



Birla Institute of Technology & Science, Pilani

Hyderabad Campus

II SEMESTER 2019-2020

Course Handout Part II

Date: 25-12-2019

In addition to Part-I (General Handout for all courses appended to the time table) 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 | : | Sridhar Raju |

Course Description:

Types of pavements, flexible, rigid and semi-rigid; components of pavement structure; stresses and strains in flexible and rigid pavements: layered systems, visco-elastic solutions; stresses and deflections in rigid pavements; computer programmes for analysis of stresses and deflections in rigid pavements; traffic loadings, load equivalency factors, traffic projections and analysis; material characterization as input to pavement design; flexible pavement design and rigid pavement design using IRC, AASHTO, PCA methods; design of overlays; pavement deterioration, pavement performance and use of HDM-4; pavement drainage design.

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



Reference Book(s)

- R1. E. J. Yoder, M. W. Witzczak (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

| Lecture No | Topics to be Covered | Learning Objectives | Reference |
|------------|--|--|--|
| 1-3 | <u>Stresses and Strains in Flexible Pavements</u> : 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 Chapter 3 in T1 for software |
| 4-6 | Stresses Due to Curling Stresses and Deflections Due to Loading Stresses Due to Friction Concept of Dowels and 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 Chapter 5 in T1 for software |
| 7-8 | <u>Traffic Loading and Volume for Pavement Design</u> : Equivalent Single-Wheel Load Equivalent Axle Load Factor Traffic Analysis and forecasting Design Traffic Estimation | 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 | Art 6.1 to 6.4 in T1 |
| 9-20 | <u>Flexible Pavement Design</u> : IRC 37-2012 Method AASHTO MEPDG 2015 Method Design of Flexible Pavement Shoulders | Should be able to design a multi layered flexible pavement structure by IRC, AASHTO MEPDG Methods | Chapter 11 in T1 and relevant IRC, AASHTO codes of practices |



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| 21-30 | <u>Rigid Pavement Design:</u> IRC 58-2011 Method MEPDG Method | Should be able to design a rigid pavement structure by IRC, AASHTO and MEPDG methods including low volume roads | Chapter 12 in T1 and relevant IRC, AASHTO codes of practices |
| 31-40 | <u>Overlay Design:</u> Types of overlay design methods IRC Method of flexible overlay design PCA Method of Overlay Design Rigid overlay design 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 process | Chapter 13 in T1 and relevant Codes of Practices |
| 41-42 | <u>Drainage Design :</u> 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 |

Evaluation Scheme:

| Component | Duration | Weightage (%) | Date & Time | Nature of Component |
|--|----------|---------------|---|--------------------------------|
| Mid Semester test | 90 min | 25 | 2/3 3.30 - 5.00 PM | Closed book examination |
| Comprehensive Examination | 180 min | 35 | 2/5 AN | Open book examination |
| Assignments (Take Home and In-Class) | - | 15 | Will be conducted throughout the semester | Open Book |
| Presentations (Seminars and Term Papers) | - | 10 | Will be conducted throughout the semester | Open Book |
| Computer Lab Based Assignments with the standard software and other developmental activities | - | 15 | Will be conducted throughout the semester | Open Book |

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. Written makeup requests shall only be used to apply for makeups
- 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

