

GUJARAT TECHNOLOGICAL UNIVERSITY

BRANCH NAME: GEOTECHNICAL ENGINEERING
SUBJECT NAME: PAVEMENT ANALYSIS AND DESIGN
SUBJECT CODE:3714311
M.E. Semester-I

Type of course: Program Elective-I

Prerequisite: knowledge of Geotechnical Engineering

Rationale:

The major backbone of any country's infrastructure is its road and highway connectivity/development which ultimately depends on through knowledge of geotechnical engineering and its applications. The subject "pavement analysis and design" is specially introduced in first semester as program elective so as student understands the need of sustainable pavements as per regional needs. The subject caters the need of student from selecting suitable pavement material to its full testing, designing, executing with minimum maintenance as per both national and international standards. Design approaches for both rigid and flexible pavements is introduced with cost comparison and long term quality assurance.

Teaching and Examination Scheme:

| Teaching Scheme | | | Credits | 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 | % Weightage |
|---------|---|-----------|-------------|
| 1 | Introduction: Components of pavement structure, importance of subgrade soil, properties on pavement performance. Functions of subgrade, sub base, base course and wearing course. | 04 | 10 |
| 2 | Materials for pavement : Aggregate, Portland cement, asphalt, Portland cement concrete, asphalt concrete; properties, testing procedures, gradation and blending; Portland cement based materials: mixture design, production, properties, testing, Asphalt binder: refining process, properties, testing procedures, grading systems; Asphalt concrete mixture design: fundamentals of mix design procedure, mixture volumetric, current mix design procedures; | 08 | 10 |
| 3 | Analysis and stresses in Pavements: Stresses in homogeneous masses and layered systems, shear failures, area of contact and tyre pressure, Modulus of resilience or California Bearing Ratio (CBR) for different layers, equivalent single wheel load, equivalent stress and equivalent deflection criterion; equivalent wheel load factors, effects of dual wheels and tandem axles, climatic and environmental factors. Stresses due to Curling/bending, Stresses and Deflections due to Loading, Stresses due to | 10 | 20 |

| | | | |
|---|--|----|----|
| | Friction. | | |
| 4 | Design Methods for Flexible Pavements: California bearing ratio (CBR) method, U.S. Navy method. Triaxial method, Mcleod method, Boussinesq's and Burmister's analysis and design method, IRC method for Flexible Pavement Design, AASHTO Method, Design of Shoulders. | 08 | 25 |
| 5 | Design Methods for Rigid Pavements: Wheel load stresses, Liquid and elastic soil subgrade, Westergaard's analysis, IRC Method, Portland Cement Association Method, AASHTO Method, Continuous Reinforced Concrete Pavements, Design of Shoulders, Design of joints, Dowel bar and tie bars. | 08 | 25 |
| 6 | Comparison of different pavement design approaches, design of overlays, drainage system. Reliability- Statistical Concepts, Probabilistic Methods. | 04 | 10 |

Reference Books:

1. Yoder, E.J. and Witczak, M.W., Principles of Pavement Design, John Wiley and sons, 1975
2. Yang H. Huang, Design of functional pavements, Pearson Prentice Hall, 2004
3. Papagiannakis, A.T. and Masad, E.A., "Pavement Design and Materials, John Wiley & Sons Inc. 2008
4. Andrew R. Dawson, Pavements Unbound Taylor & Francis Group plc, London, UK, 2004
5. Khanna S.K., Justo C.E.G., Highway Engineering, Nem Chand & Bros., Roorkee, 2001
6. Kadiyali L.R., Principles & Practice of Highway Engineering, Khanna Publishers, 2003
7. IRC: 37-2001, Guidelines for the Design of Flexible Pavements
8. IRC: 58-2011, Guidelines for the Design of Plain Jointed Rigid Pavements, 2001
9. Sharma and Sharma, Principles and Practice of Highway Engg., Asia Publishing House, 1980.
10. Teng, Functional Designing of Pavements, McGraw- Hill, 1980.

Course Outcome:

After learning the course the students should be able to:

1. Understand components of pavements and its functions
2. Select suitable pavement material and its full scale testing
3. Determine important parameters like Modulus of resilience or California Bearing Ratio (CBR) and its usage in design
4. Select suitable pavements design method for both rigid and flexible pavements, analyze it and making cost comparison using statistical models

List of Experiment:

- 1 Plate Bearing Test.
- 2 Field CBR Test.
- 3 Marshall Stability Test
- 4 Concrete Mix Design for Pavements
- 5 Problems based on analysis for Flexible and Rigid pavement.
- 6 Tutorials based on design of Flexible Pavements for Highway.
- 7 Tutorials based on design of Rigid Pavements for Highway.
- 8 Tutorials based on design of Overlays.
- 9 Tutorials using KENPAVE software

Major Equipment:

- 1 Marshall Stability Apparatus
- 2 California Bearing Ratio (CBR) Apparatus
- 3 Compressive Testing Machine
- 4 Marshall Compaction Apparatus
- 5 Plate Bearing Test Apparatus

List of Open Source Software/learning website:

- <http://nptel.ac.in/>
- <http://ocw.mit.edu/courses/civil-and-environmental-engineering/>