Name: **Enrolment No:**	

UPES

End Semester Examination, May 2025

Course: Safety in Rail and Road Transport — **Semester:** VIII

Program: B.Tech Fire and Safety Engineering — **Time :** 03 hrs

Course Code: HSFS4003 — **Max. Marks:** 100

Instructions: Draw neat and clear figures wherever required. Assume suitable data if necessary.

SECTION A
(5Qx4M=20Marks)

S. No.	List of questions	Marks	CO
Q 1	Define the following railway terminologies: a. Bearing plates b. Interlocking	**2 + 2**	**CO1**
Q 2	Differentiate between the following: a. Narrow gauge and meter gauge b. Sleepers and ballast	**2 + 2**	**CO1**
Q 3	List the advantages of a rotary intersection over signalized intersections.	**4**	**CO1**
Q 4	How are regulatory signs different from warning signs?	**4**	**CO1**
Q 5	Draw the schematic diagrams for the following track junctions: a. Diamond crossing b. Three throw switch	**2 + 2**	**CO2**

SECTION B
(4Qx10M= 40 Marks)

Q 6	Draw a typical cross-section of a permanent way or railway track, highlighting all the various components.	**10**	**CO2**
Q 7	Explain the importance of track alignment and its basic requirements, describing the factors to be considered in selection of a good alignment.	**10**	**CO2**
Q 8	(a) Calculate the perception-reaction time for a vehicle travelling at 90 km/h, given the coefficient of longitudinal friction of 0.35 and the stopping sight distance of 170 m. (b) A valley curve has a descending gradient of 1 in 40 followed by an ascending gradient of 1 in 50. Determine the length of the valley curve required for a design speed of 80 km/hour for comfort condition.	**5 + 5**	**CO3**

<table>
<tr><td>Q 9</td><td>(a) For designing a 2-phase fixed type signal at an intersection having North-South and East-West Road where only straight-ahead traffic is permitted, the following data is available.
<table>
<tr><th></th><th>North</th><th>South</th><th>East</th><th>West</th></tr>
<tr><td>Flow (PCU/hr)</td><td>1000</td><td>700</td><td>900</td><td>550</td></tr>
<tr><td>Saturation flow</td><td>2500</td><td>2500</td><td>3000</td><td>3000</td></tr>
</table>
Total time lost per cycle is 12 seconds. Estimate the cycle length (seconds) as per Webster's approach.

OR

A two-lane urban road with one-way traffic has a maximum capacity of 1800 vehicles/hour. Under the jam condition, the average length occupied by the vehicles is 5.0 m. The speed versus density relationship is linear. For a traffic volume of 1000 vehicles/hour, determine the density of the traffic stream.</td><td>10</td><td>CO3</td></tr>
<tr><td colspan="4">SECTION-C
(2Qx20M=40 Marks)</td></tr>
<tr><td>Q 10</td><td>Design the superelevation required to maintain the design speed of a highway as 80 kmph for a horizontal curve of radius 200 m in a certain locality. If the maximum superelevation of 0.07 is not to be exceeded, what should be the maximum allowable speed on this curve? Also determine the extra widening required and length of transition curve using the following data:
Length of wheel base of the largest vehicle = 6.1 m
Pavement width = 7.2 m
Number of lanes = 2
Type of terrain = Plain
Safe limit of coefficient of friction = 0.15</td><td>20</td><td>CO4</td></tr>
<tr><td>Q 11</td><td>(a) Determine the speed for which superelevation is to be maintained if the speeds of several trains running on a main curved track are as follows:
i) 20 trains at a speed of 50 kmph
ii) 15 trains at a speed of 60 kmph
iii) 10 trains at a speed of 70 kmph
iv) 5 trains at a speed of 80 kmph
Further, evaluate the equilibrium cant on a 2 degree curve on a broad gauge for the above train combination.</td><td>10 + 10</td><td>CO3</td></tr>
</table>

	(b) The speed-density (u-k) relationship on a single lane road with unidirectional flow is u= 70-0.7k, where u is in km/hr and k is in veh/km. Determine the capacity of the road. OR (a) Describe the various possible causes which may result in a railway accident and suggest possible remedies. Illustrate how the railway accidents are classified by Indian Railways. (b) A summit curve is formed at the intersection of a 3% up gradient and 5% down gradient. To provide a stopping sight distance of 128 m, evaluate the length of summit curve required.		