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ACADEMIC - GRADUATE STUDIES AND RESEARCH DIVISION
FIRST SEMESTER 2022-2023
Course Handout Part II

Date: 10-08-2022

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 G571
Course Title	:	**Road Asset Management**
Instructor-in-Charge	:	V VINAYAKA RAM
Instructors	:	V Vinayaka Ram

Course Description : Need for Road inventory data, purpose and types. Characterization of pavement performance including the concept of pavement condition index. Application of road roughness data including the calibration for universal roughness standard. The nondestructive measurement of structural condition of the pavement at network and project level. Database Management with automated survey methods for distress prediction. Pavement deterioration models, pavement maintenance and rehabilitation techniques. Life cycle cost analysis using HDM4. Prioritization of pavement maintenance strategies. Developing asset management plans: financial plan, asset valuation, resource allocation. Economic evaluation of alternative pavement design strategy and selection of an optimal maintenance strategy.

1. **Course Description, Scope & Objective of the course**:
Maintaining the road infrastructure in a serviceable condition is crucial for creating the best road network with the least amount of investment. The largest and most significant asset on the road is the pavement. With pavement serving as the primary asset, methods and strategies for managing all types of road assets will be covered in this course. This course will cover a wide range of topics, including causes of distress, methods and tools for evaluating both flexible and rigid pavements, corrective actions, maintenance tasks, and the tools required for prioritizing maintenance tasks (HDM 4). The course will also include a few case studies that involve both routine and forensic investigations. Those who want to make pavement engineering their career will find this course very helpful.

2. **Course Outcomes:** At the end of this course, the students will develop:

1. An ability to understand the importance of implementing road asset management in general and project level & network level pavement management system in particular.
2. An ability to evaluate the flexible and rigid pavement structures comprehensively.
3. An ability to suggest remedies to address different pavement failures for both flexible and rigid pavement structures.
4. An ability to rate the pavement condition and use it for prioritising the maintenance activities during the life cycle of the pavement structure using HDM 4 software tool.

3. Text books:

TB1. Ralph Haas, Ronald Hudson, Zanieswki with Lynne Cowe Falls, "Pavement Asset Management', Wiley, 2015.

TB2. Shahin, M.Y., "Pavement Management for Airports, Roads and Parking Lots", Springer, 2nd Edition, 2005

Reference Books:

R1. IRC 82: 2015, First Revision, Code of Practice for maintenance of Bituminous Road Surfaces

R2. IRC SP 83: 2018, First Revision, Guidelines for maintenance, repair and rehabilitation of cement concrete pavements

R3. Feng Li, Jinyan Feng, Youxin Li, Siqi Zhou, Preventive Maintenance Technology for Asphalt Pavement, Springer, 2021

R4. ACRP Synthesis 22, Common Airport Maintenance Practices, Transportation Research Board, Washington DC, 2011

R5. R. Keith Moble, An Introduction to Predictive Maintenance, Second Edition, Butterworth Heinemann Publications, 2002

R6. NCHRP 523 – "Optimal Timing of Pavement Preventive Maintenance Treatment Applications", Transport Research Board, 2004

R7. NCHRP Synthesis 501 – "Pavement Management Systems: Putting data to work – A Synthesis of Highway Practice, Transport Research Board, 2017

R8. Highway Rating manuals

R9. HDM 4 manuals

R10. Derek Pearson, "Deterioration and Maintenance of Pavements, Ice Publishing, 2012

R11. Rajib Basu Mallick and Tahar El-Kochi, Pavement Engineering: Principles and Practice, CRC Press 2013

4. Course Plan:

	Learning	Topics to be covered	Referenc	SLOs

Lecture No.	objectives		e	
1-2	Introduction to Road Asset Management	Introduction to road assets and their management: Pavement structure, shoulders, road side tree plantations, street lighting, traffic signs, traffic signals, intersection elements, interchange elements etc.	TB1, TB2	a
3-4	Pavement Management Process as a part of Road Asset Management	Concepts and different levels (project and network) of pavement management and functions, application of Pavement Management System as a planning and technology improvement tool, components of PMS and their inter linkages	TB1, TB2	a,e
5	Data Requirements for Asset / pavement Management	Overview of pavement management data needs, importance of pavement failures, evaluation and remedies	TB1, TB2	a,e
6-15	Pavement failures	Identification, measurement, causative factors and general remedies for all the varieties of failure under the headings of surface defects, deformation and disintegration of flexible pavements Identification, measurement, causative factors and general remedies for all the varieties of failure under the headings of joint spalling, faulting, polished aggregate, shrinkage cracking, pumping, linear cracking, durability cracking.	R9 and relevant IRC codes	a,b,e
16-24	Pavement Condition Evaluation:	Structural Condition: Importance of structural condition evaluation of pavements, benkelman beam technique for flexible pavement evaluation, falling weight deflectometer technique for both flexible and rigid pavements Functional Condition: Importance of functional condition evaluation of pavements, pavement roughness concepts; instrumentation used to assess pavement roughness, international roughness index and its importance, measurement of surface	TB1, TB2, R1, R2, R9, R11, R12	a,b,e,f

		defects in both flexible and rigid pavements		
		Safety Condition: Pavement texture, importance of surface friction characteristics on pavement safety, discussion on the methods of evaluation of pavement safety		
		Introduction to forensic investigations with case studies		
25-26	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	TB1, TB2, R1, R2	a,b,e,h,k
27-34	Pavement Maintenance and preservation	Periodic maintenance: periodic renewals, need and importance of periodic renewals, planning and programming of renewals, identification of stretches to be renewed, types of renewal treatments, periodicity of renewal, rectification of profile at the time of renewal; pothole filling / patching, tools and equipment for pothole / patch repairs, modern mobile mechanized pothole filling/road patching technologies, arrangements for traffic and safety measures during road maintenance

Preventive maintenance and Pavement Preservation: introduction, selection of preventive maintenance treatment, warrants for preventive maintenance, flexible pavement preservation tools

Assessing maintenance needs, methods for repairing concrete pavements, crack sealing and joint resealing, crack stitching (cross stitching), partial-depth repair, full depth repair, slab stabilization, special techniques for rehabilitation of rigid pavements, repair materials, tools and plant, planning the maintenance | R1, R2 | a,c,e |

		operations, arrangement for traffic and safety, rigid pavement preservation tools		
35	Determining the present and future needs through deterioration / distress models	Importance of deterioration / distress models; Prediction models for Structural condition, functional condition (both initiation models and progression models)	Online resources, articles, R1 to R11	a,e
36-39	Priority programming of Maintenance and Rehabilitation options	Maintenance and rehabilitation alternative selection, priority programming of maintenance and rehabilitation activities; materials, design, construction and maintenance policy options, application of Highway Development and Management (HDM 4) tool	R10	a,d,e
40-42	Advanced topics	Advances in road asset management systems	Internet and other resources	a,e,g,I,j

*Student Learning Outcomes (SLOs):
SLOs are outcomes (a) through (k) plus any additional outcomes that may be articulated by the program.

   a) An ability to apply knowledge of mathematics, science and engineering
   b) An ability to design and conduct experiments, as well as to analyse and interpret data
   c) An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
   d) An ability to function on multidisciplinary teams
   e) An ability to identify, formulate, and solve engineering problems
   f) An understanding of professional and ethical responsibility
   g) An ability to communicate effectively
   h) The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
   i) A recognition of the need for, and an ability to engage in life-long learning
   j) A knowledge of contemporary issues
   k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

5. Laboratory Engagement (12 Sessions)
1. Development of technical notes for different pavement failures and maintenance activities (2 sessions)
2. Development of decision tree for various maintenance activities for flexible and rigid pavements (1 Session)

3. Case studies – (Narkatpalli-Addanki case, Begumpet airport rehabilitation case, Food corporation of India case study) – Depending on the time available, more case studies may be added (2 Sessions)
4. Landslides and their repercussion on road failures, relevant measures (1 Session)
5. Maintenance management of road furniture / assets (1 Session)
6. Thin white topping as a maintenance option (1 Session)
7. Hands on with HDM 4 software (2 Sessions)
8. Road Rating on selected road stretches and remedies (2 Sessions)

6. Evaluation Scheme:

S.No.	Evaluation Component	Duration (Min)	Weightage (%)	Date & Time	Remarks
1	Mid semester Examination	90 min	25	05/11 11.00 - 12.30PM	CB (Relevant codes books will be allowed, if needed)
2	Comprehensive Examination	180 min	35	29/12, FN	Partially OB and Partially CB (Relevant code books will be allowed, if needed for the CB part)
3	Lab based Projects and Presentations	-	20	Throughout the semester	OB
4	Term Paper and Presentations	-	10	Throughout the semester	OB
5	In class and take home Assignments	-	10	Throughout the semester	OB

7. Chamber consultation hour: Every Saturday: 2 PM to 3 PM

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

9. 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 mid semester and the comprehensive examinations only.** Other listed components will not have any scope for make-ups. Students are advised to adhere to the schedules without fail

10. 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. Submissions with high plagiarized contents will be ignored and students will not be given chance to submit the assignments again in such cases.

INSTRUCTOR-IN-CHARGE
CE G571