53 (CE 502) TREN–I

2018

TRANSPORTATION ENGG.–I

Paper : CE 502

Full Marks : 100

Time : Three hours

The figures in the margin indicate full marks for the questions.

*Answer **all** questions.*

1. *(a)* Three new roads *P, Q, R* are planned in a district. The data for these roads are given in the table below : 5

Road	Length *(km)*	Number of Villages with population		
		<2000	2000–5000	>5000
P	20	8	6	1
Q	18	19	8	4
R	12	7	5	2

Based on the principle of maximum utility what is the order of priority for these three roads. 5

(b) Calculate the safe stopping sight distance for design speed of 50*km/hr.* for — 5

(i) Two way traffic on a two lane road

(ii) Two way traffic on a single lane road

Assume coefficient of friction = 0·37.

(c) Calculate the values of — 5

(i) Head light sight distance

(ii) Intermediate sight distance for a highway with a design speed of 65*kmph*. Assume suitably all the data required.

(d) The driver of a vehicle travelling 60*km/hr* up a gradient requires 9*m* less to stop after he applies brakes, as compared to a driver travelling at same speed, down the same gradient.

What is the present gradient if coefficient of friction is 0·4 ? 5

2. (a) On a two way traffic road, the speed of overtaking vehicles are 65*kmph* and 40*kmph*. If the average acceleration is 0·92m/sec^2. Determine the overtaking sight distance indicating the details of overtaking operations.

Show the minimum length of overtaking zone and details of overtaking zone by a neat sketch. 10

(b) On a horizontal highway curve, derive the condition for — 5

(i) No overturning

(ii) No skidding.

(c) A highway is provided with a horizontal curve of radius 300*m*. Calculate super elevation required to maintain a design speed of 90*kmph*.

Calculate the maximum allowable speed if super elevation is limited to 0·07 and safe limit of transverse friction is 0·15. 5

3. (a) A expressway of four lanes, passing through a flat terrain has a horizontal curve of radius equal to ruling minimum radius. If the design speed is 120*kmph*. Calculate — 10

(i) Ruling minimum radius

(ii) Super elevation

(iii) Extra widening

(iv) Length of transition curve.

(b) Calculate the set back distance from the inner edge of the curve in a four lane carriageway, the length being 1500*m*. The stopping sight distance is 250*m*. The radius of curve is 400*m*. 5

(c) Calculate the length of summit curve for a stopping sight distance of 180*m*, on a national highway at the junction of an upward gradient of 1 in 200 and a downward gradient of 1 in 200.

Assume the height of the driver eye level to be 1·2*m* and height of object above roadway to be 0·15*m*. 5

4. (a) Load and penetration values from a CBR test are given below : 5

Calculate the CBR value.

Load *(kg)*	Penetration *(mm)*
0	0
7	0·5
24	1·0
41	1·5
59	2·0
70	2·5
81	3
98	4
110	5
129	7·5

(b) Plate bearing test conducted on a 30*cm* dia plate yielded the following observations : 5

Load *(kg)*	Settlement *(mm)*
270	0·25
580	0·5
770	0·75
1010	1·00
1260	1·25
1480	1·50
1690	1·75

Determined *'K'* value corresponding to a plate of 75*cm* diameter.

(c) Determine the average skid resistance of the pavement surface. During a braking test, a vehicle travelling at a speed of 35*kmph* was stopped by applying brakes fully and

(a) Skid marks were 5·8*m* in length

(b) Vehicle stopped within 2*sec* after application of break

(c) Vehicle stopped within 1·5*sec* and skid marks observed was 7·0*m* long.

10

5. *(a)* The speed density relationship for a particular road was found to be $v = 42{\cdot}76 - 0{\cdot}22k$, where '$v$' is the speed in km/hr and k is the density in vehicle per km. Find jam density at maximum capacity. Sketch the relationship between density and flow and indicate important traffic flow parameters on it. 5

(b) A vehicle applies brakes and skids through a distance $40m$, before colliding with another parked vehicle, the weight of which is 60% of former. Compute the critical speed of moving vehicle if distance travelled by both vehicle after collision is $12m$ before stopping. Take coefficient of friction as 0·6. 5

(c) The number of commercial vehicles per day at present count is 6000. Design life is $15yrs$. Traffic growth rate is 8%. $VDF = 4{\cdot}5$. Lateral distribution factor for 6 lane divided highway = 0·6. Calculate the number of standard axles in the design life if the construction period is 2 years. 5

(d) Compute the radius of relative stiffness of $15cm$ thick cement concrete slab from the following data :

Modulus of elasticity of cement concrete = $210000 kg/cm^2$

Poisson's ratio for concrete = 0·13

Modulus of subgrade reaction $k = 7{\cdot}5 kg/cm^3$. 5
