



P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Eighth Semester, B.E. - Civil Engineering

Semester End Examination; July - 2023

Pavement Analysis and Design

Time: 3 hrs

Max. Marks: 100

Course Outcomes

The Students will be able to:

CO1 - Apply the knowledge of science and engineering to acquire the fundamentals of various factors affecting design and performance of pavements

CO2 - Calculate the stresses and deflection in flexible pavements.

CO3 - Calculate the stresses and deflection in rigid pavements.

CO4 - Design flexible and rigid pavements.

Note: I) PART - A is compulsory. Two marks for each question.

II) PART - B: Answer any **Two** sub questions (from a, b, c) for a Maximum of **18 marks** from each unit.

| Q. No. | Questions | Marks | BLs | COs | POs |
|----------------------|--|-----------|-----|-----|---------|
| I : PART - A | | 10 | | | |
| I a. | What is contact pressure in design of pavement? | 2 | L1 | CO1 | PO1,3 |
| b. | With a sketch, describe the critical stresses and strains in elastic three layer system. | 2 | L1 | CO2 | PO3,6 |
| c. | Write the equation to calculate the cumulative number of standard axles/lanes/day. | 2 | L1 | CO3 | PO3,6 |
| d. | List the factors affecting design and performance of CC pavements. | 2 | L1 | CO4 | PO2,3,6 |
| e. | With a sketch, describe the load transfer with and without dowel bar. | 2 | L1 | CO4 | PO2,3,6 |
| II : PART - B | | 90 | | | |
| UNIT - I | | 18 | | | |
| 1 a. | What is the design factors considered in the design of pavement? Explain any three in detail. | 9 | L1 | CO1 | PO1,3 |
| b. | Compare the salient features of flexible and rigid pavements. | 9 | L2 | CO1 | PO1,3 |
| c. | Explain the significance of ESWL in pavement design | 9 | L1 | CO1 | PO1,3 |
| UNIT - II | | 18 | | | |
| 2 a. | Explain briefly the principle of Burmister's two-layer theory and mention the advantages over the elastic single layer theory for the analysis of flexible pavements. | 9 | L1 | CO2 | PO3,6 |
| b. | A flexible pavement of thickness 60 cm is laid over a subgrade. A circular load of radius 15 cm with uniform contact pressure 7.5 Kg/cm ² is applied. Assuming homogeneous elastic single layer, determine the deflection of the pavement surface under the center of the load; | 9 | L3 | CO2 | PO3,6 |

- i) Using the formula
- ii) Using deflection factor chart

Assume the elastic modulus of the subgrade as well as pavement layer to be 850 Kg/cm².

- c. Explain how the elastic moduli of subgrade and base course are estimated using plate bearing test data? 9 L1 CO2 PO3,6

UNIT - III 18

- 3 a. Enumerate the various approaches of flexible pavement design. Briefly indicate the basis of design in each case. 9 L2 CO3 PO3,6
- b. Explain briefly the CBR method of flexible pavement design as per IRC guidelines. 9 L1 CO3 PO3,6
- c. Design a new flexible pavement for a two-lane undivided carriage way using the following data:
 Design CBR value of subgrade = 8.0% 9 L3 CO3 PO3,6
 Initial traffic on completion of construction = 1800 CV per day,
 Average growth rate = 6.0% per year , Design life = 15 years,
 VDF value = 2.5

UNIT - IV 18

- 4 a. Write Westergaard’s load stress equation at critical region and discuss critical combination of stresses. 9 L2 CO4 PO2,3,6
- b. Explain how warping stresses are formed in CC pavements. Describe the Bradbury’s equations to calculate warping stresses at critical locations. 9 L1 CO4 PO2,3,6
- c. Using the data given below, calculate the wheel load stresses at, i) Interior, ii) Edge, iii) Corner regions of a CC pavements using Westergaard’s stress equation and also determine iv) the probable location where the crack is likely to develop due to corner loading. 9 L3 CO4 PO2,3,6
 Wheel load P = 5100 Kg, Modules of elasticity of cement concrete, E = 3.0×10⁵ Kg/cm². Pavement thickness h = 25 cm, poisson’s ratio of concrete = 0.15. Modulus of subgrade reaction, K = 12 kg/cm², radius of contact area = 16 cm.

UNIT - V 18

- 5 a. What are the objects of providing dowel bars and tie bars in CC pavements? Explain. 9 L1 CO4 PO2,3,6
- b. Write a note on; 9 L1 CO4 PO2,3,6
 - i) Spacing of joints
 - ii) White tapping

c. A cement concrete pavement has a thickness of 28cm and lane width Of 3.5m. Design the tie bars along the longitudinal joints using the given data below: Allowable working stress in steel

Tie bar, $S_s = 1250 \text{ Kg/cm}^2$

Unit weight of CC $W = 2400 \text{ Kg/m}^3$

Maximum value of friction coefficient, $f = 1.4$

Allowable tensile stress in deformed tie bar $S_s = 2400 \text{ Kg/cm}^2$

Allowable bond stress in deformed bar $S_b = 24.6 \text{ Kg/cm}^2$

9 L3 CO4 PO2,3,6

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