Learning	H		M	M	H	H

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

PROGRAM SPECIFIC OBJECTIVES (PSO)							
PSO1	Knowledge in Urban Development, Traffic, Transportation, and Pavement Engineering	H		M	H	H	H
PSO2	Critical analysis of design of various Transport and pavement Infrastructures and Management.	L	H	H	H	M	H
PSO3	Conceptualization and evaluation of Innovative engineering solutions to Transportation related issues.	L		H	H	M	H

TE5202 TRANSPORTATION ECONOMICS L T P C
3 0 0 3

OBJECTIVE:

- Provides knowledge in economic evaluation and Public private partnership in developing road infrastructure projects and application of systems simulation modeling.

UNIT I ECONOMIC EVALUATION 10

Need for Economic Evaluation of Urban Transport Projects – Principles of Economic Analysis – Methods of Economic and Non- Economic Evaluation – Comparison of various methods – Application of Simulation Modeling in evolving suitable evaluation techniques – Sensitivity Analysis.

UNIT II MODELING OF ROAD USER COSTS 10

Components of vehicle operating cost – Factors affecting vehicle operating cost (VOC) – Value of Travel Time Saving - Accident Cost – Case Studies -Simulation Modeling applications.

UNIT III TRANSPORT DEMAND SUPPLY CONCEPT 9

Transport demand and supply concepts - Status of transport demand supply in metropolitan cities – Demand and Supply equilibrium - Subsidy in Transport demand – Supply augmentation and saturation consideration- simulation modeling of transport demand and supply towards sustainability.

UNIT IV TRANSPORT PRICING 8

Transport costs – Elasticity of demand – Average cost and Marginal cost pricing – Market Pricing and Market Segmentation – Second best pricing – Pricing Policy – Congestion Pricing – Dynamic model Conception – Public and Private Transport Pricing – Price Co-ordination- Electronic Road Pricing (ERP).

UNIT V FINANCING TRANSPORT SYSTEM 8

Trends in Financing of Transportation Infrastructure after 1990's-Investment Needs, Options and Budgetary Support in Transport Sector – Existing Financing Practices –Principles of Build, Operate and Transfer (BOT) –BOT variants and its applicability– Special Purpose Vehicles – Risk analysis and management.

TOTAL: 45 PERIODS

OUTCOME:

CO1	Exposure on economic evaluation & methods of evaluation with both traditional and modern tools
CO2	Understand the different types of road user cost and its evaluation using modern tools

CO3	Dynamic Modelling and analysis of transport demand and supply equilibrium & conduct research pertinent to transport economics and to communicate effectively to different stakeholders as well as engage in independent life-long learning
CO4	Concept of transport pricing and its effectiveness in travel demand management
CO5	Understand the principles of financing of transport system with risk analysis.

REFERENCES

1. Stubbs P.C., Tyson W.J & Dalvi M.Q (2018),"Transport Economics"- 1st Edition, Routledge Publication,USA.
2. Sarkar P K., Maitri V.(2010), 'Economics in Highway and Transportation Planning', Standard Publisher, New Delhi, India.
3. Fenelo K.G (2018), "The Economics of Road Transport"- 1st Edition, Routledge Publication,USA.
4. David A. Hensher (2016) "Transport Economics"- 1st Edition,(2016), Routledge Publication, USA.
5. Jonathan Cowie (2009), "The Economics of Transport: A Theoretical and Applied Perspective"- 1st Edition, Routledge Publication,USA.
6. Gwilliam K.M. & Mackie P.J (2018), "Economics and Transport Policy"- 1st Edition, Routledge Publication, USA.

CO – PO Mapping - TRANSPORTATION ECONOMICS							
PO/ PSO		**Course Outcome**					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PROGRAM OUTCOMES (PO)							
PO1	Knowledge of Engineering Sciences	H	M	H	M	H	H
PO2	Problem analysis	H		L	M	L	H
PO3	Design / development of solutions	H	L	H	H		H
PO4	Investigation			M	H	M	M
PO5	Modern Tool Usage	H	M	H	H	L	H
PO6	Individual and Team work	H	H	H	H	H	H
PO7	Communication	L			L	L	L
PO8	Engineer and Society	H	M		H	H	H
PO9	Ethics	H	M	H	H	H	H
PO10	Environment and Sustainability	H	M	H	M	H	H
PO11	Project Management and Finance	M	H	M	H	H	H
PO12	Life Long Learning	H	M	M	H	H	H
PROGRAM SPECIFIC OBJECTIVES (PSO)							
PSO1	Knowledge in Urban Development, Traffic, Transportation, and Pavement Engineering	H	H	H	H	H	H
PSO2	Critical analysis of design of various Transport and pavement Infrastructures and Management.	H	H	H	H	M	H
PSO3	Conceptualization and evaluation of Innovative engineering solutions to Transportation related issues.	H	H	H	H	M	H

TE5203 PAVEMENT ANALYSIS DESIGN AND EVALUATION L T P C
3 0 0 3

OBJECTIVE:

- To impart knowledge to students on various procedures on analysis, design and evaluation of pavement.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT I SUBGRADE ASSESSEMENT 9

Types of pavements- Comparison of flexible and rigid pavements – functions and significance of subgrade properties, various methods of assessment of subgrade soil strength for pavement design - factors affecting design and performance of pavements

UNIT II ANALYSIS OF FLEXIBLE PAVEMENTS 9

Stresses and deflections in homogeneous masses – Burmister's two layer, three layer and multi-layer theories – wheel load stresses – ESWL of multiple wheels – repeated loads and EWL factors – sustained loads and pavement behaviour under traffic loads

UNIT III FLEXIBLE PAVEMENTS DESIGN METHODS 9

Principle, design steps, advantages and applications of different pavement design methods – Group Index, CBR, McLeod, Kansas triaxial test, IRC and Asphalt Institute methods

UNIT IV ANALYSIS AND DESIGN OF RIGID PAVEMENTS 9

Stresses and deflections in rigid pavements – Westergaard's analysis, Bradbury's coefficients, IRC design charts – wheel load stress, warping stress, frictional stress and combination of stresses – types of joints – Design of slab and joints – IRC method of design

UNIT V EVALUATION AND MAINTENANCE 9

Distresses in flexible and rigid pavements – structural and surface condition evaluation techniques – maintenance strategies - pavement performance prediction concepts and models – design of overlays.

TOTAL: 45 PERIODS

OUTCOMES

CO1	Apply the knowledge of science and engineering fundamentals in developing an efficient pavement design concepts.
CO2	Explain concepts and analysis of various stresses in pavements.
CO3	Designing various types of flexible pavements to meet specified needs of safety, efficiency by adopting various design standards.
CO4	Designing various types of pavements by adopting various design standards.
CO5	conduct research pertinent to pavement, evaluation and management and to communicate effectively to different stakeholders as well as engage in independent life-long learning

REFERENCES:

1. Yoder,E.J and Witezak, Principles of Pavement Design, John Wiley and Sons, 1975
2. Yang H. Huang, Pavement Analysis and Design, Prentice Hall, New Jersy,1993
3. IRC 37-2001, Guidelines for the Design of flexible Pavements, Indian Roads Congress
4. IRC 58-2002, Guidelines for the Design of Plain Jointed Rigid Pavements for Highways, Indian Roads Congress

CO – PO Mapping PAVEMENT ANALYSIS, DESIGN AND EVALUATION							
PO/ PSO		**Course Outcome**					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PROGRAM OUTCOMES (PO)							
PO1	Knowledge of Engineering Sciences	H	H	H	M		H
PO2	Problem analysis		H	H	H	L	H
PO3	Design / development of solutions	L	H	H	H		H
PO4	Investigation	H	H	H	H		H
PO5	Modern Tool Usage	M	M	M	H	H	M
PO6	Individual and Team work					L	L
PO7	Communication				L	L	L

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

PO8	Engineer and Society	M	M		H	H	H
PO9	Ethics	H	H	H	H		H
PO10	Environment and Sustainability	M			H	H	H
PO11	Project Management and Finance			M	M	H	M
PO12	Life Long Learning	M		M	M	M	M
PROGRAM SPECIFIC OBJECTIVES (PSO)							
PSO1	Knowledge in Urban Development, Traffic, Transportation, and Pavement Engineering	H		H	H	M	H
PSO2	Critical analysis of design of various Transport and pavement Infrastructures and Management.	M	H	M	H		M
PSO3	Conceptualization and evaluation of Innovative engineering solutions to Transportation related issues.			H	H	H	H

TE5211 **DESIGN STUDIO** **L T P C**
0 0 4 2

OBJECTIVE:

- Students would gain a hands on experience to solve a complete real time Traffic and Highway Project.
- Helps in Design, Analysis and Evaluate Transportation and Highway Projects.

COURSE CONTENT

I Traffic Projects

1. Traffic signal design using TRANSYT or Road alignment design using MxRoad.
2. Small Area Transport Planning using CUBE - Travel demand modeling with Trip Generation, Trip Distribution, Trip Assignment and Trip Assignment.

II Highway Projects

1. Preparation of DPR for Highway Projects.
2. Cost Estimation analysis of Highway and Pavement Projects

TOTAL : 60 PERIODS

OUTCOME:

CO1	Apply various Transportation software tools and their application in solving transportation problems on a real time basis
CO2	Understand and apply software programs for arriving solutions to various practical design problems in Transportation Engineering
CO3	Apply and analyse various plans and design various highway projects and evaluate their economical analysis

CO – PO Mapping - DESIGN STUDIO					
		Course Outcome			
PO / PSO		CO1	CO2	CO3	Overall Correlation of COs to POs
PROGRAM OUTCOMES (PO)					
PO1	Knowledge of Engineering Sciences	M	H	M	M
PO2	Problem analysis	H	H	M	H
PO3	Design / development of solutions	H	H	M	H

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

PO4	Investigation	M	H	H	H
PO5	Modern Tool Usage	H	H	M	H
PO6	Individual and Team work			M	M
PO7	Communication			H	H
PO8	Engineer and Society	H		M	M
PO9	Ethics	H		M	M
PO10	Environment and Sustainability			L	L
PO11	Project Management and Finance		M	L	L
PO12	Life Long Learning	H	H	H	H
PROGRAM SPECIFIC OBJECTIVES (PSO)					
PSO1	Knowledge in Urban Development, Traffic, Transportation, and Pavement Engineering	H	H	H	H
PSO2	Critical analysis of design of various Transport and pavement Infrastructures and Management.	H	H	H	H
PSO3	Conceptualization and evaluation of Innovative engineering solutions to Transportation related issues.	H	M	H	H

TE5212 **SEMINAR** **L T P C**
0 0 2 1

OBJECTIVES:

- To work on a specific technical topic in Transportation Engineering in order to acquire the skills of oral presentation.
- To acquire technical writing abilities for seminars and conferences.

TOTAL : 30 PERIODS

SYLLABUS CONTENT

The students will work for two hours per week guided by a group of faculty members. They will be asked to select on any topic of their choice related to transportation engineering. Students are asked to submit the brief report of their seminar topic. Similarly, the students will have to present a seminar of not less than fifteen minutes and not more than thirty minutes on the technical topic. They will also answer the queries on the topic. The students as audience also should interact. Evaluation will be based on the technical presentation and the report and also on the interaction during the seminar.

OUTCOME:

CO1	Identify various innovative and latest advancements in the transportation field through research studies.
CO2	Improve their communication skills and Understand the art of writing research work through analysis of a specific topic in the related field.
CO3	Learn to make good presentation and explain a concept.

TE5301 **MASS TRANSIT SYSTEM PLANNING** **L T P C**
3 0 0 3

OBJECTIVE:

- To identify the role of various modes of Mass Transportation like Bus and Rail and its Planning and Management

UNIT I TRANSIT SYSTEM AND ISSUES 6

Introduction to Mass Transport – Role of various modes of Mass Transport – Problems and their Impact – Transport System Performance at National, State and International levels – Public Transport and Urban Development Strategies -National Transport Policy.

UNIT II PUBLIC TRANSIT SYSTEM 9

Urban Transport System – Public Transport System Re-genesis and Technology – Physical performance of Public Transport System – Characteristics of Rail Transit – Vehicle Characteristics –Ridership Estimation- Route Planning.

UNIT III BUS TRANSIT PLANNING AND SCHEDULING 10

Route Planning and Scheduling – Bus Transport System – Performance and Evaluation – Scheduling Conceptual patterns of bus service – Network Planning and Analysis – Bus Transport System Pricing – Bus Transit System Integration – Analytical Tools and Techniques for Operation and Management – Bus Rapid Transit Systems – Case Studies

UNIT IV RAIL TRANSIT TERMINALS AND PERFORMANCE EVALUATION 10

Performance Evaluation – Efficiency, Capacity, Productivity and Utilisation – Performance Evaluation Techniques and Application – System Network Performance – Transit Terminal Planning and Design- Urban Rail Transit Planning – MRTS – LRTS, Metro Rail – Monorail – Network Design, Capacity and Traffic Fore casting - Case Studies

UNIT V IMPACT OF TRANSIT 10

Policies and Strategies for Mass Transport – Need for Integrated Approach – Unified Transport Authorities – Institutional arrangement – Urban Transport Fund – Parking Policies - Private Sector in Mass Transport – Multimodal Integration – Last mile connectivity – Transit Oriented Land Use Development – Case Studies

TOTAL: 45 PERIODS

OUTCOME:

CO1	Understand the basic concepts of mass transportation system, development strategies & policies
CO2	Inspect the public transport System performance, ridership & route planning
CO3	Compose bus transit network planning, scheduling, operation & management
CO4	Evaluate the performance of rail transit, construct terminal layout design & capacity forecasting
CO5	Appraise the Institutional arrangements, multimodal transit integration & impact of Transit Oriented Land Use

REFERENCES:

1. Michael J. Bruton , "An Introduction to Transportation Planning",Hutchinson,1985
2. Vukan R Vuchic(2007), " Urban Transit Systems and Technology", John Wiley & sons Inc
3. Vukan R Vuchic(2017), " Urban Transit Operations, Planning and Economics", John Wiley & sons Inc
4. Michael D. Meyer and Eric J.Miller , "Urban Transportation Planning – A Decision Oriented Approach", McGraw Hill Book Company, NewYork,1984
5. Hobbs F.D, "Traffic Planning and Design", Poargamon Oress
6. John W. Dickey, "Metropolitan Transportation Planning" – Tata McGraw Hill Publishing Company Limited, New Delhi,1980
7. Paul H. Wright, "Transportation Engineering – Planning and Design", John Wiley and Sons, New York,1989.

CO – PO Mapping – MASS TRANSIT SYSTEM PLANNING							
PO/ PSO		**Course Outcome**					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PROGRAM OUTCOMES (PO)							
PO1	Knowledge of Engineering Sciences	-	M	M	-	-	M
PO2	Problem analysis	-	L	-	M	-	M

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

PO3	Design / development of solutions	-	-	M	H	M	M
PO4	Investigation	-	L	-	-	M	M
PO5	Modern Tool Usage	-	-	M	M	L	M
PO6	Individual and Team work	-	-	-	-	L	L
PO7	Communication	-	M	M	-	M	M
PO8	Engineer and Society	M	-	M	-	H	M
PO9	Ethics	-	-	-	M	M	M
PO10	Environment and Sustainability	-	-	M	-	M	M
PO11	Project Management and Finance	-	-	H	-	H	H
PO12	Life Long Learning	-	M	-	M	M	M
PROGRAM SPECIFIC OBJECTIVES (PSO)							
PSO1	Knowledge in Urban Development, Traffic, Transportation , and Pavement Engineering	H	M	H	M	H	H
PSO2	Critical analysis of design of various Transport and pavement Infrastructures and Management.	-	-	H	H	M	H
PSO3	Conceptualization and evaluation of Innovative engineering solutions to Transportation related issues.	-	M	-	M	H	M

TE5311 **PRACTICAL TRAINING (4 WEEKS)** **L T P C**
0 0 0 2

OBJECTIVES:

- To train the students in the field work so as to have a firsthand knowledge of practical problems related to Transportation Engineering.
- To develop skills in facing and solving the problems experiencing in the field.

Syllabus Content:

- Students individually undertake training in reputed Companies dealing with traffic and transportation, highway projects, road construction and urban planning during the summer vacation for a specified period of two weeks.
- Students allowed to get field exposure and effectively interact with transport engineers
- At the end of training, a detailed report on the work done should be submitted to the course coordinator
- Students will be evaluated through a viva-voce examination by a team of internal staff.

OUTCOME:

CO1	Understand the various organizations and to have an exposure on projects carried out and understand the real field problem and compare the theoretical knowledge with field
CO2	Develop knowledge in analysing and understand the professional ethics
CO3	Solve Transport related problems in the field either individually or in team

CO – PO Mapping – PRACTICAL TRAINING (4 Weeks)					
PO/ PSO		**Course Outcome**			Overall Correlation of COs to POs
		CO1	CO2	CO3	
PROGRAM OUTCOMES (PO)					
PO1	Knowledge of Engineering Sciences	H	H	H	H
PO2	Problem analysis	H	H	M	H
PO3	Design / development of solutions	H	H	M	H
PO4	Investigation	H	H	M	H
PO5	Modern Tool Usage	H	H	L	H

PO6	Individual and Team work	M	M	M	M
PO7	Communication	H	M	H	H
PO8	Engineer and Society	H	H	M	H
PO9	Ethics	H	H	H	H
PO10	Environment and Sustainability	M	M	M	M
PO11	Project Management and Finance	H	H	M	H
PO12	Life Long Learning	M	H	H	H
PROGRAM SPECIFIC OBJECTIVES (PSO)					
PSO1	Knowledge in Urban Development, Traffic, Transportation, and Pavement Engineering	H	H	H	H
PSO2	Critical analysis of design of various Transport and pavement Infrastructures and Management.	H	H	H	H
PSO3	Conceptualization and evaluation of Innovative engineering solutions to Transportation related issues.	H	M	H	H

TE5312 **PROJECT PHASE I** **L T P C**
0 0 12 6

OBJECTIVES:

- To identify a specific problem for the current need of the society and collecting information related to the same through detailed review of literature.
- To develop the methodology to solve the identified problem.
- To train the students in preparing project reports and to face reviews and viva-voce examination.

SYLLABUS:

The student individually works on a specific topic approved by faculty member who is familiar in this area of interest. The student can select any topic which is relevant to his/her specialization of the programme. The topic may be experimental or analytical or case studies. At the end of the semester, a detailed report on the work done should be submitted which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work. The students will be evaluated through a viva-voce examination by a panel of examiners including one external examiner.

TOTAL: 180 PERIODS

OUTCOME:

- At the end of the course the students will have a clear idea of his/her area of work and they are in a position to carry out the remaining phase II work in a systematic way.

PO/PSO		**Overall Correlation of COs to POs**
PO1	Knowledge of Engineering Sciences	H
PO2	Problem analysis	H
PO3	Design / development of solutions	H
PO4	Investigation	H
PO5	Modern Tool Usage	H
PO6	Individual and Team work	H
PO7	Communication	H
PO8	Engineer and Society	H
PO9	Ethics	L

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

PO10	Environment and Sustainability	H
PO11	Project Management and Finance	M
PO12	Life Long Learning	H
PSO1	Knowledge in Urban Development, Traffic, Transportation , and Pavement Engineering	M
PSO2	Critical analysis of design of various Transport and pavement Infrastructures and Management.	H
PSO3	Conceptualization and evaluation of Innovative engineering solutions to Transportation related issues.	H

TE5411 **PROJECT PHASE II** **L T P C**
0 0 24 12

OBJECTIVES:

- To solve the identified problem based on the formulated methodology.
- To develop skills to analyze and discuss the test results, and make conclusions.

SYLLABUS:

The student should continue the phase I work on the selected topic as per the formulated methodology. At the end of the semester, after completing the work to the satisfaction of the supervisor and review committee, a detailed report should be prepared and submitted to the head of the department. The students will be evaluated through based on the report and the viva-voce examination by a panel of examiners including one external examiner.

TOTAL: 360 PERIODS

OUTCOME:

- On completion of the project work students will be in a position to take up any challenging practical problem and find better solutions.

PO/PSO		Overall Correlation of COs to POs
PO1	Knowledge of Engineering Sciences	H
PO2	Problem analysis	H
PO3	Design / development of solutions	H
PO4	Investigation	M
PO5	Modern Tool Usage	H
PO6	Individual and Team work	M
PO7	Communication	L
PO8	Engineer and Society	H
PO9	Ethics	L
PO10	Environment and Sustainability	H
PO11	Project Management and Finance	H
PO12	Life Long Learning	H
PSO1	Knowledge in Urban Development, Traffic, Transportation , and Pavement Engineering	H
PSO2	Critical analysis of design of various Transport and pavement Infrastructures and Management.	H
PSO3	Conceptualization and evaluation of Innovative engineering solutions to Transportation related issues.	H

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

TE5001 BASIC TRANSPORT INFRASTRUCTURE DESIGN L T P C
3 0 0 3

OBJECTIVE:

- To understand the basics of highway planning, design of road geometrics and intersections
- To design and improve facilities for pedestrian and bicyclist

UNIT I GEOMETRIC DESIGN 10

Elements of Geometric Design, Highway alignment and topography, Cross sectional elements, sight distances- stopping and passing sight distance, Design of horizontal alignment,- curve, tangent, layout and radius, Design of vertical alignment, design controls.

UNIT II DESIGN OF AT GRADE INTERSECTION 9

At grade intersection- Basic forms , factors affecting design, data requirement, conflict points, channelization- its objectives, channelizing device, design consideration,

UNIT III DESIGN OF GRADE SEPARTED INTERSECTION 9

Grade separated Intersection- necessity, types of common interchanges, layout, Interchange design elements, spacing, design of ramps, weaving at interchanges, speed change lanes,

UNIT IV DESIGN OF PEDESTRIAN FACILITIES 9

Planning for pedestrians and their characteristics**,** pedestrian space requirements, and demand, performance measure, LOS**,** design of pedestrian facility- uncontrolled, signalized junction, side walks and cross walk design, pedestrian safely programs

UNIT V PLANNING FOR BICYCLIST 8

Bicycle flow characteristics, performance measure, LOS, bicycle network planning, Integrating cycling into roadway planning, Design of bike ways, bicycle parking and storage facilities, sharing of bicycle

TOTAL : 45 PERIODS

OUTCOME:

CO1	Design the geometric elements for better traffic system.
CO2	Analyze and design uncontrolled and signalized intersection.
CO3	Understand different types of grade separated intersection and their design concept.
CO4	Design and improve the pedestrians traffic flow facilities.
CO5	Plan for facilities for cyclist and improve them.

REFERENCES:

1. Khanna, S.K, Justo C.E.G, Veeraraghavan, A. " Highway Engineering" Nem Chand Brothers, New Delhi, India, 2015
2. Kadhiyali, L.R, and Lal, N.B. "Principles and Practices of Highway Engineering" Khanna Publishers, New Delhi, India 2018
3. Srinivasa kumar, R. "Text book on Highway Engineering", University Press, India 2013
4. AASHTO, "A Policy Note on Geometric Design of Highway and Streets", 2011
5. ITE Handbook, "Highway Engineering Handbook", Mc Graw Hill, 2006
6. CSIR-CRRI, "Indo-HCM", CRRI, New Delhi, 2018.
7. Relevant IRC

CO – PO Mapping BASIC TRANSPORT INFRASTRUCTURE DESIGN							
PO/PSO		**Course Outcome**					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PROGRAM OUTCOMES (PO)							
PO1	Knowledge of Engineering Sciences	H	M	M	M	M	M
PO2	Problem analysis	M	H	H	M	L	M

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

PO3	Design / development of solutions	H	H	H	H	M	H
PO4	Investigation		H	M	M		M
PO5	Modern Tool Usage		H	M	M	L	M
PO6	Individual and Team work		H	M	L	L	M
PO7	Communication				M		M
PO8	Engineer and Society	M	M	L	H	M	M
PO9	Ethics	M	M	M	H	M	M
PO10	Environment and Sustainability	H			H	H	H
PO11	Project Management and Finance	M		M			M
PO12	Life Long Learning	H	M	M	H	H	H
PROGRAM SPECIFIC OBJECTIVES (PSO)							
PSO1	Knowledge in Urban Development, Traffic, Transportation, and Pavement Engineering	M	H	H	M	H	H
PSO2	Critical analysis of design of various Transport and pavement Infrastructures and Management.	M	M	H	L	L	M
PSO3	Conceptualization and evaluation of Innovative engineering solutions to Transportation related issues.	L	H	M	H	M	M

TE5002 WATERWAYS TRANSPORTATION SYSTEM – PLANNING AND DESIGN L T P C
3 0 0 3

OBJECTIVE:

- To introduce the various aspects of planning and design of Water Transportation Systems.

UNIT I INTRODUCTION 9

Fresh Water and Salt Water Navigation – Ocean, Currents and Tide – Canals and Waterways – Ports Types of Ships

UNIT II LOGISTICS AND MULTIMODAL TRANSPORT 9

Containers – Distribution and Collection by Road and Rail – Vehicles and Equipment used – Trade Routes- liquid cargo

UNIT III PORT PLANNING 9

Traffic Forecast, Demand, Users, Capacity – Berth occupancy – Service time – Waiting time – Principles of Planning Port Layout – Handling characteristics – Voyage Estimating

UNIT IV PORT AND TERMINAL MANAGEMENT 9

Role of ports in trade and transport – Port facility for handling liner, dry bulk and liquid trade – Basics of Port Business – Customs – Immigration, Port Health – Marine Safety – Pricing – Traffic Management in Port Premises

UNIT V INLAND WATER WAYS AND OTHER MODES OF TRANSPORT 9

Inland Water Transport – Planning, limitations and advantages – Case Studies –Pipelines – Ropeways – Beltways – other means of transport – Characteristics and Applications

TOTAL: 45 PERIODS

OUTCOME:

CO1	Understand the importance and types of waterways and navigation systems
CO2	Knowledge on the logistics applied in water transport and its
CO3	Planning of port and its infrastructures.
CO4	Terminal management and its economical analysis
CO5	Knowledge on other transport modes and their case studies.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

REFERENCES:

1. Leslie A.Bryan, "Principles of Water Transportation", University of Chicago Press
2. Paul H.Wright, J.Ashford Norman, "Transportation Engineering, Planning and Design", John Wiley and Sons Inc.,1997
3. "Shipping and Inland Water Transport for Eleventh Five Year Plan" – Report by Planning Commission

CO – PO Mapping WATERWAYS TRANSPORTATION SYSTEM– PLANNING AND DESIGN							
PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PROGRAM OUTCOMES (PO)							
PO1	Knowledge of Engineering Sciences	M	H				H
PO2	Problem analysis	L	H	L	M	M	M
PO3	Design / development of solutions	M	H	M	M		M
PO4	Investigation	H	M	M	M	H	M
PO5	Modern Tool Usage	H	M	M	H		H
PO6	Individual and Team work			M	M		M
PO7	Communication	M			H	M	M
PO8	Engineer and Society	M		M	M	M	M
PO9	Ethics	M	M	M	M		M
PO10	Environment and Sustainability	H				M	H
PO11	Project Management and Finance	H	H	H	M		H
PO12	Life Long Learning	M	M	M	L	M	M
PROGRAM SPECIFIC OBJECTIVES (PSO)							
PSO1	Knowledge in Urban Development, Traffic, Transportation , and Pavement Engineering	H	H	M	M	M	H
PSO2	Critical analysis of design of various Transport and pavement Infrastructures and Management.	M	M	H	H	H	H
PSO3	Conceptualization and evaluation of Innovative engineering solutions to Transportation related issues.	L	M	H			M

TE5003 RAIL TRANSPORTATION SYSTEMS – PLANNING AND DESIGN L T P C
3 0 0 3

OBJECTIVE:

- To introduce the various aspects of planning and design of Rail Transportation Systems.

UNIT I INTRODUCTION 9

Railway Industry – Privatization – Financing – Competition with Road Transport

UNIT II DEPENDABILITY ASPECTS 9

Regularity, Reliability, Punctuality and Safety – Modern tools to improve dependability – Time Table – Development – Scheduling - Restoring

UNIT III MANAGEMENT OF RAILWAY OPERATIONS 9

Demand based Railway Planning – Freight and Passenger Train Services – Asset Maintenance and Management

UNIT IV URBAN RAIL TRANSIT PLANNING 9

Transit and Rail Tunnels- MRTS – LRTS, Metro Rail – Monorail – High speed trains- cable railway system for steep gradients- Tubular Rail-Tramways- Case Studies

UNIT V RAILWAY INFRASTRUCTURE 9

Modern Transit Facilities - Railway Track – Transfer Station – Structures – Bridges – Tunnels – Planning and Design aspects

TOTAL: 45 PERIODS

OUTCOME:

CO1	Know the functioning of railway industry, their financing and competition with other modes.
CO2	Insight on safety, scheduling and reliability aspects with rail transport.
CO3	Freight transport management and maintenance.
CO4	Gain knowledge on different types of urban rail transits and case studies.
CO5	Knowledge on various structures and facilities provided and planning.

REFERENCES:

1. Brain Richards, Transport in Cities
2. Roberty Cervero, The Transit Metropolis, Island Press,1998
3. Vukan R.Vuchie, Urban Transit: Operations, Planning and Economics, John Wiley and Sons Inc.,2005
4. Vukan R.Vuchie, Urban Transit Systems and Technology, John Wiley and Sons,2007

CO – PO Mapping - RAIL TRANSPORTATION SYSTEMS – PLANNING AND DESIGN							
PO/PSO		**Course Outcome**					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PROGRAM OUTCOMES (PO)							
PO1	Knowledge of Engineering Sciences	M	H				H
PO2	Problem analysis	L	H	L	M	M	M
PO3	Design / development of solutions	M	H	M	M		M
PO4	Investigation	H	M	M	M	H	M
PO5	Modern Tool Usage	H	M	M	H		H
PO6	Individual and Team work			M	M		M
PO7	Communication	M			H	M	M
PO8	Engineer and Society	M		M	M	M	M
PO9	Ethics	M	M	M	M		M
PO10	Environment and Sustainability	H				M	H
PO11	Project Management and Finance	H	H	H	M		H
PO12	Life Long Learning	M	M	M	L	M	M
PROGRAM SPECIFIC OBJECTIVES (PSO)							
PSO1	Knowledge in Urban Development, Traffic, Transportation, and Pavement Engineering	H	H	M	M	M	H
PSO2	Critical analysis of design of various Transport and pavement Infrastructures and Management.	M	M	H	H	H	H
PSO3	Conceptualization and evaluation of Innovative engineering solutions to Transportation related issues.	L	M	H			M

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

TE5004 AIRPORT SYSTEM PLANNING AND DESIGN L T P C
3 0 0 3

OBJECTIVE:

- Provides a basic understanding on Airport Systems Planning and Operation

UNIT I AIRPORT PLANNING 10

Planning of airports and its impact on metropolitan city development– Accessibility – Transport Connections – Road and Rail, Expansion – Feasibility Studies – Environmental and Social Issues – Forecasting Future Traffic – Airfield Capacity and Delay - Aircraft characteristics – Airport Site Selection

UNIT II AIRPORT COMPONENTS 10

Airport Classification, Planning of Airfield Components – Runway, Taxiway, Apron, Hangar- Passenger Terminals- Geometric design of runway and taxiways-Runway pavement Design- Difference between Highway and airport pavements- Introduction to various design methods- Airport drainage.

UNIT III AIRPORT PLANNING AND AIRLINE ECONOMICS 9

Demand driven dispatch – Airline Fleet Planning Models – Network Revenue Management – Airport Performance, Slot Issues, Hub Operation, Demand Management, Multi-airport Systems- Pricing – Privatization and Deregulation, Willingness to pay and Competitive Revenue Management

UNIT IV PASSENGER CHOICE, SCHEDULING AND FLEET ASSIGNMENT 7

Load Factor Analysis, Airline Schedule Development, Introduction to PODS Passenger Choice Models, Decision Window Model, Fleet Assignment

UNIT V CASE STUDIES 9

Multi airport system – location of airport with respect to urban growth- case studies.

TOTAL: 45 PERIODS

OUTCOME:

CO1	Students can conduct Feasibility studies and plan an airport.
CO2	Knowledge on Design of various Airport components.
CO3	Knowledge on Airport Management and economics.
CO4	Able to develop scheduling and various models for Airport management.
CO5	Students get an overall knowledge about Airport planning and Design.

REFERENCES:

1. Robert Honjeff and Francis X.Mckelvey, "Planning and Design of Airports", McGraw Hill, New York,1996
2. Richard De Neufille and Amedeo Odoni, "Airport Systems Planning and Design", McGraw Hill, New York,2003
3. Airport Planning and Systems –http://airportssystems.com/Course/index-html
4. Khanna S.K and .Arora M.G, "Airport Planning and Design", Nem Chand and Bros,1999.
5. Norman.J.Ashford, Sakleh.A Mumayiz and Paul.H.Wright, "Airport Engineering Planning Design and Development of 21st Century Airports, John Wiley and sons, New Jersey,2011.

CO – PO Mapping - AIRPORT SYSTEM PLANNING AND DESIGN							
PO/PSO		**Course Outcome**					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PROGRAM OUTCOMES (PO)							
PO1	Knowledge of Engineering Sciences	M	H				H
PO2	Problem analysis	L	H	L	M	M	M
PO3	Design / development of solutions	M	H	M	M		M

PO4	Investigation	H	M	M	M	H	M
PO5	Modern Tool Usage	H	M	M	H		H
PO6	Individual and Team work			M	M		M
PO7	Communication	M			H	M	M
PO8	Engineer and Society	M		M	M	M	M
PO9	Ethics	M	M	M	M		M
PO10	Environment and Sustainability	H				M	H
PO11	Project Management and Finance	H	H	H	M		H
PO12	Life Long Learning	M	M	M	L	M	M
PROGRAM SPECIFIC OBJECTIVES (PSO)							
PSO1	Knowledge in Urban Development, Traffic, Transportation , and Pavement Engineering	H	H	M	M	M	H
PSO2	Critical analysis of design of various Transport and pavement Infrastructures and Management.	M	M	H	H	H	H
PSO3	Conceptualization and evaluation of Innovative engineering solutions to Transportation related issues.	L	M	H			M

TE5005 GEOSPATIAL TECHNIQUES L T P C
3 0 0 3

OBJECTIVE:

- Introduce the students, the recent techniques of Remote Sensing and GIS and Its application in Traffic and Transportation Engineering

UNIT I INTRODUCTION TO REMOTE SENSING 10

Definition – Types of Remote Sensing -Components of Remote Sensing – Energy, Sensor, Interacting Body – Active and Passive Remote Sensing – Platforms – Aerial and Space Platforms – Aircraft and Satellites – Electromagnetic Radiation – EMR Spectrum - Aerial Photography and types Overlap and sidelap – stereoscopes - Flight mission – Types of satellites - Energy, Sensor, Interacting Body – Electromagnetic Radiation – Spectral signatures.

UNIT II INTRODUCTION TO GIS 10

Basic Concept and Components of GIS – Hardware and Software – Data input and output - Data Types - Spatial and non-spatial – Vector and Raster – Maps and types of maps – Map scale and importance – Geo-referencing – Map Projection – Types of Projection – Height referencing – Introduction to GPS & DGPS

UNIT III DATA STRUCTURES AND ANALYSIS 9

Digitization and Scanning - Geographic database - GIS Modelling - Raster and Vector data structures – Raster and Vector data analysis – Data storage – DEM and TIN models - Edge matching - Rubber sheeting - Buffering and overlaying techniques – Errors in database .

UNIT IV BASIC APPLICATIONS IN TRANSPORTATION 8

Highway and Railway Alignment- Bus route rationalization – Accident analysis – Applications of Aerial Photography and Satellite Imageries- Visual Interpretation and Digital Image Processing.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT V ADVANCED APPLICATIONS 8

Integration of GIS,GPS and Remote Sensing Techniques – Intelligent Transport System (ITS) – Components and Advantages - Advanced Traffic Management System Advanced Traveler Information System (ATIS) – Automatic Vehicle Location System (AVLS) Advanced Public Transportation System - Commercial Vehicle Operation.

TOTAL: 45 PERIODS

OUTCOME:

CO1	Understand the concepts and principles of remote sensing
CO2	Knowledge on working principles of GIS and its interpretation
CO3	Analysis of Data Structures, buffering and overlaying techniques.
CO4	Applying the GIS techniques and image processing in transportation field
CO5	Understand application of GIS in integration to information technology applied in transport sector.

REFERENCES:

1. Srinivas M.G, "Remote Sensing Applications", Narosa Publishing House, 2001
2. Anji Reddy, "Remote Sensing and Image Interpretation", John Wiley and Sons Inc. New York, 1987.
3. Burrough P.A, "Principles of GIS for Land Resources Assessment", Oxford Publication,1994.
4. Jeffrey Star and John Ester, Geographical Information System – An Introduction, Prentice Hall Inc., Englewood Cliffe,1990.
5. Marble, D.F, Calkins, H.W and Penquest, Basic Readings in GIS, Speed System Ltd., New York,1984.

CO – PO Mapping - GEOSPATIAL TECHNIQUES

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PROGRAM OUTCOMES (PO)							
PO1	Knowledge of Engineering Sciences	M	H				H
PO2	Problem analysis	L	H	L	M	M	M
PO3	Design / development of solutions	M	H	M	M		M
PO4	Investigation	H	M	M	M	H	M
PO5	Modern Tool Usage	H	M	M	H		H
PO6	Individual and Team work			M	M		M
PO7	Communication	M			H	M	M
PO8	Engineer and Society	M		M	M	M	M
PO9	Ethics	M	M	M	M		M
PO10	Environment and Sustainability	H				M	H
PO11	Project Management and Finance	H	H	H	M		H
PO12	Life Long Learning	M	M	M	L	M	M
PROGRAM SPECIFIC OBJECTIVES (PSO)							
PSO1	Knowledge in Urban Development, Traffic, Transportation, and Pavement Engineering	H	H	M	M	M	H
PSO2	Critical analysis of design of various Transport and pavement Infrastructures and Management.	M	M	H	H	H	H
PSO3	Conceptualization and evaluation of Innovative engineering solutions to Transportation related issues.	L	M	H			M

TE5006 DYNAMIC SIMULATION MODELING FOR SUSTAINABLE TRANSPORTATION AND MANAGEMENT **L T P C 3 0 0 3**

OBJECTIVE

- Offers basic and fundamental principles of Systems Approach and its application in simulating and modeling the complex and dynamic traffic and transportations systems.

UNITI SYSTEMS APPROACH CONCEPT 9

System – Concepts, Theories – Classification – Models – Concept of Modeling exercises - Phases in model building process – System Approach –Dynamics Simulation (D.S) View Points with its Paradigms– Fundamentals of GPSS & Monto carlo method – Pseudo Random generators – Differences between approaches.

UNITII MODEL CONCEPTUALISATION 9

Model Verification- Causal Loop (C.L) Diagramming Approach – Justification for links – Conceptualization and Development of Causal Loop Representations - Case Study examples in C.L diagramming in Transportation Planning – Principles of Systems and its Hierarchies.

UNITIII MODEL DEVELOPMENT ANDSCENARIOANALYSIS 9

System Dynamic Model Development - Flow Diagramming methodologies – Stocks and Rate Variable Concepts – Relevance of selection in Level and other auxiliary variables – Significance of Optimization Techniques in Simulation Modeling– Importance of Policy and Scenario Analysis.

UNIT IV APPLICATION OF SIMULATION CONCEPTS 9

Applications of GPSS - Simple queuing problems - Analysis of simulation results - Model Verification , Calibration and Validation - Replication of random conditions –Time series and forecasting analysis.

UNITV MODELINGTRANSPORTATION SYSTEMS 9

Simulation Models - Application In Basic Population Sector for Traffic, Transportation Systems – Modeling of any traffic and Trip Forecasting systems /Productions and Service Level Quality Enhancement – Modeling of Basic Land Use and Transport system interactions- Other Relevant areas- Future traffic simulation Models.

TOTAL: 45 PERIODS

OUTCOME

CO1	Concept and Knowledge on dynamic simulation modelling with conventional modelling
CO2	Understand the model conception & design algorithm for transportation problems
CO3	Exposure in model representation with model symbols with its significance
CO4	Model verification , calibration & validation & compae it with traditional approach
CO5	Application of dynamic simulation modelling exercise to wide range of traffic and transportation issues

REFERENCES

1. PratabMohapatra K.J.et al., "Introduction to System Dynamics Modeling", University Press, Hyderabad,1994
2. Thirumurthy A.M. (1992), "Environmental Facilities and Urban Development in India – A System Dynamics Model for Developing Countries, Academic Foundations, India.
3. Christopher A. Chung (2003), “Simulation Modeling Handbook: A Practical Approach”- 1st Edition, CRC Press Publication, USA
4. Winnie Daamen, Christine Buisson, Serge P. Hoogendoorn (2017), “Traffic Simulation and Data: Validation Methods and Applications”- 1st Edition, CRC Press Publication, USA .
5. Coyle R.G (2001), "System Dynamics Modelling A Practical Approach" - 1st Edition, Chapman & Hall / CRC Press Publications, Washington D.C, USA
6. Nancy Roberts et al. (1983), "Introduction to Computer Simulation – A System Dynamics Modeling Approach", Addison – Wesley, London.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

CO – PO Mapping - DYNAMIC SIMULATION MODELING FOR SUSTAINABLE TRANSPORTATION & MANAGEMENT							
PO/PSO		**Course Outcome**					Overall Correlation of CO s to POs
		CO1	CO2	CO3	CO4	CO5	
PROGRAM OUTCOMES (PO)							
PO1	Knowledge of Engineering Sciences	H	H	H	H	H	H
PO2	Problem analysis	L	H	H	M	H	H
PO3	Design / development of solutions	L	H	H	H	H	H
PO4	Investigation	M	H	H	H	H	H
PO5	Modern Tool Usage	H	H	H	H	H	H
PO6	Individual and Team work	H	H	H	H	H	H
PO7	Communication	M	M	M	H	L	M
PO8	Engineer and Society	H	H	H	H	H	H
PO9	Ethics	H	H	H	H	H	H
PO10	Environment and Sustainability	H	H	H	H	H	H
PO11	Project Management and Finance	M	M	H	M	H	H
PO12	Life Long Learning	H	H	H	H	H	H
PROGRAM SPECIFIC OBJECTIVES (PSO)							
PSO1	Knowledge in Urban Development, Traffic, Transportation, and Pavement Engineering	H	H	H	H	H	H
PSO2	Critical analysis of design of various Transport and pavement Infrastructures and Management.	M	H	H	H	H	H
PSO3	Conceptualization and evaluation of Innovative engineering solutions to Transportation related issues.	M	H	H	H	H	H

TE5007 COMPUTATIONAL TECHNIQUES IN TRANSPORTATION ENGINEERING **L T P C**
3 0 0 3

OBJECTIVES

- To be introduced to systems approach.
- To learn the fundamentals of simulation and the GPSS language.
- To be introduced to advanced computational techniques such as GA and ANN.

UNIT I INTRODUCTION **9**

Introduction to systems approach - Typical transportation systems - Mathematical models. Fundamentals of simulation - Monte Carlo method - Continuous and discrete models - Simulation languages. Probability concepts - Random numbers - Pseudo random generators - Arrival patterns - Service time distributions – Manual simulation of simple queuing system

UNIT II FUNDAMENTALS OF SIMULATION **9**

GPSS Fundamentals - Creating and moving transactions - Queues and facilities - Event scheduling – Standard numerical attributes – Parameters and save values - Functions - Priority - Preemption - Collection of statistics - Report preparation. Internal logic of GPSS processor - Program control statements.

UNIT III APPLICATION OF SIMULATION CONCEPTS 9

Applications of GPSS - Simple queuing problems - Inventory problems - Simulation of ports - Railway platforms and level crossings - Traffic signals. Analysis of simulation results - Model validation - Replication of random conditions - Time series analysis.

UNIT IV APPLICATION OF GENETIC ALGORITHM IN SIMULATION 9

Genetic Algorithm - Terminology in GA – Strings, Structure, Parameter string - Data Structures – Operators - Algorithm – Application in Transportation. Fuzzy Logic.

UNIT V APPLICATION OF ARTIFICIAL NEURAL NETWORKS IN SIMULATION 9

Artificial Neural Networks - Basics of ANN – Topology - Learning Processes - Supervised and unsupervised learning. Least mean square algorithm, Back propagation algorithm - Applications.

TOTAL: 45 PERIODS

OUTCOME:

CO1	Gain Knowledge on Various Types of Modeling
CO2	Knowledge on fundamentals of simulation techniques and functions.
CO3	Application of simulation techniques in transport sector, modeling and validation.
CO4	Gain knowledge on genetic algorithm in simulation and fuzzy logic.
CO5	Applications of ANN and its application in transport sector.

REFERENCES:

1. Gordon, G., *System Simulation,* Prentice-Hall of India,2005
2. GPSS/PC, *User Manual, Minuteman Software,* USA,2005
3. David E. Goldberg, Genetic Algorithms in Search, Optimisation and Machine Learning, Addison-Wesley,1989

Zurada J.M. , .Introduction to artificial neural systems., Jaico Publishers,2006

CO – PO Mapping- COMPUTATIONAL TECHNIQUES IN TRANSPORTATION ENGINEERING							
PO/PSO		**Course Outcome**					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PROGRAM OUTCOMES (PO)							
PO1	Knowledge of Engineering Sciences	M	H	H		H	H
PO2	Problem analysis	L	H	L	M	M	M
PO3	Design / development of solutions	M	H	M	M		M
PO4	Investigation	H	M	M	M	H	M
PO5	Modern Tool Usage	H	M	M	H		H
PO6	Individual and Team work			M	M		M
PO7	Communication	M			H	M	M
PO8	Engineer and Society	M		M	M	M	M
PO9	Ethics	M	M	M	M		M
PO10	Environment and Sustainability	H				M	H
PO11	Project Management and Finance	H	H	H	M		H
PO12	Life Long Learning	M	M	M	L	M	M
PROGRAM SPECIFIC OBJECTIVES (PSO)							
PSO1	Knowledge in Urban Development, Traffic, Transportation, and Pavement Engineering	H	H	M	M	M	H
PSO2	Critical analysis of design of various Transport and pavement Infrastructures and Management.	M	M	H	H	H	H
PSO3	Conceptualization and evaluation of Innovative engineering solutions to Transportation related issues.	L	M	H			M

TE5008 SUSTAINABLE URBAN AND TRANSPORT PLANNING L T P C
3 0 0 3

OBJECTIVE:

- Helps in understanding the basic concept of Sustainable Urban and Transport Development and its influence on region, city and built environment
- To expose the students to the need, methodology, documentation and requirements of environmental and social impact assessment of Transportation Projects

UNIT I SUSTAINABLE URBAN AND TRANSPORT PRINCIPLES 9

Urban Sustainable Development, Methods and Tools for Sustainable Appraisal and Assessment , Future Scenarios, Integrated planning, Sustainable Transportation – Principles indicators and its implications, Guidelines for Environmentally sound Transportation, Benefits of Sustainable Transportation

UNIT II THE URBAN BUILT ENVIRONMENT 9

Urban Form- Neighborhood component and structure, Land Use, Green and Smart cities, Compact Development, Principles of street design – complete streets, Transit planning, Road side infrastructure Planning, Transport Integrated Urban land use Planning

UNIT III PLANNING FOR SUSTAINABLE TRANSPORTATION MODES 10

Pedestrian – Planning Principles, Tools, Designs, Methods to measure success, Cycles- Planning Principles, Cycle Track Network, Crossings and intersections and junctions, – Equity Principle, Accessibility, Mobility – Roads, Traffic, Public Transport, Business and Goods Traffic

UNIT IV ENVIRONMENTAL REGULTIONS AND EIA 8

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, Coastal Regulation Zone - Ambient Air Quality and noise Standards and its measurement - EIA – methods of impact analysis and its process

UNIT V ENVIRONMENTAL IMPACT INDENTIFICATION, PREDICTION AND MITIGATION 9

Impact of existing and new transportation projects on - air, noise, community and economic activity, Indigenous people, Health and safety of residents, Land acquisition and Resettlement, IRC guidelines and MOEF guidelines

TOTAL: 45 PERIODS

OUTCOME:

CO1	To be acquainted with sustainable urban transportation systems and principles.
CO2	Understand basic urban form and integrated land use planning.
CO3	Able to develop Sustainable Transportation Modes.
CO4	Knowledge on various Environmental Regulations and Acts.
CO5	Various environmental impacts of Transportation projects and guidelines to be followed.

REFERENCES:

1. Joe Ravetz, City Region 2020 – "Integrated Planning for a Sustainable Environment, 2000 .
1. Sustainable Transportation and TDM – Planning the balances, Economic, Social and Ecological objectives; Victoria Transport Policy Institute, 2007 .
2. Tumlin Jeffrey, "Sustainable Transportation Planning- Tools for Creating Vibrant", Healthy and Resilient Communities, John Wiley & Sons, 2012.
3. Larry W Canter, "Environmental Impact Assessment", McGraw Hill Publishers, 1996.
4. John Glasson, Riki Therivel, Andrew Chadwick, Introduction to Environmental Impact Assessment", 4th Edition, Routledge, New York.2012
5. World Bank; "the Impact of Environmental Assessment – A Review of World Bank Experience, Washington, 1997.
6. World Bank; Road and the Environment, World Bank Technical paper no. 363, Washington, 1997.
7. Scottish Natural Heritage , A handbook on environmental impact assessment, 4th Edition, Natural Heritage Management, www.snh.gov.uk., (2013)

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

CO – PO Mapping - SUSTAINABLE URBAN AND TRANSPORT PLANNING							
PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PROGRAM OUTCOMES (PO)							
PO1	Knowledge of Engineering Sciences	M	M		H	H	H
PO2	Problem analysis			M	H	H	H
PO3	Design / development of solutions	L	M	M	H		M
PO4	Investigation	H	H	M		H	H
PO5	Modern Tool Usage	M	H	M	H	M	M
PO6	Individual and Team work		H				H
PO7	Communication		M	M			M
PO8	Engineer and Society	M	M	H	H	H	H
PO9	Ethics	H	H		M	H	H
PO10	Environment and Sustainability	H	H	H	H	H	H
PO11	Project Management and Finance		H	M	M		M
PO12	Life Long Learning	L	M	L	M	L	M
PROGRAM SPECIFIC OBJECTIVES (PSO)							
PSO1	Knowledge in Urban Development, Traffic, Transportation, and Pavement Engineering	L		M			L
PSO2	Critical analysis of design of various Transport and pavement Infrastructures and Management.	M	M				M
PSO3	Conceptualization and evaluation of Innovative engineering solutions to Transportation related issues.		M	M		M	M

TE5009 ANALYTICAL TECHNIQUES IN TRANSPORTATION ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

- Understand various Analytical techniques in solving transportation problems.
- To analyse and manage data clustering and management
- To gain knowledge on conducting surveys, Evaluation and validation of data in Evaluating a Decision

UNIT I COMPUTATIONAL INTELLIGENT TECHNIQUES 9

Concept of fuzzy sets- basics elements of fuzzy systems; Artificial Neural Networks – Introduction- Characteristics of neural netwoks- Multilayered feed forward neural networks trining- validation of neural models.

UNIT II MULTI ATTRIBUTE DECISION MAKING METHODS 9

Attribute weights, Minimax method, Maximax methods, simple additive weighting method, TOPSIS.

UNIT III INTRODUCTION TO BIG DATA 9

Evolution of Big data - Best Practices for Big data Analytics - Big data characteristics - Validating - The Promotion of the Value of Big Data - Big Data Use Cases- Characteristics of Big Data Applications - Perception and Quantification of Value -Understanding Big Data Storage - A General Overview of High-Performance Architecture.-

UNIT IV CLUSTERING AND CLASSIFICATION 9

Advanced Analytical Theory and Methods: Overview of Clustering - K-means - Use Cases - Overview of the Method - Determining the Number of Clusters - Diagnostics - Reasons to Choose and Cautions .- Classification: Decision Trees - Overview of a Decision Tree - The General Algorithm - Decision Tree Algorithms - Evaluating a Decision Tree - Decision Trees in R - Naïve Bayes - Bayes‘ Theorem - Naïve Bayes Classifier.

UNIT V DELPHI TECHNIQUES 9

Introduction – Conducting Delphi survey- Methodological consideration- selection and size of panel- Questtionaire design and scoring methods-feedback- merits and consenses.

TOTAL: 45 PERIODS

OUTCOME:

CO1	Understand the concepts of fuzzy logic and Artificial Neural Network
CO2	Analyse Multi Attribute Decision Making Methods
CO3	Understand Big data characteristics and Applications -
CO4	Interpret various clustering techniques and classifications
CO5	Understand the concepts of Delphi techniques and methodologies.

REFERENCES:

1. Traffic and transportation Engineering, Dusan Teodoravic and Milan Janic.
2. Mobility Pattern,Big Data and Transport Analutics, Constantinos Antoniou, Loukas Dimitriou.

CO – PO Mapping - ANALYTICAL TECHNIQUES IN TRANSPORTATION ENGINEERING

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PROGRAM OUTCOMES (PO)							
PO1	Knowledge of Engineering Sciences	M	H	H		H	H
PO2	Problem analysis	L	H	L	M	M	M
PO3	Design / development of solutions	M	H	M	M		M
PO4	Investigation	H	M	M	M	H	M
PO5	Modern Tool Usage	H	M	M	H		H
PO6	Individual and Team work			M	M		M
PO7	Communication	M			H	M	M
PO8	Engineer and Society	M		M	M	M	M
PO9	Ethics	M	M	M	M		M
PO10	Environment and Sustainability	H				M	H
PO11	Project Management and Finance	H	H	H	M		H
PO12	Life Long Learning	M	M	M	L	M	M
PROGRAM SPECIFIC OBJECTIVES (PSO)							
PSO1	Knowledge in Urban Development, Traffic, Transportation , and Pavement Engineering	H	H	M	M	M	H
PSO2	Critical analysis of design of various Transport and pavement Infrastructures and Management.	M	M	H	H	H	H
PSO3	Conceptualization and evaluation of Innovative engineering solutions to Transportation related issues.	L	M	H			M

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

TE5010 **ROAD SAFETY SYSTEM** **L T P C**
3 0 0 3

OBJECTIVES:

- Helps in identifying the reasons for road accidents and scientific Investigation.
- Provides knowledge on road safety audit and its methodology

UNIT I INTRODUCTION **10**

Accident Scenarios – Global, National , Regional and Chennai Mega City Levels - Causes of accidents – Human factors – Vehicles – Road and its condition – Environmental Factors- Conventional methods and Inadequacies- Case studies – Application of Dynamic Simulation Modeling in Accident Prediction.

UNIT II ACCIDENT STUDIES **8**

Accident Data Collection - Accident prevention- Types of Statistics- Accident Rates - Statistical Methods in Accident Analysis-Crash reconstruction Theories –All Safety Measures for Road Safety -Computer Record Systems –RADMS- Case studies.

UNIT III ACCIDENT ANALYSIS TECHNIQUES **9**

Collision and Condition Diagram – Preparation, Spatial Analysis of Accidents – Methods and GIS in Accident Analysis - Black Spot, Black Route and Area Identification. Conventional Accident Prediction Models – Development – Empirical Bayees Approach – Before and After Evaluation – Case Studies

UNIT IV ROAD SAFETY AUDIT **10**

Introduction to safety- Road safety management system- Need for Road Safety Audit – Concept and Elements of Safety Audit – Safety Audit for existing roads – Legal requirements – Provisions of Motor Vehicle Act and role of NGO" s in prevention of accidents. Case Studies.

UNIT V ACCIDENT COSTING **8**

Trends in cost of Road Accidents - Significance -– Conventional Methods - Application of Dynamic Modeling in Crash Costing-Economic Analysis of Road Accident Cost in India.

TOTAL : 45 PERIODS

OUTCOME:

CO1	Apply the knowledge of science and engineering fundamentals in developing an efficient road safety system & conduct research pertinent to road safety and management and to communicate effectively to different stakeholders as well as engage in independent life-long learning
CO2	Explain concepts and analysis of accident data collection and studies
CO3	Knowledge in accident analysis techniques with various advanced methods.
CO4	Concepts & Significance of road safety audit and management system with case studies.
CO5	conduct research pertinent to road accident costing and to communicate effectively to different stakeholders as well as engage in independent life-long learning

REFERENCES:

1. Martin Belchar,"Practical Road Safety Auditing", Ice Publishing, 2015
2. Ministry of Surface Transport, "Accident Investigation and Prevention Manual for Highway Engineers in India, Government of India ,2001.
3. Indian Roads Congress -IRC (2013), Ministry of Road Transport & Highways (MORTH, formerly MOST) Road Safety Audit Manual (IRC:SP-88) .
4. Geetam Tiwari, Dinesh Mohan (2016), "Transport Planning and Traffic Safety: Making Cities, Roads, and Vehicles Safety"- 1st Edition, CRC Press Publication, USA.
5. Dhillon B.S (2011), "Transportation Systems Reliability and Safety"- 1st Edition, CRC Press Publication, USA.

6. Martin Belcher, Steve Proctor and Phil Cook (2011), “Practical Road Safety Auditing”- 3rd Edition, ICE Publication, Scotland.
7. Ministry of Surface Transport (2001), "Accident Investigation and Prevention Manual for Highway Engineers in India, Government of India.
8. Martin Belcher, Steve Proctor, Phil Cook (2015), "Practical Road Safety Auditing", 3rd edition, ICE Publications, USA

CO – PO Mapping- ROAD SAFETY SYSTEM							
PO/PSO		**Course Outcome**					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PROGRAM OUTCOMES (PO)							
PO1	Knowledge of Engineering Sciences	H	H	H	H	H	H
PO2	Problem analysis	H	H	H	H	L	H
PO3	Design / development of solutions	H	H	H	H	H	H
PO4	Investigation	H	H	H	H	H	H
PO5	Modern Tool Usage	H	H	H	H	H	H
PO6	Individual and Team work	H	L	L	M	H	H
PO7	Communication	H	L	M	M	H	M
PO8	Engineer and Society	H	M	M	H	H	H
PO9	Ethics	H	H	M	M	H	H
PO10	Environment and Sustainability	H	M	M	H	H	H
PO11	Project Management and Finance	H	M	M	M	H	M
PO12	Life Long Learning	H	M	M	M	H	H
PROGRAM SPECIFIC OBJECTIVES (PSO)							
PSO1	Knowledge in Urban Development, Traffic, Transportation , and Pavement Engineering	H	H	H	H	H	H
PSO2	Critical analysis of design of various Transport and pavement Infrastructures and Management.	H	H	M	M	H	H
PSO3	Conceptualization and evaluation of Innovative engineering solutions to Transportation related issues.	H	M	M	H	H	H

TE5011 TRAFFIC FLOW THEORY L T P C
3 0 0 3

OBJECTIVE:

- To impart knowledge in Traffic Flow Characteristics, Flow Modeling and Computer Simulation

UNIT I TRAFFIC FLOW FUNDAMENTALS 10

Fundamentals of Traffic Flow – Flow Parameters – Nature of traffic flow – Approaches to Traffic Flow - Spacing, Gap and Headway Characteristics – Probabilistic aspects of Traffic Flow – Various Distributions – Gap acceptance – Vehicle arrival studies.

UNIT II TRAFFIC FLOW CHARACTERISTICS 10

Traffic Flow characterization – Categories of Traffic Flow – Macroscopic and Microscopic Traffic Flow Models – Centrally versus Individually controlled modes – Vehicular Stream Models - Lighthill and Withams Theory – Application of theory to deal bottlenecks – Trajectory Diagrams – Shock waves – Propagation and equation – Greenbergs extension of law of continuity – Car Following theory.

UNIT III QUEUING MODELS 8

Queuing Theory – Types of Queuing Model – Queuing Characteristics and Behaviour – Transition- Diagram – Queuing Cost Model Application to Traffic Engineering

UNIT IV TRAFFIC DELAYS 8

Delay at Intersections - Type of delays - Manual measurement – Saturated and oversaturated intersections – Arrival Pattern

UNIT V INTELLIGENT TRANSPORT SYSTEM 9

Introduction to Intelligent Transportation Systems (ITS)- Sensors - Travel information– ITS Applications- Electronic Toll Collection- Passenger Information System- Vehicle Tracking- - Traffic Enforcement.

TOTAL: 45 PERIODS

OUTCOME:

CO1	Apply fundamentals principles of traffic flow and its probabilistic nature in traffic studies
CO2	Analyze & contrast the applications of various types of traffic flow models and theories
CO3	Identify queuing characteristics, model & theory involves to understand the behaviour of queuing
CO4	Estimate delay and its measurement in saturated and oversaturated condition at intersections by manual approach
CO5	Interpret the application of IT and sensors in traveller & passenger information, ETC, vehicle racking in the field of Intelligent transportation system

REFERENCES:

1. Drew, D.R., "Traffic Flow Theory and Control", McGraw Hill,NewYork,1968
2. Highway Capacity Manual, Special Report 209, Transportation Research Board (TRB), National Research Council, WashingtonDC,1988
3. May A.D., "Traffic Flow Fundamentals", Prentice Hall Inc., NewJersey,1990
4. Papacostas C.S., Prevedouros, "Transportation Engineering and Planning", 3rd Edition, Prentice Hall of India, New Delhi,2002
5. TRB, Traffic Flow Theory - A Monograph, SR165, 1975.
6. Kadiyali, L.R, "Traffic Engineering and Transport Planning", Khanna Publishers,Delhi,2006

CO – PO Mapping - TRAFFIC FLOW THEORY

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PROGRAM OUTCOMES (PO)							
PO1	Knowledge of Engineering Sciences	M	-	M	M	H	M
PO2	Problem analysis	-	-	M	H		M
PO3	Design / development of solutions	-	-	M	M	H	M
PO4	Investigation	-	M	-	M		M
PO5	Modern Tool Usage	-	-	H	H	H	H
PO6	Individual and Team work	-	-	-	-	L	L
PO7	Communication	-	H	-	-	H	H
PO8	Engineer and Society	-	-	M	M	M	M
PO9	Ethics	-	M	-	-	M	M
PO10	Environment and Sustainability	-	-	M	M	M	M
PO11	Project Management and Finance	-	L	-	-	L	L
PO12	Life Long Learning	-	-	M	-	M	M
PROGRAM SPECIFIC OBJECTIVES (PSO)							
PSO1	Knowledge in Urban Development, Traffic, Transportation , and Pavement Engineering	H	M	M	M	H	M

PSO2	Critical analysis of design of various Transport and pavement Infrastructures and Management.	-	-	M	M	M	M
PSO3	Conceptualization and evaluation of Innovative engineering solutions to Transportation related issues.	-	-	H	H	H	H

TE5012 INTELLIGENT TRANSPORTATION SYSTEMS L T P C
3 0 0 3

OBJECTIVE:

- To learn the fundamentals of ITS.
- To study the ITS functional areas
- To have an overview of ITS implementation in developing countries

UNIT I INTRODUCTION TO INTELLIGENT TRANSPORT SYSTEM 8

Introduction to Intelligent Transportation Systems (ITS) -Definition – Role and Responsibilities – Advanced Traveller Information System – Fleet Oriented ITS Services – Electronic Toll Collection – Critical issues – Security – Safety

UNIT II ITS ARCHITECTUREAND HARDWARE 9

Architecture – ITS Architecture Framework – Hardware Sensors – Vehicle Detection – Techniques – Dynamic Message Sign – GPRS – GPS – Toll Collection

UNIT III ADVANCED TRANSPORT MANAGEMENT SYSTEM 10

Video Detection – Virtual Loop - Cameras - ANPR – IR Lighting – Integrated Traffic Management – Control Centre – Junction Management Strategies- ATMS – Advanced Traveler Information Systems (ATIS)- Route Guidance – Issues -– Historical – Current – Predictive Guidance – Data Collection – Analysis – Dynamic Traffic Assignment (DTA) – Components – Algorithm.

UNIT IV ADVANCED TRAVELLER AND INFORMATION SYSTEM 9

Travel Information – Pre Trip and Enroute Methods- Basic ATIS Concepts – Smart Route System – Data Collection – Process – Dissemination to Travelers – Evaluation of Information – Value of Information – Business Opportunities

UNIT V CASE STUDIES 9

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.

TOTAL: 45 PERIODS

OUTCOME:

CO1	Relate the basic responsibilities and application of of ITS in fleet services & ETC etc. in the field of smart transportation
CO2	Construct the architecture frame work of ITS and working techniques of various sensors, vehicle detection & DMS
CO3	Inspect the advanced transportation management system, application of different instruments for vehicle detection & traffic data collection
CO4	Perceive the concepts of ATIS involves in smart routing, data collection, evaluation & Opportunities in business
CO5	Compile various case studies dealing with Integration of Automated Highway Systems & ITS implementations stratagies in developed countries & developing countries

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

REFERENCES:

1. Intelligent Transport Systems, Intelligent Transportation Primer, Washington, US,2001.
2. Henry F.Korth, and Abraham Siberschatz, Data Base System Concepts, McGraw Hill,1992.
3. Turban E.,"Decision Support and Export Systems Management Support Systems", Maxwell Macmillan,1998.
4. Sitausu S. Mittra, "Decision Support Systems – Tools and Techniques", John Wiley, New York,1986.
5. Cycle W.Halsapple and Andrew B.Winston, "Decision Support Systems – Theory and Application" ,Springer Verlog, New York, 1987
6. ITS Hand Book 2000: Recommendations for World Road Association (PIARC) by Kan Paul Chen, John Miles.

CO – PO Mapping - INTELLIGENT TRANSPORTATION SYSTEMS							
PO/PSO		**Course Outcome**					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PROGRAM OUTCOMES (PO)							
PO1	Knowledge of Engineering Sciences	H	H	M	M	H	H
PO2	Problem analysis	H	H	M	M	H	H
PO3	Design / development of solutions	L	H	H	M	H	H
PO4	Investigation	H	H	M	M	H	H
PO5	Modern Tool Usage	M	M	M	H	H	H
PO6	Individual and Team work	H	H	H	H	H	H
PO7	Communication	M	M	M	L	H	H
PO8	Engineer and Society	M	M	M	H	H	H
PO9	Ethics	H	H	H	H		H
PO10	Environment and Sustainability	M	M	M	H	H	H
PO11	Project Management and Finance	M	H	M	M	H	M
PO12	Life Long Learning	M	H	M	M	H	H
PROGRAM SPECIFIC OBJECTIVES (PSO)							
PSO1	Knowledge in Urban Development, Traffic, Transportation , and Pavement Engineering	H	M	M	M	H	H
PSO2	Critical analysis of design of various Transport and pavement Infrastructures and Management.	H	H	M	M	H	H
PSO3	Conceptualization and evaluation of Innovative engineering solutions to Transportation related issues.	H	M	H	M	H	H

TE5013 ADVANCED SYSTEM DYNAMICS MODELING IN TRANPORTATION ENGINEERING **L T P C 3 0 0 3**

OBJECTIVE:

- To provide advanced level of knowledge in System Dynamics Modeling in Transportation Engineering

UNIT I COMPLEXITY AND SYSTEMS THINKING **8**

Change – Complexity and Interdependency – Systems thinking – Floundering – Level of abstractions- Tools and Transitions in Systems Thinking – Synthesis and Organizational Learning

UNIT II ADVANCED MODELING EFFORTS 8

Steady State Modeling – Discrete vs. Continuous – Generic infrastructures –Subsystems – Sensitivity parametering - Case Studies

UNIT III ADVANCED SIMULATING TECHNIQUES 10

Graphical Bulletin function – Conveyor flows – Converter – Flow substitutes – Connector – Normalizing Inputs – Generic flow activities – Case Studies

UNIT IV MODELING PROCESS 10

System Dynamics Modeling challenges – Steps in Modeling Process – Guidelines – Model Boundary– Modeling soft variables – Quantification vs. Measurement

UNIT V SOPHISTICATED DYNAMICS MODELING 9

Need – Isolation Process – Demand Expansions – Cycle functions – Sensitivity Analysis – Alternative view of Dynamic Modeling

TOTAL: 45 PERIODS

OUTCOME:

CO1	Knowledge on Advancements in dynamic simulation modelling efforts
CO2	Apply the knowledge in developing an advanced dynamic simulation modelling efforts for dealing complex transportation problems
CO3	Designing various types of simulating techniques to address wide range of issues
CO4	Designing various types of modelling process appropriately.
CO5	Conduct research pertinent to traffic and transportation planning and management and to communicate effectively to different stakeholders as well as engage in independent life-long learning

REFERENCES:

1. System Dynamic Modeling - A Practical Approach
2. Traffic Simulation and Data
3. Pratab Mohapatra K.J. et al., "Introduction to System Dynamics Modeling", University Press, Hyderabad,1994
4. Thirumurthy A.M., Environmental Facilities and Urban Development in India – A System Dynamics Model for Developing Countries, Academic Foundations, India,1992
5. Umadevi, G, Land Use Transport Interaction Modeling – A Systems Approach, Ph.D thesis, Division of Transportation Engineering, College of Engineering, Guindy, Anna University, Chennai,2001
6. Technical Manual on An Introduction to Systems Thinking – STELLA Research Software, High Performance Systems Inc., Hannover,1996
7. Advanced Manual on An Introduction to Systems Thinking – STELLAII Research Software, High Performance Systems Inc., Hannover,2002

CO – PO Mapping - ADVANCED SYSTEM DYNAMICS MODELING IN TRANSPORTATION ENGINEERING							
PO/PSO		**Course Outcome**					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PROGRAM OUTCOMES (PO)							
PO1	Knowledge of Engineering Sciences	H	H	M	M	H	H
PO2	Problem analysis	H	H	M	M	H	H
PO3	Design / development of solutions	L	H	H	M	H	H
PO4	Investigation	H	H	M	M	H	H
PO5	Modern Tool Usage	M	M	M	H	H	H
PO6	Individual and Team work	H	H	H	H	H	H
PO7	Communication	M	M	M	L	H	H
PO8	Engineer and Society	M	M	M	H	H	H

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

PO9	Ethics	H	H	H	H		H
PO10	Environment and Sustainability	M	M	M	H	H	H
PO11	Project Management and Finance	M	H	M	M	H	M
PO12	Life Long Learning	M	H	M	M	H	H
PROGRAM SPECIFIC OBJECTIVES (PSO)							
PSO1	Knowledge in Urban Development, Traffic, Transportation, and Pavement Engineering	H	M	M	M	H	H
PSO2	Critical analysis of design of various Transport and pavement Infrastructures and Management.	H	H	M	M	H	H
PSO3	Conceptualization and evaluation of Innovative engineering solutions to Transportation related issues.	H	M	H	M	H	H

TE5014 PAVEMENT MANAGEMENT SYSTEM L T P C

3 0 0 3

OBJECTIVE:

- To introduce the concepts of design, evaluation and performance of existing and new flexible and rigid pavements with due emphasis on systems approach and performance prediction models.

UNIT I PAVEMENT MANAGEMENT PROCESS 9

Historical background – general nature and applicability of systems methodology – basic components of Pavement Management System –Network and Project level of PMS - PMS functions- planning pavement investments.

UNIT II FUNCTIONAL EVALUATION AND PERFORMANCE 9

General concepts – economic and functional evaluation – evaluation of pavement performance– pavement distresses – condition surveys – safety evaluation visual rating of distresses, image processing; pavement friction, texture depth and skid resistance -LCMS laser crack management system- PCI development-application of GIS in pavement evaluation-case studies.

UNIT III PAVEMENT STRUCTURAL EVALUATION 9

Factors affecting Structural Condition of Flexible and Rigid Pavements- Pavement Deterioration- Evaluation by Non-Destructive Tests such as FWD, Benkelman Beam Rebound Deflection, Plate Load Test, Evaluation by Destructive Test Methods, and Specimen Testing - Structural analysis of Airfield pavements

UNIT IV PERFORMANCE PREDICTION MODELS 9

Pavement performance prediction - concepts, Techniques for developing prediction models – ranking and optimization methodologies- AASHO, CRRI and HDM models – computer applications – ANN, MATLAB–deterioration modeling- Pavement prioritization techniques.

UNIT V MAINTENANCE AND REHABILITATION 9

Repair of pavement defects – types of maintenance of flexible and rigid pavements - Preservation and surface treatments - fog seals, crack sealing, slurry sealing and Overlays - Design of Overlays- Whitetopping, microsurfacing ,thin overlays . Use of Geo synthetics in Pavement.

TOTAL: 45 PERIODS

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

OUTCOME:

CO1	Apply the knowledge on methods of pavement management.
CO2	Conduct research on the functional evaluation and performance of pavements
CO3	Conduct research on the Structural performance of pavements
CO4	Apply the mathematical theories and concepts in predicting the performance of pavements.
CO5	Understand and Select various maintenance and rehabilitation methods with real time case studies.

REFERENCES:

1. Sahini M.Y., Chapman and Hall," Pavement Management for Airports, Roads and Parking Lots" , New York,1992.
2. Srinivasa Kumar.R," Pavement Evaluation, Maintenance & Management system, Universities Press India P Ltd, 2014
3. Ralph Haas, W. Ronald Hudson and John Zaniewski, Modern Pavement Management, Kreigar Publishing Company, New York,1994
4. Michael Sargious, Pavements and Surfacings for Highways and Airports, Applied Science Publishers Limited, London,1975

CO – PO Mapping - CO – PO Mapping - PAVEMENT MANAGEMENT SYSTEM							
PO/PSO		**Course Outcome**					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PROGRAM OUTCOMES (PO)							
PO1	Knowledge of Engineering Sciences	H	H	H		L	H
PO2	Problem analysis		M	M			M
PO3	Design / development of solutions	M	M	M	M	L	M
PO4	Investigation	H	H	H			H
PO5	Modern Tool Usage	M	M	H	H	H	H
PO6	Individual and Team work	L			L	L	L
PO7	Communication					L	L
PO8	Engineer and Society		M	M	M		M
PO9	Ethics	H	H	H	H		H
PO10	Environment and Sustainability	H	H	H			H
PO11	Project Management and Finance				M	M	M
PO12	Life Long Learning		M	M	M		M
PROGRAM SPECIFIC OBJECTIVES (PSO)							
PSO1	Knowledge in Urban Development, Traffic, Transportation, and Pavement Engineering	H	H	H	H	M	H
PSO2	Critical analysis of design of various Transport and pavement Infrastructures and Management.	H	H	H	M	L	H
PSO3	Conceptualization and evaluation of Innovative engineering solutions to Transportation related issues.	H	M	M	M	H	M

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

TE5015 ENVIRONMENTAL IMPACT ASSESSMENT OF TRANSPORTATION PROJECTS **L T P C 3 0 0 3**

OBJECTIVE:

- To expose the students to the need, methodology, documentation and requirements of environmental and social impact assessment of Transportation Projects.

UNIT I ENVIRONMENTAL REGULTIONS AND EIA 10

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, Coastal Regulation Zone - Ambient Air Quality and noise Standards - EIA in Project Cycle- Impact of Traffic and transport on Environment-EIA Notification- EIA process and terms of reference for EIA of transportation Projects.

UNIT II ENVIRONMENTAL IMPACT INDENTIFICATION AND PREDICTION 10

Vehicle and Traffic Noise, Ambient Noise Level, Heath Effects, Vibration – Damage to building, Exhaust Emission –Measurement of Air and Noise Pollution- Air Pollution effects on Human being, Vegetation and Animals -Data analysis and Prediction of Pollution and Impact Data – Line source emission modeling– Noise pollution prediction.

UNIT III SOCIAL IMPACT ASSESSMENT 8

Urban Growth Indicators of Environmental Quality, Energy use, Fuel Economy in Transportation, Energy Efficiency strategies - Land Acquisition- Public Consultation - Cost benefit analysis - Rehabilitation Plans

UNIT IV ENVIRONMENTAL MANAGEMENT PLAN 9

Assessment of impacts – air – water – soil – noise – biological-visual — Cumulative Impact Assessment - Analysis of alternatives - Mitigation measures for Air and Noise Pollution – mitigating the impacts on flora and fauna - Environmental monitoring plan – Institutional arrangements- Documentation of EIA findings - Post project audit

UNIT V CASE STUDIES 8

Case studies on Environmental and social Impact assessment of Transportation projects such as Highways, Railways, Airports, Flyovers, Bridges, Ports and Harbor,

TOTAL: 45 PERIODS

OUTCOME:

- Students would have understood the impact of Transportation projects on the environment and are able to develop and implement mitigation measures.
- They will also know about the legal requirements of Environmental Assessment for projects.

REFERENCES:

1. Larry W Canter, "Environmental Impact Assessment", McGraw Hill Publishers, 1996.
2. John Glasson, Riki Therivel, Andrew Chadwick, Introduction to Environmental Impact Assessment", 4th Edition, Routledge, New York.2012
3. David Banister; "Transport Policy and Environment" Routledge,UK,, 2002
4. World Bank; "the Impact of Environmental Assessment – A Review of World Bank Experience, Washington, 1997.
5. World Bank; Road and the Environment, World Bank Technical paper no. 363, Washington, 1997.
6. Scottish Natural Heritage, A handbook on environmental impact assessment, 4th Edition, Natural Heritage Management, www.snh.gov.uk., 2013

CO – PO Mapping - ENVIRONMENTAL IMPACT ASSESSMENT OF TRANSPORTATION PROJECTS							
PO/PSO		**Course Outcome**					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PROGRAM OUTCOMES (PO)							
PO1	Knowledge of Engineering Sciences	M	M		H	H	H
PO2	Problem analysis			M	H	H	H
PO3	Design / development of solutions	L	M	M	H		M
PO4	Investigation	H	H	M		H	H
PO5	Modern Tool Usage	M	H	M	H	M	M
PO6	Individual and Team work		H				H
PO7	Communication		M	M			M
PO8	Engineer and Society	M	M	H	H	H	H
PO9	Ethics	H	H		M	H	H
PO10	Environment and Sustainability	H	H	H	H	H	H
PO11	Project Management and Finance		H	M	M		M
PO12	Life Long Learning	L	M	L	M	L	M
PROGRAM SPECIFIC OBJECTIVES (PSO)							
PSO1	Knowledge in Urban Development, Traffic, Transportation, and Pavement Engineering	L		M			L
PSO2	Critical analysis of design of various Transport and pavement Infrastructures and Management.	M	M				M
PSO3	Conceptualization and evaluation of Innovative engineering solutions to Transportation related issues.		M	M		M	M

TE5016 URBAN INFRASTRUCTURE AND ASSET MANAGEMENT L T P C
3 0 0 3

OBJECTIVE:

- The course will emphasize the use of emerging technologies, information systems, and decision making tools that support the various elements of the asset management framework.

UNIT I ROAD ASSET MANAGEMENT 9

Road Asset management- designing and developing rigid (or flexible) pavement with integrated structure for underground utilities & services- Network of underground road system, need for and planning and development.

UNIT II INNOVATIVE TRANSPORT MODES 9

straddling bus concept and development (eg China)- e-rickshaws- Alternate (renewable) energy options for powering transport system- solar powered aircraft -bio-bus and its impact on solid waste management - solar-powered traffic signals and street lights- all-electric bus route with wireless charging -buses park over metal plates buried in the road.

UNIT III TELECOMMUNICATION & ITS IMPACT ON TRANSPORT 9

Commerce- e-tailing-mobile application in trade &commerce- internet-banking- internet and mobile phone in governance-services ranging from e-billing & payment for services-EB/telephone/income tax/ municipal tax & service charges/cooking gas booking &payment-booking and payment of air, train &train tickets; booking and payment of cinema tickets-teleshopping of groceries-tele-checking at airports- obtaining birth and death certificates-booking and payment for call taxis & autorickshaws; carpooling through net and mobile phones-global meets through teleconferencing- case studies

UNIT IV CLOUD-COMPUTING AND ITS IMPACTON TRANSPORT 9

The contribution of transport planning & development in conceptualization of smart cities-advances in capturing and processing traffic data in real time and managing traffic congestion-role of SCOOT & SCAT in reducing and minimizing traffic congestion- establishment of a sensor-networked and monitored city communication infrastructure, efficiently phasing traffic lights, and providing real-time guidance to drivers, can aid in reducing congestion. Digitally monitored parking spaces, able to dynamically alter prices according to available spaces, help control time spent cruising for parking.

UNITV ROLE OF SMART CARD AND COMMUTING 9

Electronic Road Pricing (ERP) and congestion pricing- Innovative financing- carbon credit - case studies

TOTAL: 45 PERIODS

OUTCOME:

CO1	Understanding the road assets and their management techniques.
CO2	Classify the various innovative infrastructures and technologies in transport field
CO3	Understand the impact of telecommunication in transport sectors and their applications.
CO4	Explain Cloud computing and its impact in Transportation engineering
CO5	Understand the road pricing techniques and financial viability

REFERENCES:

1. International Infrastructure Management Manual. Edition2011.
2. Asset Management for Road sector" , OECD Publications Service, 2, Paris Cedex 16, France 2001.

CO – PO Mapping - URBAN INFRASTRUCTURE AND ASSET MANAGEMENT							
PO/PSO		**Course Outcome**					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PROGRAM OUTCOMES (PO)							
PO1	Knowledge of Engineering Sciences	H	H	H		L	H
PO2	Problem analysis		M	M			M
PO3	Design / development of solutions	M	M	M	M	L	M
PO4	Investigation	H	H	H			H
PO5	Modern Tool Usage	M	M	H	H	H	H
PO6	Individual and Team work	L			L	L	L
PO7	Communication					L	L
PO8	Engineer and Society		M	M	M		M
PO9	Ethics	H	H	H	H		H
PO10	Environment and Sustainability	H	H	H			H
PO11	Project Management and Finance				M	M	M
PO12	Life Long Learning		M	M	M		M

PROGRAM SPECIFIC OBJECTIVES (PSO)							
PSO1	Knowledge in Urban Development, Traffic, Transportation, and Pavement Engineering	H	H	H	H	M	H
PSO2	Critical analysis of design of various Transport and pavement Infrastructures and Management.	H	H	H	M	L	H
PSO3	Conceptualization and evaluation of Innovative engineering solutions to Transportation related issues.	H	M	M	M	H	M

TE5017 LOGISTICS IN TRANSPORTATION ENGINEERING L T P C
3 0 0 3

OBJECTIVE:

- Provides an understanding on Freight Transport, Modeling, Location of the Facility and its Management

UNIT I LOGISTICS 7

Introduction – Trade Logistics Service, Freight Costs – Freight Demand Models.

UNIT II FREIGHT TRANSPORT 10

Econometric Models for Freight Forecasting – Input Output Models – Regional Network Systems – Graph Theory Application in Network Planning.

UNIT III DISTRIBUTION MANAGEMENT 10

Supply Chain – Warehousing – Facility Location, Inventory – Mode Choice – Distribution System, Vehicle Routing and Scheduling- Monitoring of overloaded commercial vehicles

UNIT IV LOGISTICS MANAGEMENT 10

Logistics out sourcing – IT Application in Freight Logistics – Technology in Logistics Management – Intermodal Transportation

UNIT V ITS APPLICATION IN FREIGHT TRANSPORT 8

Commercial Fleet Management, Toll Plaza Analysis- E commerce - E tailing- City logistics Evaluating Schemes – case studies

TOTAL : 45 PERIODS

OUTCOME:

CO1	Understands basic knowledge about logistics
CO2	Knowledge on freight transport models and application
CO3	Able to manage the distribution in real time application
CO4	Managing logistics with technology.
CO5	Applying ITS in freight transport with case studies

REFERENCES

1. Blanchard S.Benjamen, "Logistics Engineering and Management", Prentice Hall, Inc, Eaglewood Cliffs, New Jersey 07632,1986
2. Coyle J.J.Bardi JE, "The Management of Business Logistics", West Publishing Company, New York,1984
3. Daganzo F.C and Newell FG, Vol.19B, No.5, pp.397-407, Physical Distribution from a Warehouse; Vehicle Coverage and Inventory Levels, Transportation Research,1985
4. Edwin Bacht J.A., "Geography of Transportation and Business Logistics", Wm C Brown Company Publishers, Dubuque, IOWA,1970
5. Herron P.David, "Managing Physical Distribution for Profit", Harvard Business Review, 1979

6. Khanna K.K., "Physical Distribution Management", Logistical Approach, Himalaya Publishing House, Bombay,1985
7. Planning Commission, Government of India, Total Transport System Study – Report on Commodity Flows, Railways, Highways and Coastal Shipping, (Interim) by RITES, New Delhi, 1987.
8. Shapiro D. Roy and Heskett L.James, "Logistics Strategy-Cases and Concepts", Wesg Publishing Company, New York,1985

CO – PO Mapping - LOGISTICS IN TRANSPORTATION ENGINEERING							
PO/PSO		**Course Outcome**					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PROGRAM OUTCOMES (PO)							
PO1	Knowledge of Engineering Sciences		M	M	M		
PO2	Problem analysis		M	M	M		M
PO3	Design / development of solutions		M	M	M		M
PO4	Investigation			M	M		M
PO5	Modern Tool Usage		M	L	M	H	M
PO6	Individual and Team work		H	H	H	M	H
PO7	Communication				M	H	H
PO8	Engineer and Society	M	H	M	M	L	M
PO9	Ethics	M	M	M	H	L	M
PO10	Environment and Sustainability					M	M
PO11	Project Management and Finance	L	M	H	H	M	H
PO12	Life Long Learning	M	H	M	H	M	M
PROGRAM SPECIFIC OBJECTIVES (PSO)							
PSO1	Knowledge in Urban Development, Traffic, Transportation , and Pavement Engineering					M	M
PSO2	Critical analysis of design of various Transport and pavement Infrastructures and Management.		H	H	H		H
PSO3	Conceptualization and evaluation of Innovative engineering solutions to Transportation related issues.	L	H	M	H	H	H

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

OPEN ELECTIVE COURSES (OEC)

OE5091 BUSINESS DATA ANALYTICS L T P C
3 0 0 3

OBJECTIVES:

- To understand the basics of business analytics and its life cycle.
- To gain knowledge about fundamental business analytics.
- To learn modeling for uncertainty and statistical inference.
- To understand analytics using Hadoop and Map Reduce frameworks.
- To acquire insight on other analytical frameworks.

UNIT I OVERVIEW OF BUSINESS ANALYTICS 9

Introduction – Drivers for Business Analytics – Applications of Business Analytics: Marketing and Sales, Human Resource, Healthcare, Product Design, Service Design, Customer Service and Support – Skills Required for a Business Analyst – Framework for Business Analytics Life Cycle for Business Analytics Process.

Suggested Activities:

- Case studies on applications involving business analytics.
- Converting real time decision making problems into hypothesis.
- Group discussion on entrepreneurial opportunities in Business Analytics.

Suggested Evaluation Methods:

- Assignment on business scenario and business analytical life cycle process.
- Group presentation on big data applications with societal need.
- Quiz on case studies.

UNIT II ESSENTIALS OF BUSINESS ANALYTICS 9

Descriptive Statistics – Using Data – Types of Data – Data Distribution Metrics: Frequency, Mean, Median, Mode, Range, Variance, Standard Deviation, Percentile, Quartile, z-Score, Covariance, Correlation – Data Visualization: Tables, Charts, Line Charts, Bar and Column Chart, Bubble Chart, Heat Map – Data Dashboards.

Suggested Activities:

- Solve numerical problems on basic statistics.
- Explore chart wizard in MS Excel Case using sample real time data for data visualization.
- Use R tool for data visualization.

Suggested Evaluation Methods:

- Assignment on descriptive analytics using benchmark data.
- Quiz on data visualization for univariate, bivariate data.

UNIT III MODELING UNCERTAINTY AND STATISTICAL INFERENCE 9

Modeling Uncertainty: Events and Probabilities – Conditional Probability – Random Variables – Discrete Probability Distributions – Continuous Probability Distribution – Statistical Inference: Data Sampling – Selecting a Sample – Point Estimation – Sampling Distributions – Interval Estimation – Hypothesis Testing.

Suggested Activities:

- Solving numerical problems in sampling, probability, probability distributions and hypothesis testing.
- Converting real time decision making problems into hypothesis.

Suggested Evaluation Methods:

- Assignments on hypothesis testing.
- Group presentation on real time applications involving data sampling and hypothesis testing.
- Quizzes on topics like sampling and probability.

UNIT IV ANALYTICS USING HADOOP AND MAPREDUCE FRAMEWORK 9

Introducing Hadoop – RDBMS versus Hadoop – Hadoop Overview – HDFS (Hadoop Distributed File System) – Processing Data with Hadoop – Introduction to MapReduce – Features of MapReduce – Algorithms Using Map-Reduce: Matrix-Vector Multiplication, Relational Algebra Operations, Grouping and Aggregation – Extensions to MapReduce.

Suggested Activities:

- Practical – Install and configure Hadoop.
- Practical – Use web based tools to monitor Hadoop setup.
- Practical – Design and develop MapReduce tasks for word count, searching involving text corpus etc.

Suggested Evaluation Methods:

- Evaluation of the practical implementations.
- Quizzes on topics like HDFS and extensions to MapReduce.

UNIT V OTHER DATA ANALYTICAL FRAMEWORKS 9

Overview of Application development Languages for Hadoop – PigLatin – Hive – Hive Query Language (HQL) – Introduction to Pentaho, JAQL – Introduction to Apache: Sqoop, Drill and Spark, Cloudera Impala – Introduction to NoSQL Databases – Hbase and MongoDB.

Suggested Activities:

- Practical – Installation of NoSQL database like MongoDB.
- Practical – Demonstration on Sharding in MongoDB.
- Practical – Install and run Pig
- Practical – Write PigLatin scripts to sort, group, join, project, and filter data.
- Design and develop algorithms to be executed in MapReduce involving numerical methods for analytics.

Suggested Evaluation Methods:

- Mini Project (Group) – Real time data collection, saving in NoSQL, implement analytical techniques using Map-Reduce Tasks and Result Projection.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course, the student will be able to:

- Identify the real world business problems and model with analytical solutions.
- Solve analytical problem with relevant mathematics background knowledge.
- Convert any real world decision making problem to hypothesis and apply suitable statistical testing.
- Write and Demonstrate simple applications involving analytics using Hadoop and MapReduce
- Use open source frameworks for modeling and storing data.
- Apply suitable visualization technique using R for visualizing voluminous data.

REFERENCES:

1. Vignesh Prajapati, “Big Data Analytics with R and Hadoop”, Packt Publishing, 2013.
2. Umesh R Hodeghatta, Umesha Nayak, “Business Analytics Using R – A Practical Approach”, Apress, 2017.
3. Anand Rajaraman, Jeffrey David Ullman, “Mining of Massive Datasets”, Cambridge University Press, 2012.
4. Jeffrey D. Camm, James J. Cochran, Michael J. Fry, Jeffrey W. Ohlmann, David R. Anderson, “Essentials of Business Analytics”, Cengage Learning, second Edition, 2016.
5. U. Dinesh Kumar, “Business Analytics: The Science of Data-Driven Decision Making”, Wiley, 2017.
6. A. Ohri, “R for Business Analytics”, Springer, 2012
7. Rui Miguel Forte, “Mastering Predictive Analytics with R”, Packt Publication, 2015.

Business Data Analytics

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	1	1	2	3	1
CO2	2	1	1	2	1	1
CO3	1	1	2	3	3	1
CO4	2	2	1	2	1	1
CO5	1	1	2	2	1	1
CO6	1	1	1	3	2	1

OE5092 INDUSTRIAL SAFETY LT P C
3 0 0 3

OBJECTIVES:

- Summarize basics of industrial safety
- Describe fundamentals of maintenance engineering
- Explain wear and corrosion
- Illustrate fault tracing
- Identify preventive and periodic maintenance

UNIT I INTRODUCTION 9

Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

UNIT II FUNDAMENTALS OF MAINTENANCE ENGINEERING 9

Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

UNIT III WEAR AND CORROSION AND THEIR PREVENTION 9

Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT IV FAULT TRACING 9

Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

UNIT V PERIODIC AND PREVENTIVE MAINTENANCE 9

Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

TOTAL: 45 PERIODS

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

OUTCOMES:

CO1: Ability to summarize basics of industrial safety
CO2: Ability to describe fundamentals of maintenance engineering
CO3: Ability to explain wear and corrosion
CO4: Ability to illustrate fault tracing
CO5: Ability to identify preventive and periodic maintenance

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											
CO2	✓											
CO3	✓	✓	✓									
CO4	✓	✓	✓									
CO5	✓	✓	✓									

REFERENCES:

1. Audels, Pump-hydraulic Compressors, Mcgrew Hill Publication, 1978.
2. Garg H P,Maintenance Engineering, S. Chand and Company,1987.
3. Hans F. Winterkorn ,Foundation Engineering Handbook, Chapman & Hall London,2013.
4. Higgins & Morrow , Maintenance Engineering Handbook,Eighth Edition,2008

OE5093 OPERATIONS RESEARCH L T P C
3 0 0 3

OBJECTIVES:

- Solve linear programming problem and solve using graphical method.
- Solve LPP using simplex method
- Solve transportation , assignment problems
- Solve project management problems
- Solve scheduling problems

UNIT I LINEAR PROGRAMMING 9

Introduction to Operations Research – assumptions of linear programming problems - Formulations of linear programming problem – Graphical method

UNIT II ADVANCES IN LINEAR PROGRAMMING 9

Solutions to LPP using simplex algorithm- Revised simplex method - primal dual relationships – Dual simplex algorithm - Sensitivity analysis

UNIT III NETWORK ANALYSIS – I 9

Transportation problems -Northwest corner rule, least cost method,Voges's approximation method - Assignment problem -Hungarian algorithm

UNIT IV NETWORK ANALYSIS – II 9

Shortest path problem: Dijkstra's algorithms, Floyds algorithm, systematic method -CPM/PERT

UNIT V NETWORK ANALYSIS – III 9

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models

TOTAL: 45 PERIODS

OUTCOMES:

CO1: To formulate linear programming problem and solve using graphical method.
CO2: To solve LPP using simplex method
CO3: To formulate and solve transportation, assignment problems
CO4: To solve project management problems
CO5: To solve scheduling problems

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											
CO2	✓											
CO3	✓	✓	✓									
CO4	✓	✓	✓									
CO5	✓	✓	✓									

REFERENCES:

1. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010
2. Hitler Libermann, Operations Research: McGraw Hill Pub. 2009
3. Pant J C, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Pannerselvam, Operations Research: Prentice Hall of India 2010
5. Taha H A, Operations Research, An Introduction, PHI, 2008

OE5094 COST MANAGEMENT OF ENGINEERING PROJECTS L T P C
3 0 0 3

OBJECTIVES:

- Summarize the costing concepts and their role in decision making
- Infer the project management concepts and their various aspects in selection
- Interpret costing concepts with project execution
- Develop knowledge of costing techniques in service sector and various budgetary control techniques
- Illustrate with quantitative techniques in cost management

UNIT I INTRODUCTION TO COSTING CONCEPTS 9

Objectives of a Costing System; Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost; Creation of a Database for operational control.

UNIT II INTRODUCTION TO PROJECT MANAGEMENT 9

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities, Detailed Engineering activities, Pre project execution main clearances and documents, Project team: Role of each member,Importance Project site: Data required with significance, Project contracts.

UNIT III PROJECT EXECUTION AND COSTING CONCEPTS 9

Project execution Project cost control, Bar charts and Network diagram, Project commissioning: mechanical and process, Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis, Various decision-making problems, Pricing strategies: Pareto Analysis, Target costing, Life Cycle Costing.

UNIT IV COSTING OF SERVICE SECTOR AND BUDGETERY CONTROL 9

Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis, Budgetary Control: Flexible Budgets; Performance budgets; Zero-based budgets.

UNIT V QUANTITATIVE TECHNIQUES FOR COST MANAGEMENT 9

Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Learning Curve Theory.

TOTAL: 45 PERIODS

OUTCOMES

CO1 – Understand the costing concepts and their role in decision making
CO2 – Understand the project management concepts and their various aspects in selection
CO3 – Interpret costing concepts with project execution
CO4 – Gain knowledge of costing techniques in service sector and various budgetary control techniques
CO5 - Become familiar with quantitative techniques in cost management

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓		✓			✓	✓		✓	✓
CO2	✓	✓	✓		✓				✓		✓	✓
CO3	✓	✓	✓		✓	✓					✓	✓
CO4	✓	✓	✓		✓		✓				✓	✓
CO5	✓	✓	✓		✓	✓	✓				✓	✓

REFERENCES:

1. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher, 1991
2. Charles T. Horngren and George Foster, Advanced Management Accounting, 1988
3. Charles T. Horngren et al Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi, 2011
4. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting, 2003
5. Vohra N.D., Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd, 2007

OE5095 COMPOSITE MATERIALS L T P C
3 0 0 3

OBJECTIVES:

- Summarize the characteristics of composite materials and effect of reinforcement in composite materials.
- Identify the various reinforcements used in composite materials.
- Compare the manufacturing process of metal matrix composites.
- Understand the manufacturing processes of polymer matrix composites.
- Analyze the strength of composite materials.

UNIT I INTRODUCTION 9

Definition – Classification and characteristics of Composite materials - Advantages and application of composites - Functional requirements of reinforcement and matrix - Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT II REINFORCEMENTS 9

Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers - Properties and applications of whiskers, particle reinforcements - Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures - Isostrain and Isostress conditions.

UNIT III MANUFACTURING OF METAL MATRIX COMPOSITES 9

Casting – Solid State diffusion technique - Cladding – Hot isostatic pressing - Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving - Properties and applications.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT IV MANUFACTURING OF POLYMER MATRIX COMPOSITES 9

Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding - Properties and applications.

UNIT V STRENGTH 9

Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

TOTAL: 45 PERIODS

OUTCOMES:

- CO1 - Know the characteristics of composite materials and effect of reinforcement in composite materials.
- CO2 – Know the various reinforcements used in composite materials.
- CO3 – Understand the manufacturing processes of metal matrix composites.
- CO4 – Understand the manufacturing processes of polymer matrix composites.
- CO5 – Analyze the strength of composite materials.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		✓	✓	✓								
CO2		✓	✓	✓	✓						✓	
CO3			✓	✓	✓		✓				✓	
CO4			✓	✓	✓		✓				✓	
CO5				✓	✓		✓					

REFERENCES:

1. Cahn R.W. - Material Science and Technology – Vol 13 – Composites, VCH, West Germany.
2. Callister, W.D Jr., Adapted by Balasubramaniam R, Materials Science and Engineering, An introduction, John Wiley & Sons, NY, Indian edition, 2007.
3. Chawla K.K., Composite Materials, 2013.
4. Lubin.G, Hand Book of Composite Materials, 2013.

OE5096 WASTE TO ENERGY L T P C
3 0 0 3

OBJECTIVES:

- Interpret the various types of wastes from which energy can be generated
- Develop knowledge on biomass pyrolysis process and its applications
- Develop knowledge on various types of biomass gasifiers and their operations
- Invent knowledge on biomass combustors and its applications on generating energy
- Summarize the principles of bio-energy systems and their features

UNITI INTRODUCTION TO EXTRACTION OF ENERGY FROM WASTE 9

Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

UNITII BIOMASS PYROLYSIS 9

Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT III BIOMASS GASIFICATION 9

Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

UNIT IV BIOMASS COMBUSTION 9

Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

UNITV BIO ENERGY 9

Properties of biogas (Calorific value and composition), Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production -Urban waste to energy conversion - Biomass energy programme in India.

TOTAL: 45 PERIODS

OUTCOMES:

CO1 – Understand the various types of wastes from which energy can be generated
CO2 – Gain knowledge on biomass pyrolysis process and its applications
CO3 – Develop knowledge on various types of biomass gasifiers and their operations
CO4 – Gain knowledge on biomass combustors and its applications on generating energy
CO5 – Understand the principles of bio-energy systems and their features

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓		✓									✓
CO2	✓		✓									✓
CO3	✓	✓	✓		✓							✓
CO4	✓	✓	✓		✓		✓					✓
CO5	✓	✓	✓		✓							✓

REFERENCES:

1. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
2. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

AUDIT COURSES (AC)

AX5091 ENGLISH FOR RESEARCH PAPER WRITING L T P C
2 0 0 0

OBJECTIVES

- Teach how to improve writing skills and level of readability
- Tell about what to write in each section
- Summarize the skills needed when writing a Title
- Infer the skills needed when writing the Conclusion
- Ensure the quality of paper at very first-time submission

UNIT I INTRODUCTION TO RESEARCH PAPER WRITING 6

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT II PRESENTATION SKILLS 6

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction

UNIT III TITLE WRITING SKILLS 6

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check

UNIT IV RESULT WRITING SKILLS 6

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

UNIT V VERIFICATION SKILLS 6

Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first- time submission

TOTAL: 30 PERIODS

OUTCOMES

CO1 –Understand that how to improve your writing skills and level of readability
CO2 – Learn about what to write in each section
CO3 – Understand the skills needed when writing a Title
CO4 – Understand the skills needed when writing the Conclusion
CO5 – Ensure the good quality of paper at very first-time submission

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1										✓		✓
CO2										✓		✓
CO3										✓		✓
CO4										✓		✓
CO5										✓		✓

REFERENCES

1. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011
2. Day R How to Write and Publish a Scientific Paper, Cambridge University Press 2006
3. Goldbort R Writing for Science, Yale University Press (available on Google Books) 2006
4. Highman N, Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book 1998.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

AX5092 **DISASTER MANAGEMENT** **L T P C**
2 0 0 0

OBJECTIVES

- Summarize basics of disaster
- Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Develop the strengths and weaknesses of disaster management approaches

UNIT I INTRODUCTION **6**

Disaster: Definition, Factors and Significance; Difference between Hazard And Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT II REPERCUSSIONS OF DISASTERS AND HAZARDS **6**

Economic Damage, Loss of Human and Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

UNIT III DISASTER PRONE AREAS IN INDIA **6**

Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides And Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference To Tsunami; Post-Disaster Diseases and Epidemics

UNIT IV DISASTER PREPAREDNESS AND MANAGEMENT **6**

Preparedness: Monitoring Of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological And Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT V RISK ASSESSMENT **6**

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival

TOTAL : 30 PERIODS

OUTCOMES

CO1: Ability to summarize basics of disaster
CO2: Ability to explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
CO3: Ability to illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
CO4: Ability to describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
CO5: Ability to develop the strengths and weaknesses of disaster management approaches

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											
CO2	✓											
CO3	✓	✓	✓									
CO4	✓	✓	✓									
CO5	✓	✓	✓									

REFERENCES

1. Goel S. L., Disaster Administration And Management Text And Case Studies",Deep & Deep Publication Pvt. Ltd., New Delhi,2009.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

2. NishithaRai, Singh AK, “Disaster Management in India: Perspectives, issues and strategies” NewRoyal book Company,2007.
3. Sahni, PardeepEt.Al. ,” Disaster Mitigation Experiences And Reflections”, Prentice Hall OfIndia, New Delhi,2001.

AX5093 SANSKRIT FOR TECHNICAL KNOWLEDGE L T P C
2 0 0 0

OBJECTIVES

- Illustrate the basic sanskrit language.
- Recognize sanskrit, the scientific language in the world.
- Appraise learning of sanskrit to improve brain functioning.
- Relate sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power.
- Extract huge knowledge from ancient literature.

UNIT I ALPHABETS **6**
Alphabets in Sanskrit

UNIT II TENSES AND SENTENCES **6**
Past/Present/Future Tense - Simple Sentences

UNIT III ORDER AND ROOTS **6**
Order - Introduction of roots

UNIT IV SANSKRIT LITERATURE **6**
Technical information about Sanskrit Literature

UNIT V TECHNICAL CONCEPTS OF ENGINEERING **6**
Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

TOTAL: 30 PERIODS

OUTCOMES

- CO1 - Understanding basic Sanskrit language.
- CO2 - Write sentences.
- CO3 - Know the order and roots of Sanskrit.
- CO4 - Know about technical information about Sanskrit literature.
- CO5 - Understand the technical concepts of Engineering.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1										✓		✓
CO2										✓		✓
CO3												✓
CO4												✓
CO5												✓

REFERENCES

1. “Abhyaspustakam” – Dr. Vishwas, Samskrita-Bharti Publication, New Delhi
2. “Teach Yourself Sanskrit” Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. “India’s Glorious Scientific Tradition” Suresh Soni, Ocean books (P) Ltd., New Delhi, 2017.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

AX5094 **VALUE EDUCATION** **L T P C**
2 0 0 0

OBJECTIVES
Students will be able to
- Understand value of education and self-development
- Imbibe good values in students
- Let the should know about the importance of character

UNIT I
Values and self-development–Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non-moral valuation. Standards and principles. Value judgements

UNIT II
Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline

UNIT III
Personality and Behavior Development-Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour.
Universal brother hood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature

UNIT IV
Character and Competence–Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively.

TOTAL: 30 PERIODS

OUTCOMES
Students will be able to
- Knowledge of self-development.
- Learn the importance of Human values.
- Developing the overall personality.

Suggested reading
1. Chakroborty, S.K."Values and Ethics for organizations Theory and practice", Oxford University Press, New Delhi

AX5095 **CONSTITUTION OF INDIA** **L T P C**
2 0 0 0

OBJECTIVES
Students will be able to:
- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional
- Role and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolutionin1917and its impact on the initial drafting of the Indian Constitution.

UNIT I HISTORY OF MAKING OF THE INDIAN CONSTITUTION
History, Drafting Committee, (Composition & Working)

UNIT II PHILOSOPHY OF THE INDIAN CONSTITUTION
Preamble, Salient Features

UNIT III CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES

Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT IV ORGANS OF GOVERNANCE

Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.

UNIT V LOCAL ADMINISTRATION

District's Administration head: Role and Importance, • Municipalities: Introduction, Mayor and role of Elected Representative, CEO, Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy(Different departments), Village level:Role of Elected and Appointed officials, Importance of grass root democracy.

UNIT VI ELECTION COMMISSION

Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.

TOTAL: 30 PERIODS

OUTCOMES

Students will be able to:

- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the conceptualization
- of social reforms leading to revolution in India.
- Discuss the circumstances surrounding the foundation of the Congress Socialist Party[CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
- Discuss the passage of the Hindu Code Bill of 1956.

Suggested reading

1. The Constitution of India,1950(Bare Act),Government Publication.
2. Dr.S.N.Busi, Dr.B. R.Ambedkar framing of Indian Constitution,1st Edition, 2015.
3. M.P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis,2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

AX5096 PEDAGOGY STUDIES L T P C
2 0 0 0

OBJECTIVES

Students will be able to:

- Review existing evidence on there view topic to inform programme design and policy
- Making under taken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

UNIT I INTRODUCTION AND METHODOLOGY

Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions **-** Overview of methodology and Searching.

UNIT II THEMATIC OVERVIEW

Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.

UNIT III EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES

Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT IV PROFESSIONAL DEVELOPMENT

Professional development: alignment with classroom practices and follow up support - Peer support - Support from the head teacher and the community - Curriculum and assessment - Barriers to learning: limited resources and large class sizes

UNIT V RESEARCH GAPS AND FUTURE DIRECTIONS

Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact.

TOTAL: 30 PERIODS

OUTCOMES

Students will be able to understand:

- What pedagogical practices are being used by teachers informal and informal classrooms in developing countries?
- What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

Suggested reading

1. Ackers J, HardmanF (2001) Classroom interaction in Kenyan primary schools, Compare, 31(2): 245-261.
2. Agrawal M (2004)Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36(3):361-379.
3. Akyeampong K (2003) Teacher training in Ghana-does it count? Multi-site teacher education research project (MUSTER) country report 1.London:DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33(3): 272–282.
5. Alexander RJ(2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M(2003) Read India: Amass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf

AX5097 STRESS MANAGEMENT BY YOGA L T P C
2 0 0 0

OBJECTIVES

- To achieve overall health of body and mind
- To overcome stress

UNIT I

Definitions of Eight parts of yoga.(Ashtanga)

UNIT II

Yam and Niyam - Do's and Don't's in life - i) Ahinsa, satya, astheya, bramhacharya and aparigraha, ii) Ahinsa, satya, astheya, bramhacharya and aparigraha.

UNIT III

Asan and Pranayam - Various yog poses and their benefits for mind & body - Regularization of breathing techniques and its effects-Types of pranayam

TOTAL: 30 PERIODS

OUTCOMES

Students will be able to

- Develop healthy mind in a healthy body thus improving social health also
- Improve efficiency

SUGGESTED READING

1. 'Yogic Asanas for Group Tarining-Part-I":Janardan Swami Yoga bhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

AX5098	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS	L T P C 2 0 0 0

OBJECTIVES

- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

UNIT I

Neetisatakam-holistic development of personality - Verses- 19,20,21,22 (wisdom) - Verses-29,31,32 (pride & heroism) – Verses- 26,28,63,65 (virtue) - Verses- 52,53,59 (dont's) - Verses-71,73,75,78 (do's)

UNIT II

Approach to day to day work and duties - Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48 - Chapter 3-Verses 13, 21, 27, 35 Chapter 6-Verses 5,13,17,23, 35 - Chapter 18-Verses 45, 46, 48.

UNIT III

Statements of basic knowledge - Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 Chapter 12 -Verses 13, 14, 15, 16,17, 18 - Personality of role model - shrimad bhagwad geeta - Chapter2-Verses 17, Chapter 3-Verses 36,37,42 - Chapter 4-Verses 18, 38,39 Chapter18 – Verses 37,38,63

TOTAL: 30 PERIODS

OUTCOMES

Students will be able to

- Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
- The person who has studied Geeta will lead the nation and mankind to peace and prosperity
- Study of Neet is hatakam will help in developing versatile personality of students.

Suggested reading

1. Gopinath, Rashtriya Sanskrit Sansthanam P, Bhartrihari's Three Satakam, Niti-sringar-vairagya, New Delhi,2010
2. Swami Swarupananda , Srimad Bhagavad Gita, Advaita Ashram, Publication Department, Kolkata, 2016.