B.E. CONSTRUCTION ENGINEERING THIRD YEAR SECOND SEMESTER EXAM 2024

Subject: **HIGHWAY ENGINEERING**

Time: Three hours

Full Marks: 100

(50 marks for each part)
Use separate answer script for each part.

PART-I

Answer any two questions .

Assume relevant data wherever required

Q-1(a) Estimate the axle load repetitions and characteristic rebound deflection for an existing two lane state highway located near Kolkata. The present traffic on road is 150A cvpd. The Benkelman beam deflection survey data are given below. The day temperature recorded on the day of survey was $40°C$ and the moisture correction factor 1.1A . where ' A' is the last digit of your examination roll number.

Recorded pavement deflection (mm) are as following

1.75, 2.1, 0.75, 1.99 , 1.12, 2.97, 2.04, 2.65, 1.34, 1,76,1.83, 1.86, 2.01, 1.94, 1.86, 2.56, 1.55, 2.89, 1.75, 1.29.   CO4   (17)

(b) Explain the significance of VDF and lane distribution factors. (8) CO4

Q-2. (a) Determine the length of the expansion and contraction joint for 150mm thick slab in a two lane undivided road . Assume coefficient of thermal expansion of concrete as $10 \times 10^{-6} / °C$. [assume relevant data which are required.]

(12)   CO5

(b) Explain TDC in both concrete and flexible road pavement. (8)   CO5

© Explain why expansion joints are provided in concrete pavement but not in bituminous road pavement.   (5)   CO3

Q-3(a) Determine the thickness of a concrete road pavement resting on a subgrade with modulus of subgrade reaction as 42 MPa/m with a traffic load of 300 CVPD. (18) CO5

(b) Explain the cause of rutting and cracking in a bituminous road pavement . (7) CO5

[Turn over

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PART-II
Different parts of the same question should be answered together.

CO1 [25]	Answer all questions in this block [1] (a) Describe the essential features of cold mix technology. **OR** Compare between HOT MIX and COLD MIX. (b) List few modern materials used in pavement construction with its impact on pavements **OR** Short note on Mastic Asphalt. (c) Briefly narrate Plate Load test **OR** Is VG Bitumen is the demand / requirement of users or the statutory bodies? Why there is a need to shift from Penetration to Viscosity Grade Paving Bitumen? (d) CBR test results on road sub grade are shown in the table below. What is the design CBR value of the subgrade?　(**REF. Table 1**) Proving Capacity (LOAD) = 50KN, Proving Ring Maximum division = 8XX, XX = Last two digit of your EXAM Roll No.　(e.g. if EXAM Roll no is ……..<u>41</u>, so XX= 41, proving ring maximum division = 841) **[5+5+5+10]**
CO2 [25]	Answer all questions in this block 2. (a) Discuss why the stability is important and the significance of what the data from the Marshall stability and flow test provides. What are the essential properties of bituminous mixes? **OR** Derive the relationships of these test properties which are used to design the bituminous mixes by Marshall testing method?　(10) (b)The results of a Marshall test are listed below.　(i)Find V_v, V_b VMA and VFB (ii) what will be the optimum bitumen content? (Assume relevant data if required)　(15)

Bitumen (%)	Weight in Air (gm)	Weight in water (gm)	Weight after wax coating (gm)	Volume(g/cm^3)	Stability Value (kg)	Flow Value (mm)
3.5	1230.40	679.56	1238.80	534.1	375.56	1.95
4	1251.88	692.50	1262.85	534.1	521.44	2.15
4.5	1242.44	675.49	1253.53	534.1	588.74	2.65
5	1244.73	679.50	1254.39	534.1	534.22	2.75
5.5	1245.85	682.74	1257.84	534.1	228.95	2.85

The students of the course should be able to

CO1: Describe different Road Construction Materials and their applications in construction of flexible pavements (K2, A1).

CO2: Illustrate design of bituminous mix for use in flexible pavement. (K3).

CO3: Use Indian Standard Guidelines for obtaining thickness of overlay. (K3).

CO4: Use Indian Standard Guidelines for solving problems on Flexible and Rigid Pavements design (K3).

Table 1: CBR test data of a subgrade soil

Penetration (mm)	0.5	1	1.5	2.0	2.5	3	3.5	4	4.5	5	6	7	8	9	10	12.5
Load Dial Reading	8	13.5	14	25	43.5	61	76.5	90	103.5	116	136.5	153	165	176	185	195