Birla Institute of Technology & Science, Pilani
Hyderabad Campus

**ACADEMIC – GRADUATE STUDIES AND RESEARCH DIVISION**
**SECOND SEMESTER 2023-2024**

Course Handout Part II

Date: 07-01-2024

In addition to Part-I (General Handout for all courses appended to the timetable), this portion gives further specific details regarding the course.

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| Course No. | : | CE G518 |
| Course Title | : | Pavement Analysis and Design |
| Instructor-in-Charge | : | **Prof. V. Vinayaka Ram** |

**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 (MEPDG), 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 MEPDG 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. Hence, the drainage design will also be introduced to enable the students field ready.

**Text Book(s)**

T1. Yang H Huang (2010) Pavement Analysis and Design, Pearson, Prentice Hall, NJ, 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 37-2012, IRC 58-2011, IRC 81-1997, IRC Sp 76 – 2015, MEPDG and other relevant codes of practices

R9. AASHTO (2015) Mechanistic Empirical Pavement Design Guide – A Manual of Practice, USA, 2nd Edition

R10. Pavement Drainage Theory and Practice by G L Sivakumar Babu, Prithvi S Kandhal, Nivedya Mandankara Kottayi, Rajib Basu Mallick and A Veeraragavan, CRC Press (2020).


| Lecture No | Topics to be Covered | Learning Objectives | Reference |
|---|---|---|---|
| 1-4 | Stresses and Strains in Flexible Pavements: Homogeneous Mass; Layered Elastic Systems Viscoelastic Solutions | 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 | Art 2.1 to 2.3 in T1<br>Chapter 3 in T1 for software |
| 5-7 | Stresses and Strains in Rigid Pavements: Curling Stresses; deflections; Stresses Due to Friction; concept of joints: Expansion, contraction and longitudinal joints; dowelled expansion joints | 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 the design concepts for dowel and tie bars | Art 4.1 to 4.4 in T1<br>Chapter 5 in T1 for software |

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| 8-9 | Traffic Loading and Volume for Pavement Design: Equivalent Single-Wheel Load;<br>Equivalent Axle Load Factor<br>Traffic Analysis and forecasting<br>Design Traffic Estimation | How to arrive at a traffic load factor for the design of both flexible or rigid pavement. Should be able to forecast the traffic intensity for the chosen design period | Art 6.1 to 6.4 in T1 |
| 10-21 | Flexible Pavement Design:<br>IRC 37-2018 Method;<br>Introduction to AASHTO MEPDG 2020 Method;<br>Design of Flexible Pavement Shoulders | Should be able to design a multi layered flexible pavement structure by IRC method, and get introduced to the intricacies of MEPDG Method of flexible pavement design | Chapter 11 in T1 and relevant IRC, AASHTO codes of practices |
| 22-34 | Rigid Pavement Design: IRC 58-2020 Method<br>Introduction to MEPDG Method | Should be able to design a rigid pavement structure by IRC Method and get introduced to MEPDG method of rigid pavement design | Chapter 12 in T1 and relevant IRC, AASHTO codes of practices |
| 35-40 | Overlay Design:<br>Overlay design using BBD, FWD methods; AI's principle component analysis method of overlay design<br>Thin white topping design with IRC: SP-76-2015 | Should be able to design structural overlays for both flexible and rigid pavement structures as a rehabilitation measure | Chapter 13in T1 and relevant Codes of Practices |
| 41-42 | Drainage Design : Methods of controlling the water in pavements, Drainage design and drainage capacity computations | Should be able to design the drainage and also compute drainage capacity | Chapter 8 in T1<br>R10 |

**Evaluation Scheme:**

| Component | Duration | Weightage (%) | Date & Time | OB / CB |
|---|---|---|---|---|
| Mid semester Test | 90 min | 30 | 11/03 - 11.00 - 12.30PM | OB |
| Assignments (In-class and Take home) | | 15 | Throughout the semester | OB |
| Term Paper | | 10 | Throughout the semester | OB |

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| Lab based assignments | | 10 | Throughout the semester | OB |
| Comprehensive Examination | 180 min | 35 | 06/05 AN | Partially OB and Partially CB |

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

**Notices:** Students are advised to look for notices in their respective CMS. Important notices will be put up in the Civil Engineering Department's notice board also.

**Make-up Policy:**

- Make up requests received on social networking platforms / SMS / WHATSAPP etc. will be ignored and no further action will be initiated.
- 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 shall be maintained by all the students throughout the Semester and any kind of academic dishonesty is unacceptable. Students are encouraged to **use standard plagiarism checking software like Turnitin** to check the assignments and reports before submission to avoid action.

**INSTRUCTOR-IN-CHARGE**
**CE G518**