CODE NO: 07A80106   R07   SET No - 1

IV B.TECH - II SEMESTER EXAMINATIONS, APRIL/MAY, 2011
PAVEMENT ANALYSIS AND DESIGN
(CIVIL ENGINEERING)

Time: 3hours   Max. Marks: 80

Answer any FIVE questions
All Questions Carry Equal Marks
- - -

1.a) What are the basic requirements of a pavement? Explain various pavement types and its component layers with neat sketch?

b) What are the factors affecting the pavement design and the performance of pavements?   [8+8]

2.a) How do you compute the stresses in flexible pavement? Explain the concept of ESWL?

b) Sketch and show the dimensions of the most realistic contact areas on flexible and rigid Pavements for a standard axle load of 80 KN with a tyre pressure of 552 KPa. If the contact area on rigid pavement is assumed as rectangle, what should be the dimension of the rectangular area?   [8+8]

3.a) Explain the concept given by Burmister for two layered theory for pavement design with neat sketch?

b) A set of dual tyres is spaced at 850 mm centre and carries a total load of 200 KN with a tyre pressure of 705 KPa. Assuming the pavement to be homogeneous half space, determine ESWL for a pavement of 635 mm thick using
i) Equal vertical stress criteria- one layer theory and
ii) Equal vertical deflection criteria – one layer theory (Foster and Ahlvin's Method).   [8+8]

4.a) Write various assumptions of westergaard used in finding out wheel load stresses? Write any three functions of dowel bar and tie bars.

b) Determine the thickness of a concrete pavement using Westergaard's Corner load formula to support a maximum wheel load of 5100 Kg. Allow 15% for impact, the tyre pressure may be taken as 6.1 kg/cm^2. The modulus of sub-grade reaction is 6.8 kg/cm^2. The flexural strength of concrete may be taken as 45 kg/cm^2. Use FS as 2.0. Also find out the distance from the corner at which the max stress occurs. Assume other data as per IRC.   [8+8]

5.a) Write the CBR test procedure with neat sketch; also explain the procedure for finalizing the CBR value? What is the role of vehicle damage factor in flexible pavement design?

b) Design a flexible pavement as per IRC: 37-2001(cumulative standard axle's method) using the following data. Sub-grade soil CBR is 5%, Commercial traffic is 1700 /day, design life is 15 years, growth rate of traffic is 8.5 % per annum, construction period is one year, sub-base CBR is 22% and base CBR is 78 %, Vehicle damage factor is 3.1.   [8+8]

6. Design the size and spacing of dowel bars at the expansion joint of CC pavement having thickness 25 cm. E = 3×10^5 kg/cm^2, μ = 0.15, design wheel load 5100 kg, Joint spacing 2.5 cm, Fs = 1000 kg/cm^2, Ff = 1400 Kg/cm^2, Fb = 100 Kg/cm^2 and K= 7.1 Kg/cm^2. Assume other data suitably as per IRC.   [8+8]

7.a) What is the difference between the crushing test and the impact test conducted on aggregates? How do you perform the shape test on an aggregate?

  b) Explain the procedure followed for conducting the marshal stability test and highlight the Impartment parameters which influence the marshal stability? [8+8]

8.a) Write the test procedure of Benkelman beam deflection test? Explain the design Procedure of the flexible overlay over flexible pavement?

  b) Write a short note on any two of the following
    i) Soil- cement stabilization
    ii) Gravel roads
    iii) Pavement Failures
    iv) Tie bars and Dowel bars. [8+8]

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CODE NO: 07A80106

R07

SET No - 2

IV B.TECH - II SEMESTER EXAMINATIONS, APRIL/MAY, 2011
PAVEMENT ANALYSIS AND DESIGN
(CIVIL ENGINEERING)

Time: 3hours   **Max. Marks: 80**

Answer any FIVE questions
All Questions Carry Equal Marks

- - -

1.a) What are the desirable properties of road aggregates? Explain the concept of composite pavements?

  b) Differentiate between flexible pavement and rigid pavement system?   [8+8]

2.a) Explain the concept of ESWL? Find out the ESWL of a duel wheel assembly carrying 2044 kg each for pavement thickness of 15, 18 and 22 cm. The c/c tyre spacing is 27cm and distance between the walls of the tyres is 11 cm.

  b) Explain the role of tyre pressure and contact pressure in the pavement design?

[8+8]

3.a) Explain the concept of layered systems as per Burmister's approach? Draw a neat sketch of Two layered system of flexible pavement?

  b) A total load of 89 KN was applied on the surface of a two layer system through a rigid plate 305 mm in diameter. Layer I has a thickness of 203 mm and layer II has an elastic modulus of 44.20 MPa. Both layers are incompressible with a poisson ratio of 0.50. If the deflection of the plate is 2.54 mm, determine the elastic modulus of layer I.   [8+8]

4.a) How do you calculate stresses at critical load positions in a rigid pavement analysis? Explain the concept of radius of relative stiffness of slab to sub-grade?

  b) Compute the radius of relative stiffness and equivalent radius of resisting section for a cement concrete pavement. Take the following data. Thickness of pavement 20cm; Modulus of elasticity of cement concrete 3×10^5 kg/cm^2; Poisson's ratio 0.15; Modulus of sub-grade reaction 3.8 kg/cm^3; Design wheel load P = 5100 kg; Tyre pressure 6.1 kg/cm^2.   [8+8]

5.a) Explain the procedure for determination of CBR value? How do you design the CBR value after the CBR test? Why the corrections are required after plotting the curves from CBR test results?

  b) A plate load test is carried out on soil sub grade soil using a 300 mm radius rigid plate. A load of 5 tonnes resulted in a deflection of 1.20mm. Find out the elastic modulus of the soil if the Poisson's ratio is 0.50.   [8+8]

6.a) Design a suitable bituminous pavement section (as per IRC 37:2001) for a new pavement construction with the following available information. The pavement will be a two lane road with a single carriageway. The traffic expected is 600 CV/day in both the directions with average vehicle damage factor of 2.1. Design sub grade CBR is 6% and the assumed design life of the pavement is 12 years.

  b) In axle load survey the axles of a sample of about 10% of randomly chosen trucks are weighed using axle load pads, different configurations of axle loads are represented in the sample. Calculate EALF and vehicle Damage Factor.   [8+8]

Single axle		Tandem axle	
Axle Load	No. of Axles	Axle Load	No. of Axles
2	0	4	0
4	1	8	14
6	6	12	21
8	144	16	101
10	20	20	44
12	14	24	42
14	8	28	44
16	4		
18	2		

7.a) What are the requirements of Bituminous concrete? Explain the need of Marshal Design mix for bituminous pavements?

b) Explain the step wise procedure for construction of Cement concrete roads including quality control tests as per the IRC / IS code provisions. [8+8]

8.a) Explain various methods of soil stabilization? Describe the procedure for soil – lime stabilization in a detailed manner.

b) Write a short note on any two of the following
   i)   Benkelman Beam Test
   ii) Flexible pavement failures
   iii) Temperature stresses in rigid pavements
   iv) Pavement Joints. [8+8]

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R07

SET No - 3

IV B.TECH - II SEMESTER EXAMINATIONS, APRIL/MAY, 2011
PAVEMENT ANALYSIS AND DESIGN
(CIVIL ENGINEERING)

Time: 3hours   Max. Marks: 80

Answer any FIVE questions
All Questions Carry Equal Marks

- - -

1.a) What is the necessity of highway material characterization?
 b) Draw the cross section of flexible pavement and write the function of each layer?
[8+8]

2.a) Explain various axle load configurations with neat sketches as per IRC.
 b) What is rigidity factor? How the rigidity factor is influences on the pavement?
[8+8]

3.a) What are the parameters required as the input for pavement analysis? Explain non-uniform Stress field?
 b) The radius of a tyre imprint is approximated to a circle of 150mm. What is the maximum loading duration on a particular point of pavement by truck moving at a speed of 80 kmph?   [8+8]

4.a) Describe the layered elastic concept and the stresses involved in the multilayered structure with neat sketch ?
 b) How is the combined effect of temperature stress and load stress considered in concrete pavement? Design the dowel bar system at the transverse joint of Cement Concrete pavement having thickness 26 cm. $E = 3 \times 10^5$ kg/cm^2, μ =0.15, design wheel load 5100 kg, Joint spacing 2.0 cm, Fs = 1000 kg/cm^2, Ff = 1400 Kg/cm^2, Fb = 100 Kg/cm^2 and K = 9.8 Kg/cm^2. Assume other data suitably as per IRC.   [8+8]

5.a) Design a suitable bituminous pavement section (as per IRC 37:2001) for a new expressway pavement construction with the following available information. The pavement will be a two lane road with a single carriageway. The traffic expected is 950 CV/day in both the directions with average vehicle damage factor of 2.8. Design sub grade CBR is 6% and the assumed design life of the pavement is 12 years.
 b) Explain the various types of joints provided in Cement concrete pavement with neat sketches? How do you design the contraction and expansion joints?   [8+8]

6.a) Describe the desirable properties of highway materials and their importance in road construction?
 b) Explain the physical significance of the theoretical maximum specific gravity used in the Marshal Stability test? Draw a curve between VMA and percentage bitumen in the total mix and explain its variation?   [8+8]

7.a) What are the various factors considered for mechanical stabilization? Under what circumstances the mechanical stabilization method is preferable?
 b) Explain the construction procedure and equipments used for Water Bound Macadam road with neat sketches?   [8+8]

8.a) What are the methods of pavement evaluation? Describe Present Serviceability Index and Present Serviceability rating concept in functional evaluation of pavement

   b) Write a short note on any two of the following
      i)   Benkelman Beam Test   ii) Rigid pavement failures
      iii) Plate load test   iv) CBR test.   [8+8]

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IV B.TECH - II SEMESTER EXAMINATIONS, APRIL/MAY, 2011
PAVEMENT ANALYSIS AND DESIGN
(CIVIL ENGINEERING)

Time: 3hours   Max. Marks: 80

Answer any FIVE questions
All Questions Carry Equal Marks
- - -

1.a) Write the structural difference between flexible pavements and rigid pavements?
   b) Explain the concept of ESWL with neat sketch? Determine the ESWL of a duel wheel assembly carrying 2044 kg each for pavement thickness of 16, 18 and 20 cm. The c/c tyre spacing is 28cm and distance between the walls of the tyres is 11 cm.   [8+8]

2.a) What are the design factors considered for flexible pavement? Explain the role of climatic and environmental factors in pavement design?
   b) A set of dual tyres is spaced at 850 mm centre to centre and carries a total load of 200 KN with a tyre pressure of 705 KPa. Assuming the pavement to be homogeneous half space, determine ESWL for a pavement of 635 mm thick using (a) equal vertical stress criteria – one layer theory and (b) equal vertical deflection criteria –one layer theory (Foster and Ahlvin's method).   [8+8]

3.a) Explain the concept of layered systems as per Burmister's approach? Draw a neat sketch of Two layered system of flexible pavement?
   b) Find the design sub-grade resilient modulus to be used in Asphalt Institute Method of design of flexible pavements from the following values of resilient moduli obtained from triaxial test on soil sub-grade. The design ESAl is 10^5.

   Resilient moduli: 42.80, 47.30, 58.30, 60.70, 65.20, 70.10, 73.50, 78.0, 82.50, 86.60, 93.20, 97.70 MPa.   [8+8]

4.a) Explain the stresses developed in rigid pavement? How the radius of relative stiffness and modulus of sub-grade reaction will influence the rigid pavement design?
   b) Determine the longitudinal and transverse temperature steel required for a two lane CC pavement, 210 mm thick, 18.5mm long and 7.0 m wide, with a longitudinal joint at the centre, given the following data. Unit weight of concrete is 23.6 KN/m^3, coefficient of sub-grade friction is 1.50 and allowable tensile stress in wire fabric is 297 MPa.   [8+8]

5.a) Explain the procedure of flexible pavement design as per IRC 37-2002 by cumulative standard axles method and write the significance of vehicle damage factor?
   b) Determine the thickness of a concrete pavement using Westergaard's Corner load formula to support a maximum wheel load of 5100 Kg. Allow 10% for impact, the tyre pressure may be taken as 5.8 kg/cm^2. The modulus of sub-grade reaction is 7.10 kg/cm^2. The flexural strength of concrete may be taken as 45 kg/cm^2. Use FS as 1.80. Also find out the distance from the corner at which the max stress occurs. Assume other data as per IRC.   [8+8]

6.a) Write the desirable properties of bitumen used for the road construction? If the penetration test result of bitumen carried out at 50° C is 100, what is its viscosity?

b) How is optimum bitumen content determined by the Marshal Stability test? What is the difference between bitumen and tar? [8+8]

7.a) Explain step by step procedure of construction of earthen roads and gravel roads? How do you organize the quality control mechanism for the same?

b) What are the main objectives of soil stabilization? Describe various techniques of soil stabilization? [8+8]

8.a) The existing black top flexible pavement was tested using Benkelman Beam with a test vehicle of 8170 kg rear axle load. The commercial vehicle traffic is 5000 v/day; the observations recorded at a pavement temperature of 43 ° C are given below: Length of test stretch is 500m. Moisture content is 6% for Sandy/ Gravelly soil sub-grade for low rain fall area (annual rain fall ≤ 1350 mm). Assume other data suitably.

Sl. No. Subsection	Deflection (mm)	Sl. No. Subsection	Rebound Deflection (mm)
1	1.46	6	1.62
2	1.50	7	1.71
3	1.58	8	1.86
4	1.81	9	1.45
5	1.92	10	1.53

b) Write a short note on any two of the following
i) Benkelman Beam deflection studies   ii) Mud pumping mechanism
iii) Soil cement stabilization   iv) PSR and PSI concepts.
[8+8]

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