

**ACADEMIC – GRADUATE STUDIES AND RESEARCH DIVISION**

**BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI-HYDERABAD CAMPUS**

**SECOND SEMESTER 21-22**

# Course Handout Part II

Date: 15-01-2022

In addition to part-I (General Handout for all courses appended to the time table) this portion gives further specific details regarding the course.

Course No. : CE G518

## Course Title : Pavement Analysis and Design

## Instructor-in-Charge : V Vinayaka Ram

**Description :** Basic concepts in transportation planning, accessibility and mobility, land use interaction, government role in transportation planning. characteristics of travel and transport problems, transportation survey and data collection: planning, design and implementation, travel analysis zone (TAZ) development, traditional four-step modelling process, analysis of travel behaviour and demand: studying travel behaviour, analysing urban travel markets; innovations in transportation modelling: travel behaviour model, activity-based models. econometric modelling using rstudio, modelling travel demand with CUBE. Transportation Demand Management (TDM), Transportation System Management (TSM), Smart City Transportation Planning: Transit-Oriented Development (TOD), Pedestrian-Oriented Development, liveable street planning, multimodal transportation planning, shared mobility concepts, integrated transportation management and planning. transportation & energy, climate change, fuel choice and green mobility.

**Scope and Objective of the Course:**

This course primarily covers the analysis and design mechanisms for both flexible and rigid pavements in general. The Multi-layer analysis for flexible pavements and slab analysis for rigid pavements structures will be covered with the relevant theory as well as software interfaces. The structural design of the pavements is usually dictated by the requirements of parameters related to traffic, foundation as well as environmental factors. Many International agencies like American Association of Highway Transport Officials (AASHTO), Asphalt Institute (AI), Australian Road Board (ARB), Portland Cement Association (PCA) along with Indian Roads Congress have introduced the necessary guidelines to design the pavement structures. Apart from the IRC guidelines, which are being followed throughout India, Mechanistic Empirical Pavement Design Guide, published by AASHTO for both flexible and rigid pavement structures has become an important standard to be followed throughout the World. In this direction, the course is planned with IRC and AASHTO guidelines for the design of pavements. In addition, course also deals with the prominent mechanisms available to design the structural overlays for the in-service failed flexible and rigid pavements. Drainage plays a very prominent role in up keeping the pavements in serviceable condition for long time. In this course, the drainage design will also be introduced to enable the student field ready.

**Text Book(s)**

T1. Yang H Huang (2010) Pavement Analysis and Design, Pearson, Prentice Hall, NJ, USA 2nd Edition

T2. AASHTO (2015) Mechanistic Empirical Pavement Design Guide – A Manual of Practice, USA, 2nd Edition

**Reference Book(s)**

R1. E. J. Yoder, M. W. Witczak (2004) Principles of Pavement Design, 2nd Edition, Wiley International

R2. Coleman O'Flaherty (ed.) (2015) Highways, The Location, Design, Construction and Maintenance of Road Pavements, ICE Publishing 5th edition, ISBN: 9780727759931

# R3. Rajib B. Mallick and Tahar El-Korchi, (2014) Pavement Engineering Principles and Practice, Second Edition, CRC Press.

R4. Norbert J. Delatte, Concrete Pavement Design, Construction, and Performance, Second Edition, CRC Press.

R5. Papagiannakis A T, Masad E A (2008), Pavement Design and Materials, Second Edition, John Wiley and Sons

R6. ACI 325 – 12 R – 02, 2002, Guide for design of Jointed Concrete Pavements for Streets and Local Roads, American Concrete Institute, USA

R7. Norbert J. Delatte, 2014, Concrete Pavement Design, Construction and Performance, 2nd edition, CRC Press

R8. IRC:15-2015, IRC:37-2018, IRC:58-2015, IRC: SP:72-2015, IRC: SP:62-2014, IRC:115-2015, IRC:117-2015, IRC 81-1997, IRC SP 76 – 2015, MEPDG and other relevant codes of practices

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| **Lecture No** | **Learning Objectives** | **Topics to be Covered** | **Chapter in the text book / References** |
| 1-3 | Learn how to compute the stresses and strains at any point in a multi layered flexible pavement structure? Also should be able to identify locations where critical stresses and strains happen | Stresses and Strains in Flexible Pavements:  Homogeneous Mass; Layered Elastic Systems  Viscoelastic Solutions | Art 2.1 to 2.3 in T1  Chapter 3 in T1 for software |
| 4-6 | Learn how to compute the stresses and strains at any point in a rigid pavement structure due to curling, loading and friction. Also should be able to learn about why dowel and tie bars are needed in rigid pavements | Stresses due to curling  Stresses and Deflections due to Loading  Stresses Due to Friction  Concept of Dowels and Joints | Art 4.1 to 4.4 in T1  Chapter 5 in T1 for software |
| 7-8 | Learn how to arrive at a traffic load factor for the design of either flexible or rigid pavement. Should be able to forecast the traffic intensity for the chosen design period | Traffic Loading and Volume for Pavement Design:  Equivalent Single-Wheel Load  Equivalent Axle Load Factor  Traffic Analysis and forecasting  Design Traffic Estimation | Art 6.1 to 6.4 in T1 and relevant IRC codes |
| 9-20 | Should be able to design a multi layered flexible pavement structure by IRC, AASHTO MEPDG Methods | Flexible Pavement Design:  IRC 37-2018 Method  AASHTO MEPDG 2015 Method  Design of Flexible Pavement Shoulders | Chapter 11 in T1 and relevant IRC, AASHTO codes of practices |
| 21-30 | Should be able to design a rigid pavement structure by IRC, AASHTO and MEPDG methods including low volume roads | Rigid Pavement Design:  IRC 58-2015 Method  MEPDG Method | Chapter 12 in T1 and relevant IRC, AASHTO codes of practices |
| 31-40 | Should be able to design structural overlays for both flexible and rigid pavement structures as a rehabilitation process | Flexible Pavement Overlay Design:  Types of overlay design methods  IRC Method of flexible overlay design  AI Principle Component Analysis Method  Flexible pavement overlay design using Falling weight deflectometer studies  Rigid pavement overlay design:  Thin white topping design with IRC: SP-76-2015  Rigid pavement overlay design using Falling weight deflectometer studies | Chapter 13in T1 and relevant Codes of Practices |
| 41-42 | Learn how to design the drainage and also compute drainage capacity | Drainage Design :  Methods of controlling the water in pavements, Drainage design and drainage capacity computations | Chapter 8 in T1 |

**Evaluation Scheme:**

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| **Component** | **Duration** | **Weightage (%)** | **Date & Time** | **Nature of the Component** |
| Mid Semester test | 90 min | 25 | As per the time table | Partially OB + Partially CB |
| Comprehensive Examination | 120 min | 35 | 07th May 2022 - FN | Partially OB + Partially CB |
| Assignments | - | 15 | Throughout the semester | OB |
| Presentations (Seminars and Term Papers) | - | 10 | Throughout the semester | OB |
| Computer Lab Based Assignments with the standard software and other developmental activities | - | 15 | Throughout the semester | OB |

**Chamber Consultation Hour:** Will be announced during the first class

**Notices:** Students are advised to look for notices in their respective CMS / google classrooms.

**Make-up Policy:**

* Make up requests received on social networking platforms / SMS / WHATSAPP etc. will be ignored and no further action will be initiated. It shall be requested through mail communication along with all the suitable proofs.
* Make up will be granted only for genuine reasons and will be considered on a case to case basis. However, prior permission is a must.
* For medical cases, a certificate from the concerned physician from the Medical Centre/hospital must be produced. In addition, copies of the prescription should be submitted as a proof. Hostel office / warden / chief warden should certify that they have the information regarding the illness of the applicant.
* Made-up medical certificates / other proofs will be seriously considered and will be referred to disciplinary committee for further necessary action.
* Make up policy is applicable for Mid-semester test and the comprehensive examinations only. Other listed components will not have any scope for make-ups.

**Academic honesty and academic integrity Policy:**

Academic honesty and academic integrity are to be maintained by all of the students throughout the Semester and no type of academic dishonesty is acceptable. Students are encouraged to **use anti-plagiarism software** to check reports before submission.

**INSTRUCTOR-IN-CHARGE**

CE G518