b. The table gives the traffic in PCU/hr approaching from four directions. 10 4 3 1,3

From direction / Turning movement	North	East	South	West
Left turn	400	250	300	400
Right turn	380	300	500	410
Straight	600	400	500	350

Design the rotary intersection in the urban road having four lane divided carriageway. Evaluate the capacity of the rotary designed.

29. a. The axle load data collected from a toll weigh bridge is given in the following table. Determine the damaging factor that influences in the design of pavement. 10 3 4 1,2

Vehicle type	Axle configuration	Wheel load (tonnes)	Frequency
2 - axle vehicle	1st - single axle single wheel	2.025	40
	2nd - single axle dual wheel	3.820	
3 - axle vehicle	1st - single axle single wheel	1.575	25
	2nd + 3rd - random axle	4.87 + 4.48	

(OR)

b. Design the flexible pavement layers for the following conditions and sketch the composition of pavement. 10 3 4 1,3

- CBR of subgrade soil : 6% and 9%
- Number of commercial vehicles : 500 cv/day (in each direction)
- Two lane two-way road
- Traffic growth rate: 7%
- High density corridor
- Terrain condition : Rolling

Evaluate the increase in thickness of each layer for 6% and 9% CBR and give inference.

30. a. Identify the most critical combinations of stresses in the rigid pavement slab and give your inference in these locations of the slab. 10 4 5 1,2

Modulus of elasticity of concrete = 3.3×10^5 kg/cm^2
Poisson's ratio of concrete = 0.15
Wheel load = 4100 kg
Radius of loaded area = 12 cm
Slab thickness = 18 cm
Modulus of subgrade reaction = 6 kg/cm^3

(OR)

b. 40 kN load is applied at 150 mm from the pavement edge of the slab of 250 mm thickness. The dowel bars are provided at a spacing of 300 mm. Check the adequacy of the dowel system. Use the following information: 10 4 5 1,2

Modulus of subgrade reaction = 15 MN/m^3
Diameter of dowel bar = 20 mm
Land width = 3.5 m
Modulus of dowel support is 400 GN/m^3, M20 grade concrete

Take joint width of 2 cm. Assume other relevant data required.

* * * * *

Reg. No.														

B.Tech. DEGREE EXAMINATION, JUNE 2022
Sixth Semester

18CEC303T – HIGHWAY ENGINEERING AND DESIGN
(For the candidates admitted from the academic year 2018-2019 to 2019-2020)
(Use of IRC 37;2018 and IRC 58:2015 can be permitted)

Note:
(i) **Part - A** should be answered in OMR sheet within first 40 minutes and OMR sheet should be handed over to hall invigilator at the end of 40th minute.
(ii) **Part - B** should be answered in answer booklet.

Time: 2½ Hours Max. Marks: 75

PART – A (25 × 1 = 25 Marks) Marks BL CO PO
Answer **ALL** Questions

1. A terrain with cross slope less than 10% is said to be 1 1 1 1
(A) Plain (B) Mountains
(C) Hilly (D) Steep

2. The full width of land acquired for a highway alignment is 1 1 1 1
(A) Carriageway width (B) Lane width
(C) Right of way width (D) Embankment with

3. The maximum grade compensation for a curve of radius 75 m is 1 2 1 1
(A) 1% (B) 2%
(C) 3% (D) 4%

4. Identify the category of road that falls under the urban roads. 1 2 1 1
(A) Notional highway (B) State highway
(C) Arterial roads (D) Village roads

5. The rise provided on the horizontal curve for a super elevation of 6% is _____ on a two lane road of width 7.5 m. 1 2 1 1
(A) 450 mm (B) 45 mm
(C) 450 cm (D) 4.5 cm

6. The separation of fronts of two successive vehicles measured in meters is 1 1 2 1
(A) Tone headway (B) Space headway
(C) Traffic flow (D) Density

7. The multiple pen recorder is used in _____ survey. 1 1 2 1
(A) Traffic volume (B) Spot speed
(C) Moving observer (D) Home interview

8. The enoscope method is adopted in the data collection of _____ survey. 1 1 2 1
(A) Home interview survey (B) Moving observer survey
(C) Tag-on-vehicle survey (D) Spot speed survey

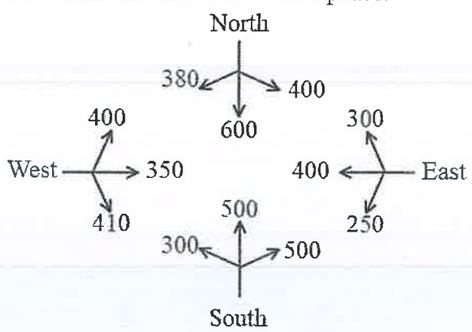
9. The design speed of a road is determined from spot speed data using _____ in the cumulative frequency curve. 1 2 2 1,2
(A) 98th percentile (B) 85th percentile
(C) 50th percentile (D) 15th percentile

10.	The area under the parking accumulation curve is used to determine the _____.	1	1	2	1
	(A) Parking volume (B) Parking load (C) Parking duration (D) Parking pattern				
11.	The sign board indicating the presence of hospital is represented in _____ shape.	1	1	3	1
	(A) Circular (B) Triangular (C) Octagon (D) Rectangular				
12.	Pick the incorrect statement about the interchanges.	1	2	3	2
	(A) It is the space sharing control measure (B) It reduces the number of conflicts (C) It allows the traffic to wait before access into intersection (D) It has ramps at the intersection area				
13.	The broken line on the road marking represents	1	2	3	1
	(A) Cross that line anytime (B) No passing (C) Cross only at emergency (D) Move in reduced speed				
14.	The proportion of weaving traffic should lie in the range of _____ at any rotary intersection	1	1	3	1
	(A) 0.1 to 0.4 (B) 0.4 to 1 (C) 1 to 1.4 (D) 1.4 to 1.9				
15.	The diverging conflict is NOT reduced before the intersection area in the _____ control measure.	1	2	3	2
	(A) Channelization (B) Flared-type (C) Diamond interchange (D) Traffic signal				
16.	As per the IS specifications, the penetration of bitumen is measured at _____.	1	1	4	1
	(A) 25°C (B) 30°C (C) 60°C (D) Room temperature				
17.	Rutting in the bituminous pavement occurs due to _____.	1	2	4	1,2
	(A) Tensile strain at bottom of bituminous layer (B) Tensile strain at top of subgrade (C) Compressive strain at bottom of bituminous layer (D) Compressive strain at top of subgrade				
18.	Choose the factor that does not influence the mix design of bituminous mixture.	1	2	4	1
	(A) Air voids (B) Density of mix (C) Aggregate gradation (D) CBR of soil				
19.	Identity the incorrect statement related to resilient modulus	1	2	4	1
	(A) Resilient modulus depends on confinement pressure (B) It is the ratio of deviatoric stress to total strain (C) It varies with moisture content (D) It is ratio of deviatoric stress to elastic strain				
20.	The ring and ball apparatus is used for _____ determination.	1	1	4	1
	(A) Penetration (B) Softening point (C) Absolute viscosity (D) Kinematic viscosity				
21.	Tie bars are provided to	1	1	5	1
	(A) Transfer load (B) Resist cracks (C) Hold slab together (D) Resist moisture infiltration				
22.	The concrete mix for the rigid pavement are designed for the required _____ strength.	1	2	5	2
	(A) Compressive (B) Flexural (C) Tensile (D) Axial				
23.	The water table for rigid pavement should be _____ below the ground level.	1	1	5	1
	(A) 0.4 m (B) 0.8 m (C) 1.2 m (D) 1.5 m				
24.	During daytime, the nature of curling (or) temperature stress at the top of concrete pavement is	1	2	5	2
	(A) Compressive (B) Tensile (C) Same as bottom layer (D) No stress is induced				
25.	The effective length of load transfer action of dowel bar is	1	2	5	1
	(A) 1.0 times the radius of relative stiffness (B) 1.2 times the radius of relative stiffness (C) 1.0 times the radius of slab contact (D) 1.2 times the radius of slab contact				

PART – B (5 × 10 = 50 Marks)

Answer **ALL** Questions

		Marks	BL	CO	PO
26. a.	A two-lane road is to be constructed on a national highway having a curve of radius 400 m. Determine the required geometric elements for this curve. Assume necessary data for the design.	10	4	1	1,3
	(OR)				
b.	Design a summit curve for a national highway on a rolling terrain at a junction of a rising gradient of 1 in 50 and a falling gradient of 1 in 30. This curve is expected to fulfill the sight distance requirements both passing and non-passing. Assume necessary data as per IRC guidelines.	10	4	1	1,3
27. a.	Devise the survey protocol to develop the travel demand matrix for the Chengalpat district with the following demographic details Total population : 2556244 Number of town panchayats and municipalities : 12 and 8 Number of villages: 636	10	3	2	1,2
	(OR)				
b.	Develop a methodology for conducting the survey to determine the traffic stream parameters in the four lane single carriageway road carrying traffic from both the direction. Discuss the analysis of data collected.	10	3	2	1,2
28. a.	Design the traffic signal control measure for the traffic movement shown in the figure below. Assume the approaching lanes are having 7 m width in the urban area. Permit the traffic from one direction in each phase.	10	4	3	1,3



All numbers are in PCU/hr

Take the saturation headway of 1.2 sec on a single lane.

(OR)