SEMESTER S7

HIGHWAY MATERIALS AND DESIGN

Course Code	PECET746	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:3:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	PCCET502	Course Type	Theory

Course Objectives:

1. Understand the characteristics of various highway materials, tests on highway materials, and design of bituminous mixes,
2. Analyse the stresses on pavements and to design major types of pavements using different approaches so that it has better performance and longer service life

SYLLABUS

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Module No.	Syllabus Description	Contact Hours
1	**Pavements and materials: Desirable properties and testing of materials:** Introduction to highway pavements-Flexible and rigid pavements-component parts - Functions and significance of layers. Pavement Materials – Desirable properties, principle and procedure of tests for assessment of subgrade soil, road aggregates and bitumen.	9
2	**Bituminous mixes requirements and design:** Materials for durable pavements- Artificial aggregates, types of binders, -emulsions, cut backs and modified binders-grading, characteristics and uses. Aging of bitumen and aging tests. Requirements of bituminous mixes, Specifications for bituminous pavement layers. Grading of aggregates, design of bituminous mixes using Marshall Method.	9
3	**Design of flexible pavements:** Introduction to analysis and design of flexible pavements: Factors affecting design and performance of pavements, ESWL of multiple wheels, Repeated loads and EWL factors, stresses and	9

	deflections in homogeneous masses and layered system. Design of flexible pavements: Empirical, semi - empirical and theoretical approaches for flexible pavement design- Design of pavement using CBR method, Triaxial method, Burmister's two-layer theory and IRC method.	
4	**Design of rigid pavements:** Introduction to analysis and design of rigid pavements: Types of stresses -wheel load stress, warping stress, frictional stress and critical combination of stresses, Westergaard's Analysis. Joints in cement concrete pavements: Types of joints and functions, Joint spacings, design of tie bar and dowel bar using IRC method. Design of slab thickness- IRC methods of design of cement concrete slab.	**9**

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

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End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Identify suitable materials for different types of pavements and Interpret material test results with respect to field conditions and standards.	**K3**
CO2	Apply the pavement material properties to analysis of pavements and Evaluate material properties in design of pavement mixes.	**K3**
CO3	Determine the stresses and design flexible pavements with better performance and longer service life	**K3**
CO4	Determine the stresses and design rigid pavements with better performance and longer service life and Design the reinforcements in cement concrete pavements	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

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CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3		3	3	3		3		2
CO2	3	3	3	3		3	3	3		3		2
CO3	3	3	3	3		3	3	3	3	3		1
CO4	3	3	3	3		3	2	3				

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Highway Engineering	SK Khanna , CEO Justo, A. Veeraragavan	Nem Chand & Bros	Revised 10th Edition - 2017
2	Principles and Practices of Highway Engineering	Kadiyali, L. R. and N.B Lal,	Khanna Publishers, 2013	Seventh edition, 2017
3	Principles of Transportation and Highway Engineering	Rao G. V.	Tata McGrawHill	1996
4	Principles of Pavement Design	Yoder E J and Witezak M W	John Wiley and sons	2nd Edition 2011
5	IRC: 37-2018, Guidelines for the Design of Flexible Pavements			
6	IRC: 58 - 2015, Guidelines for the Design of Rigid Pavements			
7	MoRTH specifications			

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Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Pavement Analysis and Design	Yang H. Huang	Prentice Hall	2004
2	Pavement Engineering – Principles and Practice	Rajib B. Mallick and Tahar El-Korchi	CRC Press (Taylor and Francis Group)	

Video Links (NPTEL, SWAYAM…)	
SL. No.	**Link ID**
1	https://nptel.ac.in/courses/105106221
2	https://nptel.ac.in/courses/105104098