Bihar Engineering University, Patna
End Semester Examination - 2022

Course: B.Tech. | *Semester: VII* | *Time: 03 Hours*
Code: 101703 | *Subject: PAVEMENT DESIGN* | *Full Marks: 70*

Instructions:-
(i) The marks are indicated in the right-hand margin.
*(ii) There are **NINE** questions in this paper.*
*(iii) Attempt **FIVE** questions in all.*
*(iv) Question No. **1** is compulsory*

Q.1 ***Choose the correct answer of the following: (Answer any seven)*** **[2 x 7 = 14]**

(a) Flexible pavements derive stability primarily from
- I. The aggregate interlock, particle friction and cohesion ✓
- II. The cohesion alone
- III. The binding power of bituminous material
- IV. The flexural strength of the surface course

(b) ESAL stands for
- I. Equivalent Single Axle load
- II. Equivalent Standard Axle load
- III. Enhanced Single Axle load
- IV. Enhanced Standard Axle load

(c) In a cement concrete pavement, dowel bars are used in
- I. Longitudinal joints
- II. Construction joints
- III. Dummy joints
- IV. Expansion joints

(d) Which of the below is not a critical load position in Rigid Pavement.
- I. interior
- II. corner
- III. edge
- IV. center

(e) Which of the below is a type of empirical methods used for the design of flexible pavements
- I. Group index method
- II. Burmister's method
- III. Triaxial test
- IV. IRC method

(f) The load transfer to lower layers in flexible pavements is by
- I. Bending action of layers
- II. Shear deformation
- III. Grain-to-grain contact
- IV. Consolidation of subgrade

(g) According to Boussinesq's theory, the soil mass is not considered to be__
- I. Elastic
- II. Infinite
- III. Homogeneous
- IV. Isotropic

(h) In cement concrete pavement, tie bars are installed in
- I. Expansion joint
- II. Contraction joint
- III. Warping joint
- IV. Longitudinal joint

P.T.O.

(i) The general requirements in constructing a reinforced concrete road is to place a single layer of reinforcement.

I. Bottom of the slab
II. Top of the slab
III. At the middle
IV. Equally distributed at the top and bottom

(j) IRC Guideline for design and construction of continuously reinforced concrete pavement is

I. IRC 118:2015
II. IRC 37:2018
III. IRC 58:2015
IV. IRC 73:1980

Q.2 (a) Explain flexible and rigid pavements and bring out the points of difference. [7]

(b) Explain ESWL and the concept in the determination of the equivalent wheel load. [7]

Q.3 (a) Explain how climatic variation affects pavement design and performance. [7]

(b) The width of expansion joint gap is 2.5 cm in a cement concrete pavement, If the laying temperature is 10°C and the maximum slab temperature in summer is 54°C, calculate the spacing between expansion joints. Assume coefficient of thermal expansion of concrete as 10×10^{-6} per °C. [7]

Q.4 (a) Write the advantages and limitations of CBR method of flexible pavement design. [7]

(b) A plate load test was conducted on a soaked subgrade during monsoon season using a plate diameter of 30 cm. The load values corresponding to the mean settlement dial reading are given below. Determine the modulus of subgrade reaction for the standard plate. [7]

Mean settlement values, mm	0.0	0.24	0.52	0.76	1.02	1.23	1.53	1.76
Load values, kg	0.0	460	900	1180	1360	1480	1590	1640

Q.5 (a) Classify different types of joints in CC pavements and mention the objects of each. [6]

(b) A cement concrete pavement has a thickness of 26 cm and lane width of 3.5 m. Design the tie bar along the longitudinal joints using the data given below. [8]

Allowable working stress in steel in tie bar, $S_S = 1250$ kg/cm^2

Unit weight of CC, $W = 2400$ kg/cm^2

Maximum value of friction coefficient, $f = 1.2$

Allowable bond stress in deformed bars, $S_S = 2000$ kg/cm^2

Allowable bond stress in deformed bars, $S_b = 24.6$ kg/cm^2

Q.6 (a) Determine the total thickness of flexible pavement assuming single layer elastic theory and using the following data: [7]

Design wheel load = 4200 kg

Tyre Pressure = 6.0 kg/cm^2

Elastic modulus = 150 kg/cm^2

Permissible deflection = 0.25 cm

(b) Briefly explain various types of distress in bituminous pavements. [7]

Q.7 (a) What are the limitations of Boussinesq's theory of stress analysis? [7]

(b) A semi-infinite soil mass is subjected to stress under a circular plate having a 15 cm radius. The load intensity over the plate is 4200 kg. Calculate the vertical stress in the soil circular plate under the loading axis at 3 m depth and rebound surface deflection under plate when [7]
$E = 40MPa$ and $\mu = 0.5$

Q.8 Differentiate following: [7]

(i) Flexible pavement and Rigid Pavement

(ii) Empirical Method and Mechanistic Empirical Method of Pavement design

(iii) Dowel bars and Tie bars

(iv) Jointed Plain concrete Pavement and continuously reinforced concrete pavement.

Q.9 (a) Write in brief about various types of joints in rigid pavement. [7]

(b) Find the Vehicle damage factor using the following axle load survey data. [7]

Commercial vehicle sampled = 550

No. of total axles = 1100

Load group (kN)	0-40	40-80	80-120	120-160	160-200	200-240
Frequency	100	250	400	250	80	20