Gyanmanjari Innovative University

Course Syllabus
Gyanmanjari Institute of Technology
Semester-5 (B. Tech.)

Subject: Pavement Design – BETCV15323
Type of Course: Professional Elective Courses
Prerequisite: Knowledge of Road Safety & Management

Rationale: Pavement design aims to create a durable and safe road surface by distributing traffic loads across the subgrade, ensuring structural integrity against stresses from vehicles and the environment, providing a functional surface with good riding quality and skid resistance, and considering environmental factors like climate and soil conditions, all while balancing economic and sustainability considerations to maximize the pavement's lifespan and minimize maintenance.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks					Total Marks
				Theory Marks		Practical Marks		CA	
CI	T	P	C	ESE	MSE	V	P	ALA	
2	0	2	3	60	30	10	20	30	150

Legends: CI-Class Room Instructions; T – Tutorial; P - Practical; C -- Credit; ESE - End Semester Examination; MSE- Mid Semester Examination; V – Viva; CA - Continuous Assessment; ALA- Active Learning Activities.

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Course Content:

Sr. No	Course Content	Hrs.	% Weightage
1	**Pavement Materials and Characterization:** Soil: Characterization for Earthwork, Subgrade. Effective CBR, Concept of Modulus of resilient of subgrade, Aggregate: Granular Subbase and Base layer - road aggregates used for WBM, WMM, Aggregate used in Bituminous layer, Its characteristics, gradation- Fullers equation, physical properties requirements for rural road and high-volume road., Concept of Modulus of resilient of sub base and base course as per IRC 37, Bituminous material : Bitumen, Emulsion, Modified bitumen, bituminous mix – Volumetrics, concept of modulus of resilient per IRC 37, Quality control and Quality Assurance plan for highway.	04	25
2	**Design of Flexible Pavement**: Flexible Pavement: Factors affecting pavement design, ESWL, EWLF, VDF, Stress analysis – Boussinesq's theory, Burmister's two- and three-layer theory, Flexible pavement design as performance criteria- subgrade rutting criteria and fatigue cracking criteria for bituminous layer. Overview on Pavement design for low volume road using locally available material as per IRC SP-72. Drainage consideration in pavement design	10	25
3	**Design of Rigid Pavement:** Design factors, Westergaard's stress analysis, load stress, temperature stress, Design based on fatigue behavior of concrete, IRC-58 design method – Fatigue concept (using IIT RIGID), Design of joints, Friberg's analysis of dowel bar design, Design of tie bar. Overview on Pavement design for low volume road as per IRC SP-62	10	25
4	**Maintenance of Pavement** Flexible pavement: IRC-82, need of maintenance, types, planning, system approach, types of defects, symptoms, location, cause, severity level and treatment. Preventive and periodical renewals, its warrants and treatments. Rigid pavement- Maintenance and its methodology as per IRC: SP:83, Design of overlay.	06	25

Continuous Assessment:

Sr. No.	Active Learning Activities	Marks
1	**Field Visit to Highway Construction Site:** Students will visit a highway construction site and look at different road materials (gravel, sand, asphalt pieces etc.) to get a basic understanding of what roads are made of. Students will prepare the report and upload it on GMIU Web Portal.	10

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2	**Road Failure Analysis:** Faculty will assign student groups various road failures occurring in rigid and flexible pavement and students will prepare the discussion report and upload it on GMIU Web Portal.	10
3	**Build a Road Model with Simple Materials:** Faculty will divide students in groups and students will use simple materials (e.g., cardboard, sand, gravel, paper) to build a basic road model and then prepare a presentation and upload it on GMIU web portal	10
TOTAL		**30**

Suggested Specification table with Marks (Theory): 60

Distribution of Theory Marks **(Revised Bloom's Taxonomy)**						
Level	Remembrance (R)	Understanding (U)	Application (A)	Analyze (N)	Evaluate (E)	Create (C)
Weightage %	20%	40%	20%	20%	-	-

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.

Course Outcome:

After learning the course, the students should be able to:	
CO1	Understand the quality control for pavement construction.
CO2	Design flexible pavements using relevant theories and IRC standards.
CO3	Design rigid pavements using relevant theories and IRC standards.
CO4	Understand maintenance strategies for both flexible and rigid pavements.

List of Practical

Sr. No.	Descriptions	Unit No	Hrs.
01	Determination of California Bearing Ratio (CBR) for Subgrade Soil	01	04
02	Gradation Analysis of Aggregates using Fuller's Equation	01	02
03	Determination of Physical Properties of Aggregates (Impact, Crushing, and Abrasion Tests)	01	04
04	Marshall Stability Test for Bituminous Mixes	01	04
05	Quality Control and Assurance: Testing of Bitumen and Emulsion Properties	01	02
06	ESWL and VDF Calculation for Flexible Pavement Design	02	02
07	Stress Analysis Using Boussinesq's and Burmister's Theories	02	04
08	Stress Analysis in Rigid Pavement using Westergaard's Approach	03	04
09	Design and Analysis of Dowels and Tie Bars	03	02

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10	Visual Inspection and Identification of Defects in Flexible and Rigid Pavements	04	02
TOTAL			**30**

Instructional Method:

The course delivery method will depend upon the requirement of content and need of students. The teacher, in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.
From the content 10% topics are suggested for flipped mode instruction.
Students will use supplementary resources such as online videos, NPTEL/SWAYAM videos, e-courses, Virtual Laboratory.
The internal evaluation will be done on the basis of Active Learning Assignment.
Practical/Viva examination will be conducted at the end of semester for evaluation of performance of students in the laboratory.

Reference Books:

[1] Highway Engineering by S.K. Khanna and C.E.G. Justo
[2] IRC:37 - Guidelines for the Design of Flexible Pavements
[3] IRC:58 - Guidelines for the Design of Plain Jointed Rigid Pavements for Highways
[4] IRC: SP:72 - Guidelines for the Design of Flexible Pavements Using Locally Available Marginal Materials.
[5] IRC: SP:62 - Guidelines for Design of Low Volume Roads Using Cement Concrete.
[6] IRC: SP:83 - Guidelines for Maintenance of Cement Concrete Pavements.
[7] IRC:82 - Guidelines for Maintenance of Flexible Pavements

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