



GUJARAT TECHNOLOGICAL UNIVERSITY

Master of Engineering- Transportation Engineering

Subject Code 3721302

Semester – II

Subject Name: Pavement, Design, Construction and Evaluation

Type of course: Core Course -III

Prerequisite: NIL

Rationale:

The Indian Government has set ambitious plans for upgrading of the National Highways in a phased manner. It is required to upgrade the knowledge of current practices in design of pavement structures. The objective of the course is to introduce the basic concepts of analysis and design of pavement structure. The current trends in design considering cumulative fatigue damage due to the combined effect of load and pavement temperature in rigid pavement are included in the present study. The study of recent development in design considering fatigue resistant mix and rut resistant mix for improving properties of various bituminous mix are also included. It includes the study of various types of failures of pavement and its remedial measures. It is necessary to reduce the cost of repairs and maintenance. The knowledge of construction techniques of various types of roads is backbone for the students. Various evaluation techniques are also covered in the course.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	Types of Pavements – Rigid, Flexible, Highway-Runway Comparison. explore innovative design methods that were developed to investigate distress mechanisms of pavements including alternatives intended to address some environmental performance goals, investigate decision making and design tools that will encourage the use of more sustainable pavement materials and structures, such as permeable pavements, rubber asphalt, recycled asphalt pavement (RAP) and alternative cement binders, and discuss possible applications of pavement design strategies that can have a considerable impact on fuel consumption, vehicle maintenance costs, greenhouse gas (GHG) emissions, and life-cycle costs.	5
2	Stresses in Flexible Pavements – Theories, Analysis. Design of Flexible Pavements – ESWL, Tyre Pressure, Other Factors, Various Methods for Highway and Runways Design, Mix Designs– Bituminous Mixes, Admixtures, Marshall Stability Test, Results, Control.	10
3	Stresses in Rigid Pavements – Theories, Analysis. Design of Rigid Pavements – EWLF, Other Factors Various Methods for Highways and Runways, Design of Joints,	10



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	Temperature stresses. Pre-stressed Concrete Pavements.	
4	Highway Construction Methods: Embankment, Sub- Base, Base and Surface Courses, Bituminous Pavement Construction, Cement Concrete Construction, Materials for road construction, Specification and tests, Macadam construction, surfacing and surface treatment, Road Work in Desert, Swampy, Hilly Area in Problematic Situation.	10
5	Surface and Subsurface Drainage.	2
6	Pavement evaluation and strengthening: Failures in flexible and rigid pavements, pavement evaluation, deflection survey, serviceability rating techniques, strengthening techniques, maintenance, overlays, replacements.	8
	TOTAL	45 Hr.

Suggested Specification table with Marks (Theory):

Distribution of marks weightage for cognitive level

Bloom's Taxonomy for Cognitive Domain	Marks Weightage (%)
Recall	10
Comprehension	10
Application	30
Analysis	20
Evaluate	20
Create	10

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. E. J. Yoder and M. W. Witczak, Principles of Pavement Design, John Wiley and Sons, New York, 1975
2. Tang, Pavement Design
3. Sharma & Shrama, Principles and Practice of Highway Engg.
4. Y. H. Huang, Pavement Analysis and Design. Prentice Hall, Englewood Cliffs, New Jersey, USA, 1993, ISBN-0-13-655275-7
5. H.N. Atkins, Highway Construction and Maintenance, Soils, and Concretes, Reston Publishing Company, Reston VA, 1983.
6. J. P. Watson, Highway Construction and Maintenance, Longman Scientific and Technical, New York, 1989.
7. Relevant IRC, BIS, AASHTO and PCA Specifications and Guidelines.
8. Kadiyali L. R. and Lal, N. B., Principles & Practice of Highway Engineering, Khanna Publishers, Delhi.
9. Khanna S.K., Justo C.E.G., Highway Engineering, Nem Chand & Bros., Roorkee.
10. Partho Chakraborty and Animesh Das, Principles of Transportation Engineering, PHI
11. F. L. Mannering, W. P. Kilareski and S. S. Washburn, Principles of Highway Engineering and Traffic Analysis. Wiley India Pvt. Ltd., New Delhi.



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12. Paul H. Wright, Karen K. Dixon, Highway Engineering, John Wiley & Sons, 7th edition, 2004.
13. SRC, DSIR, Bituminous Materials in Road Construction, HMSO publication.
14. Micheal Sargious Pavement and surfacing for Highway & Airports, Applied science Publishers Limited.
15. Kadiyali and Lal, Principles of highway engineering, Khanna Publishers, Delhi-6
16. IRC and IS related Codes for Flexible and Rigid Pavements design and Materials.
17. Peurifoy R.C, and C.J. Shexnaydr, Construction planning. Equipment and methods, , McGraw Hill, 2002
18. The Asphalt Handbook, MS-4, Asphalt Institute, Maryland, 1989
19. Handbook on Quality Control for Construction of Roads and Ruwaways, IRC, 1988
20. Specifications for Hot mix plant, IS:5890-1970 and IS:3066-1965, New Delhi.

Course Outcomes: At the end of the course, Student will be able

Sr. No.	CO statement	Marks % weightage
CO-1	To analyse stresses in pavements from given details, information and data set and able to present frameworks for mechanistic-empirical design methods for pavements.	20%
CO-2	To design different types of pavements using standard procedures and have knowledge of failures in pavements and their preventive measures	30%
CO-3	To describe various methods of construction of different types of roads and their components, specifications and tests thereof	10%
CO-4	To assess the problems / causes of failures in road construction in specific conditions and suggest preventive measures thereof.	30%
CO-5	To explain techniques to evaluate strength and serviceability of pavements, evaluation techniques of pavements, describe techniques of maintenance and strengthening, and suggest remedies.	10%

List of Experiments:

1. Viscosity Test
2. Plate Bearing Test.
3. Field CBR Test.
4. Pavement Evaluation by Benkelman Beam Method/Falling Weight Deflectometer
5. Road Unevenness Measurement by Bump-Integrator.
6. Evaluation of Pavement Roughness by Roughometer / Profilometer.
7. Marshall Stability Test
8. Bitumen Extractor Test
9. Mix Design for BC/DBM

List of Tutorials:

1. Problems based on analysis for Flexible and Rigid pavement.



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2. Tutorials based on design of Flexible Pavements for Highway and Runway.
3. Tutorials based on design of Rigid Pavements for Highway and Runway.
4. Tutorials based on design of Overlays.
5. Tutorials based on the pavement evaluation and strengthening.

Major Equipment:

1. Marshall Stability
2. Bump Integrator
3. CBR Apparatus
4. Viscosity meter
5. Benkelman beam

List of Open Source Software/learning website:

1. IITPAV
2. KENPAVE