Birla Institute of Technology & Science, Pilani
Hyderabad Campus

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FIRST SEMESTER 2020-2021

Course Handout Part II

Date: 17-08-2020

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 G548
Course Title : Pavement Management Systems
Instructor-in-Charge : V VINAYAKA RAM

Description: Components of pavement management systems, pavement maintenance measures; pavement performance evaluation: general concepts, serviceability, pavement distress survey systems, performance evaluation and data collection using different equipment; evaluation of pavement distress modeling and safety; pavement performance prediction: concepts, modeling techniques, structural condition deterioration models, mechanistic and empirical models, HDM-IV models, comparison of different deterioration models, functional and structural condition deterioration models; ranking and optimization methodologies: Recent developments, economic optimization of pavement maintenance and rehabilitation

Scope and Objective of the Course:

Up keeping the road infrastructure / assets in serviceable condition is very important from the point of view of providing best road network with optimal investments. Pavement is the biggest and most important asset among all the road assets. During this course, it is planned to discuss methods and means of pavement evaluation from the point of view of structural integrity, functional condition as well as safety of the road surface. Prioritisation of expenditure from the limited budget available needs many inputs. Pavement condition rating is the first step to achieve this objective. In this course, the road condition rating will be discussed at length and the students will be asked to rate a pavement to get a feel of the same. Rating manuals will be reviewed and the best rating manual will be adopted during the course. HDM 4 module will be introduced for the students to get the grip on prioritising the pavements for maintenance as well as life cycle cost analysis. Forecasting the future condition of the pavement needs performance as well as deterioration models to be covered. Also, data needs as well as other stages of overall pavement management at project and network levels will also be discussed during the course.

Text Book:

1. Ralph Haas, Ronald Hudson, Zanieswki with Lynne CoweFalls , "Pavement Asset Management', Wiley, 2015.

References:

2. RajibBasuMallick and Tahar El-Kochi, 'Pavement Engineering: Principles and Practice', CRC Press, 2013.
3. Shahin, M.Y, "Pavement Management for Airports, Roads and Parking Lots', Springer, Second Edition, 2005.
4. NCHRP 215 – " Pavement Management System Development", Transport Research Board, 1979
5. NCHRP Synthesis 501 – " Pavement Management Systems: Putting data to work – A Synthesis of Highway Practice, Transport Research Board, 2017
6. NCHRP 523 – "Optimal Timing of Pavement Preventive Maintenance Treatment Applications", Transport Research Board, 2004

Course Plan: Lectures

Lecture No.	Learning objectives	Topics to be covered	Chapter in the Text Book
1-2	Pavement Management Process	Why Pavement management, Stages of Pavement Management System (PMS), project and network levels of pavement management and functions, applications of Pavement Management System as a planning and technology improvement tool	Chapter 1, 2 and 3 of R1; Web resources, Shared Material
3	Data Requirements: Overview	Overview of pavement management data needs; Inventory data	Chapter 5 of R1
4-6	Pavement Structural Condition Evaluation	Benkelman beam studies, Falling weight deflectometer studies on both flexible and rigid pavements; back calculation concepts	Chapter 8 of R1
7-9	Pavement Functional Condition Evaluation / Surface Distress Condition Evaluation	Pavement roughness concepts; Instrumentation used to assess pavement roughness, International roughness index and its importance in pavement management process	Chapter 9 of R1
10-11	Pavement safety Condition Evaluation	Pavement Texture, Importance of surface friction characteristics on pavement safety, Discussion on the methods of Evaluation of pavement safety,	Chapter 10 of R1
12-14	Combined Measures of Pavement Quality (Pavement Rating)	Combined measures of pavement quality, Discussions on Condition Indices and Serviceability Indices, Pavement condition rating, Introduction to pavement rating manuals by different agencies	Chapter 11 of R1

15-19	Pavement Performance and deterioration Models	Structural condition (Distress) Models, Functional Condition Models, Initiation models and Progression Models	Chapter 15 of R1and Journal articles
20-21	Determining Present and Future Needs and Priority Programming of Rehabilitation and Maintenance	Establishing criteria, prediction models for pavement deterioration, determining needs, rehabilitation and maintenance alternatives, priority programming of rehabilitation and maintenance, developing combined programs of maintenance and rehabilitation	Chapters 14 and 16 of R1
22-24	Rehabilitation Design and Economic Analysis	Generating alternate strategies of design and rehabilitation; Materials, construction and maintenance policy alternatives, consideration of preservation in pavement design and analysis procedures, economic evaluation of alternate pavement design strategies and selection of optimal strategies	Chapters 17 and 18 of R1
25-28	Highway Development and Management Tools in pavement management	Introduction to HDM 4, Introduction to HDM 4 package, Case studies with multiple alternative options of construction and maintenance strategies	Chapter 19 and Chapter 33 of R1
29-31	Database Management	Integrated Database management, communicating the present status of pavement at network and project levels.	Chapters 12 and 13 of R1
32-35	Economic Evaluation of alternative pavement design and maintenance policies and selection of optimal strategy	Consideration of Environmental Costs in Selecting Alternative Strategies; Weighing Costs versus Environmental Benefits; Unique and/or Unpredictable Cost Factors; User Costs; Selection of an Optimal Strategy; Road User Cost Study report discussion	Chapter 25 of R1
36-40	Implementation of PMS	Implementation of Pavement Management System: Role of construction quality on performance, pavement preservation on maintenance needs; Emerging trends in road asset management; Urban Pavement Management System.	Chapters 27, 28 and 29 of R1
41-42	Introduction to PMS for Airports	Airport Pavement Inventory; Airport Pavement Inspection; Performance Modeling and Condition Analysis; Airport Pavement Work Planning; USDOT Federal Aviation Administration Support	Chapter 35 of R1 and R3

		and Use of PMS; Detailed Pavement Management Applications; Application of GIS/GPS in Shanghai Airport Pavement Management System	

Laboratory Engagement

Laboratory Sessions	Topics to be covered
1	Introduction to PMS lab
2 – 4	Video based lab sessions for structural condition evaluation of flexible and rigid pavements
5 – 7	Video based lab sessions for functional condition evaluation of flexible and rigid pavements
8	Mid Semester Evaluation
9 – 10	Video based lab sessions for safety evaluation of flexible and rigid pavements
11 – 15	HDM 4 demonstration and hands on practice
16	End semester Evaluation

Experiments 1 to 7 involve demonstration of structural and functional condition evaluation methods for both flexible and rigid pavements through online videos / procedure manuals etc. Students are expected to make a report of what they have learnt during these sessions and submit the same at the beginning of the next scheduled lab session. Quiz / viva will be conducted during the 8^{th} session and will be considered as mid semester evaluation. Both 9^{th} and 10^{th} sessions will be carried out, similar to sessions 1 to 7, covering the safety evaluation of both flexible and rigid pavements.

Video demonstration of HDM 4 software is being planned during 11^{th} to 15^{th} sessions and the students are expected to submit and present a comprehensive report on HDM 4 at the beginning of 16^{th} session, which will be considered as end semester evaluation.

Evaluation Scheme:

Component	Duration	Weightage (%)	Date & Time	Nature of Component
Test 1	30 min	15	September 10^{th} to September 20^{th} (during the class hour)	Open book
Test 2	30 min	15	October 9^{th} to October 20^{th} (during the class hour)	Open book
Test 3	30 min	15	November 10^{th} to November 20^{th} (during the class hour)	Open book
Comprehensive Examination	120 min	25	09/12 AN	Open Book
Term Paper (Report and Presentation)	-	10	Throughout the semester	Open book

Performance during Lab sessions	-	10	Throughout the semester	Open book
Take home and in-class Assignments	-	10	Throughout the semester	Open book

On-line extra consultation hour: Every Saturdays: 11 Noon to 12 Noon

Notices: Students are advised to look for notices in their respective CMS.

Make-up Policy:

- Make up requests received on social networking platforms / SMS / WHATSAPP etc. will be ignored and no further action will be initiated. **Makeup requests through official mails with necessary documentary proofs only will be accepted.**
- 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 should be submitted as a proof. Made-up medical certificates / other proofs will be seriously considered and referred to disciplinary committee for further necessary action.
- Make up policy is applicable for tests 1, 2, 3 and the comprehensive examination only. Other listed components will not have any scope for make-ups. Students are advised to adhere to the schedules without fail

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 / assignments before submission.

INSTRUCTOR-IN-CHARGE
CE G548