GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Engineering

Level: PG

Branch: Civil Engineering (Transportation Engineering)

Course / Subject Code: ME01069061

Subject Name: ADVANCES IN PAVEMENT MATERIALS

w. e. f. Academic Year:	2024-25
Semester:	1st Semester
Category of the Course:	PEC

Prerequisite:	Nil
Rationale:	The course on Pavement Materials deals with the basic and fundamental understanding about the behavior of various materials used in the construction of pavements. Characterization, tests and engineering properties of these materials are elaborated in context with its field application. Current practices and future trends in the area of pavement materials are discussed

No	Program Outcomes
01	Engage in critical thinking and research to develop solutions to multifold real-world problems.
02	Communicate effectively with the engineering community at large level on complex design tasks & write and present technical reports.
03	Demonstrate a high level of professionalism in handling multidisciplinary and complex traffic engineering problems.
04	Plan, assess, create, integrate, carry out, and oversee complex transportation infrastructure projects in a sustainable local and global context.
05	Address societal issues pertaining to transportation by offering technologically advanced, reasonably priced solutions while upholding high standards of ethics and professionalism.

Course Outcome:

After Completion of the Course, Student will be able to:

No	Course Outcomes	RBT Level
01	Understand basic engineering properties of various pavement materials.	R, U
02	Aware about the use of advance material for pavement construction.	U
03	Test the materials as per standards and take decision about use of alternative materials in pavement construction.	A

**Revised Bloom's Taxonomy (RBT)*

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	ESE (E)	PA / CA (M)	PA/CA (I)	ESE (V)	
3	0	2	4	70	30	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1	**Soil:** Introduction to soil as a highway material; Classification of soils; Consistency Limits; Soil compaction and role of moisture; Mechanical properties of soil (Shear strength, Unconfined compressive strength, Resilient modulus, California bearing ratio, Modulus of subgrade reaction etc.); Introduction to expansive soils, relevant tests, and soil stabilization techniques.	5	10
2	**Aggregates:** Aggregate origin, types, production, and quarrying operation; Classification of aggregates; Aggregate gradation and gradation parameters; Theories of aggregate blending; Minerology of aggregates and its importance; Aggregate shape and texture: quantification and importance; Aggregate strength properties, and relevant tests. Use of alternative/waste aggregate materials.	5	10
3	**Bitumen, Modified bitumen, Bitumen emulsion and Cutback bitumen:** Bitumen as a binding agent; Production of bitumen; Physical and rheological properties of bitumen; Introduction to viscoelasticity; Chemistry of bitumen; Ageing of bitumen; Grading of bitumen, and relevant tests: Penetration grade, Viscosity grade, Performance grade; Bitumen modification: Need, Types and Importance; PMB, CRMB, Introduction of bitumen emulsion: Theory of emulsification, Uses, Grading of emulsions, and Relevant tests; Introduction to cutback bitumen: Types, Uses, and relevant tests.	8	20
4	**Bituminous Mixtures:** Production of bituminous mixtures: Laboratory and Plant; Role of bituminous mixture and desirable properties; Volumetrics of bituminous mixture; Mix design of	8	20

	bituminous mixture: Marshall and Superpave methods; Mechanical tests and characterization of bituminous mixtures; Introduction to performance-based mix design concepts; Mix design of cold bituminous mixtures; Mix design of hot recycled mixtures.		
5	**Geosynthetic:** Use of Geotextiles, Geogrids, Geonets, Geomembranes, Geosynthetic clay liners, Geofoam, Geocells and Geocomposites in pavement.	5	10
6	**Cement:** Production of cement; Theory of hydration and importance of different hydration products; Physical and chemical properties of cement; Types of cement; Pozzolanic and geopolymer materials as alternate cement.	5	10
7	**Concrete Mix Design:** Concrete proportioning and importance of various constituents; Introduction and mix design of pavement quality concrete, Dry lean concrete and Pervious concrete.	5	10
8	**High performance concrete:** Introduction, advantages, IS requirements, various mineral admixtures: accelerators, retarders, water reducing admixtures, air-entraining admixtures, super plasticizing admixtures. Fiber reinforced concrete, ferrocement, roller compacted concrete, and high strength concrete.	4	10
	Total	**45**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
30	**20**	**30**	**10**	**10**	**--**

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

(a) Books:

References/Suggested Learning Resources:

1. Kerbs and Walkes, "Highway Materials", McGraw Hill Book
2. Atkins & Harold, Highway Materials, Soils and concretes, Prentice hall Pearson
3. Walker and Martin. Asphalt Pavement Engg.
4. HMSO, Soil Mechanics for Road Engineers
5. HMSO, Bituminous Materials for Engineers
6. MoRTH Standards for Highway constructions

7. Atkins Harold N., Highway Materials, Soils, and Concrete, Prentice Hall, 1996.
8. Kadiyali L.R. and Lal, N. B., Principles & Practice of Highway Engineering, Khanna Publishers, Delhi.
9. Various IRC codes for test of Bituminous & Concrete Roads
10. Highway Material Testing Laboratory Manual, Khanna & Justo

(b) Open source software and website:

List of Open Source Software (May not be open source but useful for the subject):

Learning website:

MOOC Course link :

https://nptel.ac.in/courses/105107219

List of Experiments

1. Various tests on Soil
2. Various tests on Aggregates
3. Various tests on Bitumen
4. Various tests on Bituminous mixes
5. Various tests on cement
6. To carry out concrete mix design as per IRC Code for pavement

List of Tutorials:

Tutorial on each of the above mentioned topics in syllabus will be included on soil, cementitious and bituminous material.

* * * * * * *