Ref No:

SRI KRISHNA INSTITUTE OF TECHNOLOGY , BANGALORE-90

COURSE PLAN

Academic Year -2018-19

Program:	B E – Civil Engineering
Semester :	8
Course Code:	15CV833
Course Title:	Pavement Design
Credit / L-T-P:	4 / 4-0-0
Total Contact Hours:	40
Course Plan Author:	Shivaprasad D G

Academic Evaluation and Monitoring Cell

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A. COURSE INFORMATION

1. Course Overview

Degree:	Engineering	Program:	civil
Semester:	4th year, 8th sem	Academic Year:	18-19
Course Title:	Pavement design	Course Code:	15CV833
Credit / L-T-P:	3/4-0-0	SEE Duration:	180 Minutes
Total Contact Hours:	40	SEE Marks:	80 Marks
CIA Marks:	30	Assignment	1 / Module
Course Plan Author:	Dhanalakshmi M	Sign	Dt:
Checked By:		Sign	Dt:
CO Targets	CIA Target : .... %	SEE Target:	.... %

2. Course Content

Module	Content	Teaching Hours	Identified Module Concepts	Blooms Learning Levels
1	Introduction: Desirable characteristics of pavement, Types and components, Difference between Highway pavement and Air field pavement, Design strategies of variables, Functions of sub grade, sub base, Base course, surface course, comparison between Rigid and flexible pavement Fundamentals of Design of Pavements: Stresses and deflections, Principle, Assumptions and Limitations of Boussinesq's theory, Burmister theory and problems on above	8	Fundamentals of pavement design	L2 understand
2	Design Factors: Design wheel load, contact pressure, Design life, Traffic factors, climatic factors, Road geometry, Subgrade strength and drainage, ESWL concept Determination of ESWL by equivalent deflection criteria, Stress criteria, EWL concept, and problems on above. Flexible pavement Design: Assumptions, Mcleod Method, Kansas method, CBR method, IRC Method (old), CSA method using IRC-37-2001, problems on above	8	Design Factors and methods of flexible pavements	L6 design
3	Flexible Pavement Failures, Maintenance and Evaluation, Types of failures, Causes, Remedial/Maintenance measures in flexible pavements, Functional Evaluation by Visual inspection and unevenness measurements, Structural evaluation by Benkleman beam deflection method, Falling weight deflectometer, GPR method. Design factors for runway pavements, Design methods for Airfield pavement and problems on above	8	Failures, Maintenance and Evaluation of flexible pavements	L5 evaluate
4	Stresses in Rigid Pavement : Types of stress, Analysis of Stresses, Westergaard's Analysis, Modified Westergaard equations, Critical stresses, Wheel load stresses, Warping stress, Frictional stress, combined stresses (using chart / equations), problems on above Design of Rigid Pavement: Design of CC pavement by IRC: 58-2002 for dual and Tandem axle load, Reinforcement in slabs, Design of Dowel bars, Design of Tie bars, Design factors for Runway pavements, Design methods for airfield pavements, problems of the above	8	Stresses and Design of Rigid Pavement	L6 design
5	Rigid Pavement Failures, Maintenance and Evaluation: Types of failures, causes, remedial/maintenance measures in rigid pavements, Functional evaluation by Visual inspection and unevenness measurements, wheel load and its repetition,	8	-Maintenance of rigid pavements -Evaluation of rigid pavements	L5 evaluate

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	properties of subgrade, properties of concrete. External conditions, joints, Reinforcement, Requirements of joints, Types of joints, Expansion joint, contraction joint, warping joint, construction joint, longitudinal joint, Design of joints	and joints	
-	**Total**	40	-	-

3. Course Material

Books & other material as recommended by university (A, B) and additional resources used by course teacher (C).

1. Understanding: Concept simulation / video ; one per concept ; to understand the concepts ; 15 – 30 minutes
2. Design: Simulation and design tools used – software tools used ; Free / open source
3. Research: Recent developments on the concepts – publications in journals; conferences etc.

Modules	Details	Chapters in book	Availability
A	**Text books (Title, Authors, Edition, Publisher, Year.)**	**-**	**-**
1, 2, 3, 4, 5	1. S K Khanna, C E G Justo, and A Veeraragavan, "Highway Engineering", Nem Chand & Brothers	2,3,6,7,8,9	In Lib
1,3,5	2. L.R.Kadiyali and Dr.N.B.Lal, " Principles and Practices of Highway Engineering", Khanna publishers	5,6,9	In Lib
1, 2, 3, 4, 5	3. Yang H. Huang , "Pavement Analysis and Design", University of Kentucky	1, 2, 4, 6, 8,9	In dept
B	**Reference books (Title, Authors, Edition, Publisher, Year.)**	**-**	
1,3,5	1. Yoder & wit zorac , "Principles of pavement design", John Wiley & Sons.	1,3,4	In Lib
2,4	2. Subha Rao, "Principles of Pavement Design".	4, 5	In Lib
2,3, 4, 5	3. R Srinivasa Kumar, "Pavement Design" , University Press.	3,4,5,7,8	In dept
	4. Relevant recent IRC codes		
C	**Concept Videos or Simulation for Understanding**	**-**	**-**
C1	https://www.youtube.com/watch?v=3oNa9Z94Hiw		
C2	https://www.youtube.com/watch?v=uJntLOgEHD4&list=PLSitSeMkk1bndRgMKgGvtl64palLKUVuH&index=34		
C3	https://www.youtube.com/watch?v=1iNbOLjhhho		
C4	https://www.youtube.com/watch?v=YXMtSAn71oU		
C5	https://www.youtube.com/watch?v=j5acA-UFPrs		
D	**Software Tools for Design**	**-**	**-**
E	**Recent Developments for Research**	**-**	**-**
1	Recent trends in pavements- https://ascelibrary.org/doi/document		
F	**Others (Web, Video, Simulation, Notes etc.)**	**-**	**-**

4. Course Prerequisites

Refer to GL01. If prerequisites are not taught earlier, GAP in curriculum needs to be addressed. Include in Remarks and implement in B.5.

Students must have learnt the following Courses / Topics with described Content . . .

Modules	Course Code	Course Name	Topic / Description	Sem	Remarks	Blooms Level
1	15CIV14	Elements of civil engineering	Basic concepts of pavement materials	1	Knowledge of basic terminologies of pavement materials is required	L2
2	15CV63	Highway engineering	Basic concepts of highway engineering	6	Knowledge of basic design terminologies of highway is required	L2

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5. Content for Placement, Profession, HE and GATE

The content is not included in this course, but required to meet industry & profession requirements and help students for Placement, GATE, Higher Education, Entrepreneurship, etc. Identifying Area / Content requires experts consultation in the area.

Topics included are like, a. Advanced Topics, b. Recent Developments, c. Certificate Courses, d. Course Projects, e. New Software Tools, f. GATE Topics, g. NPTEL Videos, h. Swayam videos etc.

Modules	Topic / Description	Area	Remarks	Blooms Level

B. OBE PARAMETERS

1. Course Outcomes

Expected learning outcomes of the course, which will be mapped to POs.

Modules	Course Code.#	Course Outcome **At the end of the course, student should be able to . . .**	Teach. Hours	Instr Method	Assessment Method	Blooms' Level
1	15CV833	Understand the characters and analyze design components of different types of pavements	8	Lecture/demonstrate	CIE/Assignment/unit test	L3
2	15CV833	Design the flexible pavements based on soil condition using different methods	8	Lecture	CIE/Assignment/unit test	L4
3	15CV833	Evaluate the causes for failure of flexible pavements using different methods	8	Lecture	CIE/Assignment/unit test	L5
4	15CV833	Design the rigid pavements based on soil condition using different method	8	Lecture	CIE/Assignment/unit test	L4
5	15CV833	Evaluate the causes for failure of rigid pavements using different methods	8	Lecture	CIE/Assignment/unit test	L5
-	-	**Total**	**40**	-	-	**L3-L5**

2. Course Applications

Write 1 or 2 applications per CO.
Students should be able to employ / apply the course learnings to . . .

Modules	Application Area Compiled from Module Applications.	CO	Level
1	Construction of different types of pavements	CO1	L2
1	Analyzing the different types of pavements	CO2	L4
2	Analyzing the application of wheel loads on bitumen pavements	CO3	L4
2	Designing of bitumen pavements	CO4	L5
3	Maintenance of bitumen pavements	CO5	L4
3	Evaluation of bitumen pavements	CO6	L5
4	Analyzing the application of stresses on concrete pavements	CO7	L4
4	Designing of concrete pavements	CO8	L5
5	Maintenance of concrete pavements	CO9	L4
5	Evaluation of concrete pavements	CO10	L5

3. Articulation Matrix

CO – PO Mapping with mapping level for each CO-PO pair, with course average attainment.

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Modules	CO.#	Course Outcomes At the end of the course student should be able to . . .	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	Level
1	CO1	Understand the characters and analyze design components of different types of pavements	3	2	1	1	-	-	-	-	-	2	-	2	X	X	X	L2
1	CO2	Design the flexible pavements based on soil condition using different methods	3	3	3		1	-	1	-	-	-	-	2	X	X	X	L5
2	CO3	Evaluate the causes for failure of flexible pavements using different methods	3	3	2	2	-	-	-	-	-	-	1	2	X	X	X	L4
2	CO4	Design the rigid pavements based on soil condition using different method	3	3	3		1	-	1	-	-	-	-	2	X	X	X	L5
3	CO5	Evaluate the causes for failure of rigid pavements using different methods	3	3	1	2	-	-	-	-	-	-	1	2	X	X	X	L4
-	15cv833	Average attainment (1, 2, or 3)	3	2.8	2	1	0.4	-	0.4	-	-	0.4	0.4	2				-
-	PO, PSO	1.Engineering Knowledge; 2.Problem Analysis; 3.Design / Development of Solutions; 4.Conduct Investigations of Complex Problems; 5.Modern Tool Usage; 6.The Engineer and Society; 7.Environment and Sustainability; 8.Ethics; 9.Individual and Teamwork; 10.Communication; 11.Project Management and Finance; 12.Life-long Learning;																

4. Curricular Gap and Content

Topics & contents not covered (from A.4), but essential for the course to address POs and PSOs.

Modules	Gap Topic	Actions Planned	Schedule Planned	Resources Person	PO Mapping

C. COURSE ASSESSMENT

1. Course Coverage

Assessment of learning outcomes for Internal and end semester evaluation. Distinct assignment for each student. 1 Assignment per chapter per student. 1 seminar per test per student.

Modules	Title	Teach. Hours	CIA-1	CIA-2	CIA-3	Asg	Extra Asg	SEE	CO	Levels
1	Introduction	8	2	-	-	1	1	2	CO1	L2,L4
2	Design factors	8	2	-	-	1	1	2	CO2	L4,L6
3	Flexible pavement failures	8	-	2	-	1	1	2	CO3	L4,L5
4	Stresses in rigid pavements	8	-	2		1	1	2	CO4	L4
5	Rigid pavement failures	8	-	-	4	1	1	2	CO5	L4,L5
-	**Total**	**40**	**4**	**4**	**4**	**5**	**5**	**10**	**-**	**-**

2. Continuous Internal Assessment (CIA)

Assessment of learning outcomes for Internal exams. Blooms Level in last column shall match with A.2.

Modules	Evaluation	Weightage in Marks	CO	Levels
1, 2	CIA Exam – 1	30	CO1,CO2	L2,L4,L4
3, 4	CIA Exam – 2	30	CO2,CO3	L4,L5,L4
5	CIA Exam – 3	30	CO4,CO5	L4,L5
1, 2	Assignment - 1	05		L2,L4,L4
3, 4	Assignment - 2	05		L4,L5,L4

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5	Assignment - 3	05		L4
1, 2	Seminar - 1		-	-
3, 4	Seminar - 2		-	-
5	Seminar - 3		-	-
1, 2	Quiz - 1		-	-
3, 4	Quiz - 2		-	-
5	Quiz - 3		-	-
1 - 5	Other Activities – Mini Project	-		
	Final CIA Marks	**20**	**-**	**-**

D1. TEACHING PLAN - 1

Module - 1

Title:	PAVEMENT DESIGN INTRODUCTION	Appr Time:	8Hrs
a	***Course Outcomes***	-	**Blooms**
-	The student should be able to:	-	**Level**
1	Understand the characters and analyze design components of different types of pavements	CO1	L3
b	***Course Schedule***	-	-
Class No	**Module Content Covered**	**CO**	**Level**
1	Introduction: Desirable characteristics of pavement, Types and components	CO1	L2
2	Difference between Highway pavement and Air field pavement,	CO1	L2
3	Design strategies of variables	CO1	L2
4	Functions of sub grade, sub base, Base course, surface course, comparison between Rigid and flexible pavement	CO1	L2
5	Fundamentals of Design of Pavements: Stresses and deflections,	CO1	L2
6	Principle, Assumptions and Limitations of Boussinesq's theory, Burmister theory	CO2	L4
7	problems on above		L3
8	problems on above		L3
c	**Application Areas**	**CO**	**Level**
1	In the construction of pavements		
d	**Review Questions**		
e	**Experiences**	-	-
1			

Module – 2

Title:	**DESIGN FACTORS**	Appr Time:	8 Hrs
a	***Course Outcomes***	-	**Blooms**
-	The student should be able to:	-	**Level**
1.	Design the flexible pavements based on soil condition using different methods	CO2	L4
b	***Course Schedule***	-	-
Class No		**CO**	**Level**
9	Design Factors: Design wheel load, contact pressure,	CO2	L4

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10	Design life, Traffic factors, climatic factors, Road geometry, Subgrade strength and drainage,	CO2	L4
11	ESWL concept Determination of ESWL by equivalent deflection criteria, Stress criteria, EWL concept, and problems on above.	CO2	L4
12	Flexible pavement Design: Assumptions, Mcleod Method,	CO2	L4
13	Kansas method, CBR method,	CO2	L4
14	IRC Method (old),	CO2	L4
15	CSA method using IRC-37-2001, problems on above	CO2	L4
16	CSA method using IRC-37-2001, problems on above	CO2	L4
c	**Application Areas**	**CO**	**Level**
1	In the construction of flexible pavements		
d	**Review Questions**	-	-
e	**Experiences**		-
1			

E1. CIA EXAM – 1

a. Model Question Paper - 1

	15CV833	Sem:	8th	Marks:	30	Time:	75 minutes
	Pavement design						

Q. Nos	Note: Answer all questions, each carry equal marks. Module : 1, 2	Marks	CO	Level
	MODULE-1(15 marks)			
1 a	Write a brief note on rigid pavement	6	CO1	L2
b	Write the difference between flexible pavement and rigid pavement	9	CO1	L2
	OR			
2 a	With a neat sketch explain the properties and function of a) sub base course b) wearing course	5	CO2	L2
b	A plate load test conducted with 0.3m dia plate on subgrade and on a pavement of thickness 0.4m sustained pressure of $0.10N/mm^2$ and $0.40N/mm^2$ respectively at 5mm deflection. Design the pavement section for 50KN wheel load and contact pressure of $0.70N/mm^2$ for an allowable deflection of 8mm using Burmister two layer theory.	10	CO2	L5
	MODULE-2(15 marks)			
3 a	List and explain the design strategies of variables of pavement	5	CO3	L2
b	Determine the total thickness of flexible pavement assuming single layer elastic theory : Design wheel load= 3700kg Tyre pressure= $5.0kg/cm^2$ Elastic modulus= $150kg/cm^2$ Permissible deflection= 0.25cm	5	CO3	L5
c	Write a brief note on assumptions and limitation of bousssinesq's theory	5	CO3	L2
	OR			
4 a	With a neat sketch describe the significance of design wheel load and contact pressure in design of pavement	6	CO4	L3
b	A circular load of radius 15cm with uniform contact pressure of $7kg/cm^2$ is applied on the surface of the homogeneous mass. Determine the vertical stress at a radial distance of 30cm at a depth of 45cm from the surface.	9	CO4	L5

b. Assignment -1

Note: A distinct assignment to be assigned to each student.

Model Assignment Questions

Crs Code:	15CV833	Sem:	8th	Marks:	30	Time:	90 – 120 minutes		
Course:	Pavement design								

Note: Each student to answer 2-3 assignments. Each assignment carries equal mark.

SNo	USN	Assignment Description	Marks	CO	Level
1		Explain two layered theory. Mentions its assumptions and limitations	5	CO1	L3
2		Explain design wheel load.	5	CO1	L2
3		Explain the concept of determining the equivalent wheel load	5	CO1	L2
4		Explain contact pressure	5	CO1	L2
5		Difference between airfield pavement and rigid pavement	5	CO2	L3
6		Write a brief note on rigid pavement	5	CO2	L3
7		Write the difference between flexible pavement and rigid pavement	5	CO2	L3
		Define ESWL	5	CO2	L2
9		With a neat sketch explain the properties and function of a) sub base course b) wearing course	5	CO2	L2
10		A plate load test conducted with 0.3m dia plate on subgrade and on a pavement of thickness 0.4m sustained pressure of 0.10N/mm² and 0.40N/mm² respectively at 5mm deflection. Design the pavement section for 50KN wheel load and contact pressure of 0.70N/mm² for an allowable deflection of 8mm using Burmister two layer theory.	5	CO2	L5
11		With a neat sketch describe the significance of design wheel load and contact pressure in design of pavement	5	CO2	L2
12		A circular load of radius 15cm with uniform contact pressure of 7kg/cm² is applied on the surface of the homogeneous mass. Determine the vertical stress at a radial distance of 30cm at a depth of 45cm from the surface.	5	CO2	L5
13		List and explain the design strategies of variables of pavement	5	CO1	L2
14		Determine the total thickness of flexible pavement assuming single layer elastic theory : Design wheel load= 3700kg Tyre pressure= 5.0kg/cm² Elastic modulus= 150kg/cm² Permissible deflection= 0.25cm	5	CO1	L5
15		Write a brief note on assumptions and limitation of bousssinesq's theory	5	CO2	L2
24					

D2. TEACHING PLAN - 2

Module – 3

Title:	FLEXIBLE PAVEMENT FAILURES		Appr Time:	12 Hrs
a	*Course Outcomes*		CO	Blooms
-	At the end of the topic the student should be able to		-	Level
1	Evaluate the causes for failure of flexible pavements using different methods		CO3	L5
b	*Course Schedule*			
Class No	Portion covered per hour		-	-
17	Flexible Pavement Failures, Maintenance and Evaluation, Types of failures, Causes,		CO3	L4
18	Remedial/Maintenance measures in flexible pavements,		CO3	L2
19	Functional Evaluation by Visual inspection and unevenness measurements, Structural		CO3	L4
20	evaluation by Benkleman beam deflection method		CO3	L4
21	Falling weight deflectometer, GPR method.		CO3	L3
22	Design factors for runway pavements		CO3	L3
23	Design methods for Airfield pavement		CO3	L5
24	Design methods for Airfield pavement and problems on above		CO3	L5

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c	**Application Areas**			**-**
1	In the maintenance of flexible pavements			-
2	In the construction of airfield pavements			
d	**Review Questions**			**-**
e	**Experiences**		**-**	**-**

Module – 4

Title:	Stresses in rigid pavements		Appr Time:	13 Hrs
a	*Course Outcomes*		**CO**	**Blooms**
-	At the end of the topic the student should be able to . . .		-	**Level**
1	Design the rigid pavements based on soil condition using different method		CO4	L4
b	*Course Schedule*			
Class No	**Portion covered per hour**		**-**	**-**
25	Stresses in Rigid Pavement : Types of stress, Analysis of Stresses		CO4	L2
26	Westergaard's Analysis, Modified Westergaard equations, Critical stresses		CO4	L4
27	Wheel load stresses, Warping stress, Frictional stress, combined stresses (using chart / equations), problems on above		CO4	L4
28	Design of Rigid Pavement		CO4	L4
29	Design of CC pavement by IRC: 58-2002 for dual and Tandem axle load		CO4	L4
30	Reinforcement of slabs		CO4	L4
31	Design of Tie bars, Design factors for Runway pavements,		CO4	L4
32	Design methods for airfield pavements, problems of the above		CO4	L4
c	**Application Areas**		**-**	**-**
1	In the construction of rigid pavements		-	-
2	In the construction of Runway pavements			
d	**Review Questions**		**-**	**-**
e	**Experiences**		**-**	**-**
1				
2				

E2. CIA EXAM – 2

a. Model Question Paper - 2

15CV833	Sem:	8th	Marks:	30	Time:	75 minutes
Pavement design						

Q. Nos	Note: Answer all questions, each carry equal marks. Module : 3, 4	Marks	CO	Level
	MODULE-3(15 marks)			
1) a	Calculate ESWL of a dual wheel assembly carrying 2044 kg each for trial pavement thickness values Of 150, 200, & 250mm center to center spacing between the two tyres =270mm and clear gap between The walls of the tyres=110mm. (By graphical method)	7	CO3	L4
b	Bring out the differences between Dual wheel load assembly and Dual tandem wheel load assembly	8	CO3	L4
2) a	A circular load of radius 12cm with uniform contact pressure of 9 kg/cm^2 is applied on the surface of a homogeneous elastic mass.Determine the vertical stress under the centre of the load at a depth of 40cm from the surface.	15	CO3	L5
	MODULE-4(15 marks)			
3) a	Explain the fundamentals in design of pavements	8	CO4	L4
b	Explain in brief two layer elastic theory by Burmister	7	CO4	L4
4) a	Calculate the deflection at the surface of a pavement due to a wheel load of 40KN and a tyre pressure of 0.5MN/m^2.The value of E of the subgrade and pavement may be assumed to be uniformly equal to 20 MN/m^2.	10	CO4	L5
b	What are types of pavement? And explain with neat sketches	5	CO4	L5

b. Assignment – 2

Note: A distinct assignment to be assigned to each student.

Model Assignment Questions								
Crs Code:	15CV833	Sem:		8th		Marks:		Time:	Minutes:

Course:	Pavement design

Note: Each student to answer 2-3 assignments. Each assignment carries equal mark.

SNo	USN	Assignment Description	Marks	CO	Level
1		Explain the procedure to find corrected 'k' value in plate bearing test		CO3	L3
2		Explain contact pressure		CO3	L2
3		What are the functions and importance of various components in a flexible pavement.		CO3	L2
4		Calculate ESWL of a dual wheel assembly carrying 2044 kg each for trial pavement thickness values Of 150, 200, & 250mm center to center spacing between the two tyres =270mm and clear gap between The walls of the tyres=110mm. (By graphical method)		CO3	L5
5		Bring out the differences between Dual wheel load assembly and Dual tandem wheel load assembly		CO3	L3
6		A Plate bearing test was conducted on a 30cm dia plate and the following readings were observed. Find the corrected k value for standard plate of 75 cm size MEAN SETLEMENT VALUES in mm 0 0.26 0.51 0.75 1.01 1.26 1.54 1.74		CO3	L5
7		A circular load of radius 12cm with uniform contact pressure of		CO3	L5

		9 kg/cm^2 is applied on the surface of a homogeneous elastic mass.Determine the vertical stress under the centre of the load at a depth of 40cm from the surface.		
8		Determine the total thickness of flexible pavement assuming single layer elastic theory and using the following data Design wheel load=4200kg Tyre pressure= 6kg/cm Elastic modulus=150kg/cm^2 Permissible deflection=0.25cm	CO3	L5
9		Using the chart find the deflection and vertical stress at the top of the subgrade assuming homogeneous elastic layer for the following load I. Design load of 5000 kg, radius of loaded area 15 cm and pavement thickness 30 cm II.Design load of 15000 kg, contact pressure of 12 kg/cm^2 and pavement thickness 90 cm. assume E of the soil mass as 80 kg/cm^2	CO3	L5
10		Explain the fundamentals in design of pavements	CO3	L2
11		Explain in brief two layer elastic theory by Burmister	CO3	L3
12		What are types of pavement? And explain with neat sketches	CO3	L2
13		Calculate the deflection at the surface of a pavement due to a wheel load of 40KN and a tyre pressure of 0.5MN/m^2.The value of E of the subgrade and pavement may be assumed to be uniformly equal to 20 MN/m^2.	CO3	L5

D3. TEACHING PLAN - 3

Module – 5

Title:	RIGID PAVEMENT FAILURES		Appr Time:	10 Hrs
a	*Course Outcomes*		**CO**	**Blooms Level**
1	Evaluate the causes for failure of rigid pavements using different methods		CO5	L5
b	*Course Schedule*		-	-
Class No	**Portion covered per hour**		**-**	**-**
33	Rigid Pavement Failures, Maintenance and Evaluation		CO5	L2
34	Types of failures, causes, remedial/maintenance measures in rigid pavements		CO5	L2
35	Functional evaluation by Visual inspection and unevenness measurements		CO5	L4
36	wheel load and its repetition, properties of subgrade		CO5	L4
37	properties of concrete.External conditions, joints		CO5	L2
38	Reinforcement, Requirements of joints, Types of joints, Expansion joint, contraction joint		CO5	L2
39	warping joint, construction joint longitudinal joint		CO5	L4
40	Design of joints		CO5	L5
	Application Areas		**-**	**-**
1	In the field of analysis of rigid pavement		-	-

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d	Review Questions	-	-
e	Experiences	-	-

E3. CIA EXAM – 3

a. Model Question Paper - 3

	CV833PC				Sem:	III	Marks:	30	Time:	75 minutes

	PAVEMENT DESIGN								
Q. Nos	**Note: Answer all questions, each carry equal marks. Module : 5**						**Marks**	**CO**	**Level**
	MODULE-5(15 marks)								
1) a	Write a note on khansas method of flexible pavement design						6	CO5	L5
b	Plate bearing test was conducted on an 30cm dia plate and the following readings were observed. Find the corrected k value for standard plate of 75 cm size						9	CO5	L5

SETLEMENT VALUES in mm	0	0.26	0.51	0.75	1.01	1.26	1.54
LOAD VALUES in	0	465	910	1200	1350	1500	1600

	OR			
2) a	Explain the various reasons for frost action in rigid pavements and how it is overcome	6	CO5	L2
b	Explain the Mc Leod method of pavement design	9	CO5	L2
	MODULE-5(15 marks)		CO5	
3) a	Explain with a neat sketch the mechanism of mud pumping in CC pavement constructed on clayey strata. Indicate the remedial measures	5	CO5	L2
b	Bring out the guidelines for flexible pavement design as per IRC 37-2001	10	CO5	L2
			CO5	
4) a	Explain the westergards wheel load stress equations.	6	CO5	L2
b	Explain the function of the components of CC pavements	8	CO5	L2

b. Assignment – 3

Note: A distinct assignment to be assigned to each student.

Model Assignment Questions								
Crs Code:	15CV833	Sem:	8th	Marks:	5 / 10	Time:	90 – 120 minutes	
Course:	PAVEMENT DESIGN							
Note: Each student to answer 2-3 assignments. Each assignment carries equal mark.								
SNo	**USN**		**Assignment Description**			**Marks**	**CO**	**Level**
1			Write a note on khansas method of flexible pavement design				CO5	L2
2			Explain the types of joints with their functions				CO5	L4
3			Explain how the wheel load and its repetition of loads effects the CC pavements				CO5	L4
4			Explain the daily variation in temperature and warping stress in CC pavements.				CO5	L4
5			Explain the various reasons for frost action in rigid pavements				CO5	L4

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			CO	
		and how it is overcome		
6		Explain the Mc Leod method of pavement design	CO5	L4
7		Write the requirements of the joints	CO5	L2
8		Explain with a neat sketch the mechanism of mud pumping in CC pavement constructed on clayey strata. Indicate the remedial measures	CO5	L4
9		Bring out the guidelines for flexible pavement design as per IRC 37-2001	CO5	L5
10		Explain the factors affecting the design and performance of CC pavements	CO5	L4
11		Explain the westergaards wheel load stress equations.	CO5	L4
12		Explain the function of the components of CC pavements	CO5	L4

F. EXAM PREPARATION

1. University Model Question Paper

Course:		Pavement design					Month / Year		May /2020	
Crs Code:		15CV833	Sem:	8	Marks:	80	Time:		180 minutes	
-	**Note**	Answer all FIVE full questions. All questions carry equal marks.					**Marks**	**CO**	**Level**	
1	a	With a neat sketch explain the properties and function of a) sub base course b) wearing course					6	CO1	L2	
	b	A plate load test conducted with 0.3m dia plate on subgrade and on a pavement of thickness 0.4m sustained pressure of $0.10N/mm^2$ and $0.40N/mm^2$ respectively at 5mm deflection. Design the pavement section for 50KN wheel load and contact pressure of $0.70N/mm^2$ for an allowable deflection of 8mm using Burmister two layer theory.					10	CO1	L5	
		OR								
-	a	Write a brief note on rigid pavement					4	CO2	L2	
	b	Write the difference between flexible pavement and rigid pavement					6	CO2	L2	
	c	With a neat sketch describe the significance of design wheel load and contact pressure in design of pavement					6			
2	a	A circular load of radius 12cm with uniform contact pressure of 9 kg/cm² is applied on the surface of a homogeneous elastic mass. Determine the vertical stress under the centre of the load at a depth of 40cm from the surface.					8	CO3	L3	
	b	Determine the total thickness of flexible pavement assuming single layer elastic theory and using the following data Design wheel load=4200kg Tyre pressure= 6kg/cm Elastic modulus=150kg/cm² Permissible deflection=0.25cm					8	CO3	L5	
		OR								
-	a	Write the difference between flexible pavement and airfield pavement					6	CO4	L2	
	b	Define ESWL					2	CO4	L2	
	c	With a neat sketch explain the properties and function of a) sub base course b) wearing course					8	CO4	L4	
3	a	Calculate the deflection at the surface of a pavement due to a wheel load of 40KN and a tyre pressure of 0.5MN/m². The value of E of the subgrade and pavement may be assumed to be uniformly equal to 20 MN/m².					8	CO5	L5	
	b	What are types of pavement and explain with neat sketches					8	CO5	L4	
		OR								
-	a	Explain the fundamentals in design of pavements					5	CO6	L2	
	b	Explain in brief two layer elastic theory by Burmister					4	CO6	L4	
	c	What are the functions and importance of various components in a flexible pavement					7	CO6	L3	

4	a	Calculate ESWL of a dual wheel assembly carrying 2044 kg each for trial pavement thickness values Of 150, 200, & 250mm center to center spacing between the two tyres =270mm and clear gap between The walls of the tyres=110mm. (By graphical method)	12	CO5	L5
	b	Bring out the differences between Dual wheel load assembly and Dual tandem wheel load assembly	4	CO4	L2
		OR			
	a	Using the chart find the deflection and vertical stress at the top of the subgrade assuming homogeneous elastic layer for the following load I. Design load of 5000 kg, radius of loaded area 15 cm and pavement thickness 30 cm II.Design load of 15000 kg, contact pressure of 12 kg/cm^2 and pavement thickness 90 cm. assume E of the soil mass as 80 kg/cm^2	10	CO5	L5
	b	Write a note on khansas method of flexible pavement design	6	CO5	L3
5	a	Bring out the guidelines for flexible pavement design as per IRC 37-2001	6	CO4	L4
	b	Explain the various reasons for frost action in rigid pavements and how it is overcome	5	CO5	L3
	c	Explain the Mc Leod method of pavement design	5	CO4	L3
		OR			
	a	Explain the types of joints with their functions	8	CO5	L2
	b	Explain how the wheel load and its repetition of loads effects the CC pavements	8	CO5	L3

2. SEE Important Questions

Course:	Pavement design					Month / Year	May /2020	
Crs Code:	15cv833	Sem:	8	Marks:	100	Time:	180 minutes	
	Note	Answer all FIVE full questions. All questions carry equal marks.				-	-	
Mo dul e	Qno.	Important Question				**Marks**	**CO**	**Year**
1	1	With a neat sketch explain the properties and function of a) sub base course b) wearing course				5	CO1	L2
	2	A plate load test conducted with 0.3m dia plate on subgrade and on a pavement of thickness 0.4m sustained pressure of 0.10N/mm^2 and 0.40N/mm^2 respectively at 5mm deflection. Design the pavement section for 50KN wheel load and contact pressure of 0.70N/mm^2 for an allowable deflection of 8mm using Burmister two layer theory.				10	CO2	L5
2	3	List and explain the design strategies of variables of pavement				5	CO3	L2
	4	Determine the total thickness of flexible pavement assuming single layer elastic theory : Design wheel load= 3700kg Tyre pressure= 5.0kg/cm^2 Elastic modulus= 150kg/cm^2 Permissible deflection= 0.25cm				5	CO4	L5
	5	Write a brief note on assumptions and limitation of bousssinesq's theory				5	CO3	L2
3	6	Calculate ESWL of a dual wheel assembly carrying 2044 kg each for trial pavement thickness values Of 150, 200, & 250mm center to center spacing between the two tyres =270mm and clear gap between The walls of the tyres=110mm. (By graphical method)				7	CO5	L5
	7	Bring out the differences between Dual wheel load assembly and Dual tandem wheel load assembly				8	CO5	L3
	8	A circular load of radius 12cm with uniform contact pressure of 9 kg/cm^2 is applied on the surface of a homogeneous elastic mass.Determine the vertical stress under the centre of the load at a depth of 40cm from the surface.				15	CO5	L5

4	9	Explain the fundamentals in design of pavements	5	CO4	L2
	10	Explain in brief two layer elastic theory by Burmister	5	CO4	L3
	11	What are types of pavement? And explain with neat sketches	5	CO4	L2
5	12	Write a note on khansas method of flexible pavement design	6	CO4	L3
	13	Bring out the guidelines for flexible pavement design as per IRC 37-2001	6	CO5	L4
	14	Explain the various reasons for frost action in rigid pavements and how it is overcome	5	CO5	L3
	15	Explain the westergards wheel load stress equations.	6	CO4	L4
	16	Explain the function of the components of CC pavements	8	CO3	L4

Course Outcome Computation

Academic Year: 2019-20
Even semester

INTERNAL TEST	T1				T2				T3			
Course Outcome	CO1	CO2		CO3	CO4	CO5	CO6		CO7		CO8	
QUESTION NO	Q1	LV	Q2	LV	Q3	LV	Q1	LV	Q2	LV	Q3	LV	Q1	LV	Q2	LV
MAX MARKS												
Average CO Attainment												

PO Computation

Program Outcome	PO1	PO3	PO3	PO1	PO12	PO12	PO6	PO1
Weight of CO - PO								
Course Outcome	CO1	CO2	CO3	CO4	CO5	CO6	CO7	CO8
Test/Quiz/Lab	T1			T2			T3	
QUESTION NO	Q1	LV	Q2	LV	Q3	LV	Q1	LV	Q2	LV	Q3	LV	Q1	LV	Q2	LV
MAX MARKS								
Average CO Attainment								

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