INSTITUTE	**FACULTY OF TECHNOLOGY**
PROGRAM	**BACHELOR OF TECHNOLOGY (CIVIL ENGINEERING)**
SEMESTER	**6**
COURSE TITLE	**PAVEMENT ENGINEERING**
COURSE CODE	**01CI0619**
COURSE CREDITS	**4**

Objective:

1 To understand fundamentals of pavement structure
2 To learn different types of stresses in pavement layers
3 To explore the fundamentals of designing pavements
4 To explore the basics of pavement maintenance

Course Outcomes: After completion of this course, student will be able to:

1 Interpret the characteristics of various construction materials of pavement.
2 Determine stress and strain in pavement structure with different loading conditions.
3 Evaluate pavement condition and suggest remedial measures for it.
4 Design pavement structure according to different conditions.

Pre-requisite of course: Highway Engineering

Teaching and Examination Scheme

Theory Hours	Tutorial Hours	Practical Hours	ESE	IA	CSE	Viva	Term Work
3	1	0	50	30	20	25	25

Contents : Unit	Topics	Contact Hours
1	**Pavement Materials** Aggregates; Aggregate gradation and gradation parameters; Theories of aggregate blending, Aggregate shape and texture: quantification and importance; Aggregate strength properties, and relevant tests., Soil: Mechanical properties of soil, Bitumen: Bitumen as a binding agent; Production of bitumen; Physical and rheological properties of bitumen, Chemistry of bitumen; Ageing of bitumen; Grading of bitumen, and relevant tests: Penetration grade, Viscosity grade, Performance grade; Bitumen modification: Need, Types and Importance; Introduction of bitumen emulsion and cutback: Types, Uses, and Application.	8

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Contents : Unit	Topics	Contact Hours
2	**Bituminous Mixtures** Production of bituminous mixtures: Laboratory and Plant; Role of bituminous mixture and desirable properties, Volumetric of bituminous mixture; Mix design of bituminous mixture: Marshall method	6
3	**Design of Flexible Pavement** Layered system concepts, Stress solution for one, two- and threelayered systems, Fundamental design concepts, Classification of axle types, standard and legal axle loads, tyre pressure, contact pressure, ESWL, EWLF and EAL concepts, Traffic analysis: ADT, AADT, truck factor, growth factor, lane distribution factor, directional distribution factor and vehicle damage factor, IRC – 37 2018 method of flexible pavement design	10
4	**Design of Rigid Pavement** Westergaard's theory and assumptions, Stresses due to curling, stresses and deflections due to loading, frictional stresses, Stresses in dowel bars and tie bars, IRC- 58 2015 method of plain jointed and continuously reinforced rigid pavement design.	10
5	**Construction and Maintenance of Pavement** Construction and preparation of subgrade, sub-base, base course, construction of bituminous layers, cement concrete surface course as per MoRT&H specifications, Introduction, factors affecting pavement deterioration, functional condition evaluation techniques, Types of Maintenance, IRC overlay design method	8
Total Hours		**42**

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
1	**Tutorial-1** Numerical problems on aggregate gradation (FM, UC) and blending	1
2	**Tutorial-2** Bitumen grading problems (Penetration, Viscosity, PG) + Short case on bitumen modification	1
3	**Tutorial-3** Calculation of volumetric properties (VMA, VFB, air voids) and interpretation of stability & flow values	2
4	**Tutorial-4** Problems on ESWL, traffic analysis (AADT, growth factor, VDF) + IRC 37 design example	4
5	**Tutorial-5** Stress analysis by Westergaard's theory (edge, corner, interior loading) + IRC 58 design example	4
6	**Tutorial-6** Case study on failure modes, IRC overlay design problem	2
Total Hours		**14**

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Textbook :

1 Analysis of Pavement Structures, Das, A. , CRC Press, Taylor and Francis Group, Florida, USA, 2015

2 Pavement Design and Materials, Papagiannakis, A.T., Masad, E.A., Wiley, 2008

References:

1 Principles of Pavement Design, Second Edition, Principles of Pavement Design, Second Edition, Yoder, E.J. and M.W. Witczak, John Wiley and Sons, New York, USA, 1975

2 Highway Engineering, Highway Engineering, S.K. Khanna and C.E.G. Gusto, A.Veeraragavan, Nem Chand and Bros, Roorkee., 2012

Suggested Theory Distribution:

The suggested theory distribution as per Bloom's taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery					
Remember / Knowledge	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Higher order Thinking / Creative**
5.00	10.00	35.00	30.00	15.00	5.00

Instructional Method:

1 At the start of course, the course delivery pattern, prerequisite of the subject will be discussed

2 Lectures will be taken in class room with the use of multi-media presentations, white board– mix of both

3 Attendance is compulsory in lectures and laboratory which carries a 5% component of the overall evaluation

4 Minimum two internal exams will be conducted and average of two will be considered as a part of 15% overall evaluation

5 Assignments based on course content will be given to the students at the end of each unit/topic and will be evaluated at regular interval. It carries a weightage of 5%.

6 Surprise tests/Quizzes will be conducted which carries 5% component of the overall evaluation.

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