

GUJARAT TECHNOLOGICAL UNIVERSITY**BE – SEMESTER- V EXAMINATION-SUMMER 2023****Subject Code: 3154008****Date: 03/07/2023****Subject Name: Highway and Traffic Engineering****Time: 02:30 PM TO 05:00 PM****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Simple and non-programmable scientific calculators are allowed.

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| Q.1 (a) Define: MDR, Freeway, Sub arterial | 03 |
| (b) Draw a typical sketch of C/S of SH two-lane two-way undivided highway in cutting. Show all the components. | 04 |
| (c) What would be SSD on a single lane two-way road for 80 kmph speed, for (i) up and (ii) down gradient, of 1 in 20. Take $f=0.36$. | 07 |
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Q.2 (a) Briefly describe with sketch PIEV theory. |
03 |
| (b) Describe with sketches various factors considered while fixing the highway alignment. | 04 |
| (c) Determine the maximum allowable speed on horizontal curve of 200 m radius of 2 lane highway. What would be Total widening on curve, and length of transition curve using IRC formula for the plain and rolling terrain, for the calculated maximum allowable speed on the same curve? Take wheelbase = 6 m. | 07 |
| OR | |
| (c) Determine OSD on 2 lane one-way and 2 lane two-way highway for the design speed of 90 kmph. Take acceleration of overtaking vehicle = 1.5 kmph/sec. | 07 |
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Q.3 (a) Define: ADT, ESWL, PHF. |
03 |
| (b) Explain with sketch “Flakiness Index Value Test” for the aggregates. | 04 |
| (c) A valley curve is formed by a descending grade of 1 in 20 meeting an ascending grade of 1 in 25. Design the length of valley curve to fulfil both comfort condition and HSD requirements for a design speed of 80 kmph. Assume, $C = 0.6 \text{ m/sec}^3$, $f = 0.36$. | 07 |
| OR | |
| Q.3 (a) Briefly describe: Tar, Emulsion, CRMB. | 03 |
| (b) Briefly discuss with sketch Penetration test of bitumen. | 04 |
| (c) The CBR test carried out on a subgrade soil gave the following readings. Draw the graph and determine the CBR value of the soil sample. | 07 |

Penetration (mm)	Load (kg)	Penetration (mm)	Load (kg)	Penetration (mm)	Load (kg)
0	0	2.0	39.3	5.0	98.1
0.5	3.2	2.5	59.4	7.5	114.4
1.0	12.3	3.0	74.7	10.0	120.3
1.5	24.1	4.0	86.2	12.5	125.6

- Q.4 (a)** State the formulae of 'Radius of relative stiffness' and 'Equivalent radius of resisting section' for the rigid pavements. Give details of each parameter of formula. **03**
- (b)** The loaded weight on the rear dual wheels of a truck is 5600 kg. The c/c spacing and clear space in the dual wheels are 30 cm and 10 cm respectively. Calculate the ESWL for the pavement thickness at (i) 30 cm, (ii) 50 cm. **04**
- (c)** Derive the necessary relationship for the super elevation on horizontal curve of highway. **07**
Design the rate of super elevation for a horizontal highway curve of radius 200m and speed 80kmph. If the maximum super elevation of 0.07 is not to be exceeded, calculate maximum allowable speed on this curve.

OR

- Q.4 (a)** Differentiate between flexible and rigid pavement. **03**
- (b)** Discuss with sketches any two types of failures in rigid pavements. Suggest remedial measures for them. **04**
- (c)** Calculate the stresses at interior, edge and corner region of cement concrete pavement using Westergaard's stress equations. Take wheel load = 4100 kg, $E_c = 3 \times 10^5 \text{ kg/cm}^2$, Pavement thickness = 15 cm, $\mu = 0.15$, Modulus of subgrade reaction $k = 5 \text{ kg/cm}^3$, Radius of contact area = 15 cm. **07**
- Q.5 (a)** Define: SMS, Traffic density, Space headway **03**
- (b)** Describe with sketch the "Spot Speed Measurement Survey" by stopwatch on mid-block section of highway. **04**
- (c)** From the following data of spot-speed study, draw graphs for frequency (%) –vs- Speed range and Cumulative frequency (%) - vs- Speed. Determine TMS, SMS, Speed for traffic regulation. **07**

Speed range (kmph)	1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90
No. of vehicles	5	11	21	28	35	26	19	10	4

OR

- Q.5 (a)** What are the causes of road accidents? **03**
- (b)** Describe with sketch any two types of (i) road markings, and (ii) road signs. **04**
- (c)** Derive an expression of Greenshields model. **07**
The speed-density relationship of traffic on a section of a freeway lane was estimated to be $V_x = 18.4 \ln (230/k)$ as per Greenberg's model. (i) Find flow, speed and density at Maximum flow, (ii) Find jam density.
