b. The floating car survey was conducted at a stretch with 3 intersection P, Q, R and the data are given in the table. Analyze the traffic stream characteristics. — 12 3 2 1

Section	Journey time (min)	Distance (km)	Number of vehicles		
			Opposing	Overtaking	overtaken
P-Q	1.97	0.8	86	20	14
Q	0.88 day	-	-	-	-
Q-R	2.46	0.9	65	23	16
Return trip					
R-Q	2.22	0.9	83	25	21
Q	1.07 day	-	-	-	-
Q-P	2.3	0.8	108	24	22

30. a. Enumerate the different types of interchanges that suits on a cross-type intersection with sketches. — 12 2 3 1

(OR)

b. Describe the various types of traffic signs with few example of indication in each type. — 12 2 3 1

31. a. The representative sample of axles and load data is given the following table. The vehicles with two axle (both front and rear axles with single wheel), three axles (front axles with single wheel and rear axles with tandem) and multi-axles vehicle (front axles with single wheel and rear axle with triden) are having a frequency of 40, 50 and 72, respectively. Determine the vehicle damage factor. — 12 4 4 2

Axle load (in tonnes)

Vehicle configuration	Front axle	Rear axle 1	Rear axle 2	Rear axle 3
Two axle vehicle	6.6	9.6	-	-
Three axle vehicle	7.0	11.6	10.8	-
Multi-axle vehicle	5	9.4	8.2	9.2

(OR)

b. For the design of new flexible pavement with four lane divided carriageway, the traffic survey on the existing road was conducted and the traffic in the year of completion of construction is found to be 6200 cv/day (sum of both directions). Mention the clause and values of various parameters and evaluate the design traffic in MSA as per the IRC guidelines. Take the damaging effect of various axle configuration as 1.416 and CBR of 6% subgrade soil. — 12 4 4 3

32. a. Calculate the wheel load stress at the various region of a cement concrete slab for a wheel load of 5100 kg is a 20 cm thick slab. Take the elastic modulus of concrete as 3×10^5 kg/cm^2, Poisson's ratio as 0.15. Modulus of subgrade reaction as 8 kg/cm^3 and the radius of contact of wheel is 15 cm. — 12 3 5 2

(OR)

b. A 30 kN load is applied at 120 mm from the pavement edge of 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 and assume other relevant data required. Modulus of subgrade reaction is 15 MN/m^3, diameter of dowel bar is 20 mm, lane width of 3.5 m, Modulus of dowel support is 400 GN/m^3 and grade of concrete M20. — 12 3 5 3

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Reg. No. ☐☐☐☐☐☐☐☐☐☐☐☐☐☐

B.Tech. DEGREE EXAMINATION, MAY 2023
Sixth Semester

18CEC303T – HIGHWAY ENGINEERING AND DESIGN
(For the candidates admitted during the academic year 2018-2019 to 2021-2022)
(Use of IRC 37 and IRC 58 to 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 & Part - C** should be answered in answer booklet.

Time: 3 hours — Max. Marks: 100

Marks BL CO PO

PART – A (20 × 1 = 20 Marks)
Answer **ALL** Questions

1. The stopping sight distance is highly influenced by — 1 2 1 1
   (A) Coefficient of lateral friction (B) Radius of curve
   (C) Reaction time of driver (D) Extra-widening of roads

2. Choose the incorrect statement. — 1 1 1 2
   (A) Multilane roads has width of 3.5 m per lane (B) A kerb of 20 cm is provided on heavy pedestrian zone
   (C) A width of 7.5 m provided for two lanes without raised kerb (D) Median is provided to avoid head on collision

3. Pick the odd one out based on the category of classification. — 1 1 1 1
   (A) National highway (B) Collection street
   (C) Other district road (D) Village road

4. The maximum limit of super elevation on a snow-bound hilly terrain is _____. — 1 1 1 1
   (A) 7% (B) 4%
   (C) 10% (D) 6%

5. The fundamental relation of traffic flow parameters is — 1 1 2 1
   (A) $v = k / q$ (B) $q = k / v$
   (C) $v = q \times k$ (D) $q = k \times v$

6. The imaginary line which defines the boundary of the study area in 0-D survey is — 1 1 2 1
   (A) Desire lines (B) Cordon lines
   (C) Screen lines (D) Contour lines

7. The base length for conducting the spot speed survey in a road with average speed of traffic >65 kmph is — 1 1 2 2
   (A) 10 m (B) 27 m
   (C) 54 m (D) 81 m

8. The area under the parking accumulation curve during a specific period is — 1 1 2 1
   (A) Parking volume (B) Parking load
   (C) Parking duration (D) Parking accumulation

9. The speed limit representation through signboard falls under _____ types. — 1 1 3 2
   (A) Regulatory (B) Warning
   (C) Cautionary (D) Informatory

10. As per IRC recommendations the proportion of wearing traffic should be in the range of _____ for rotary design. — 1 1 3 2
   (A) 0.1 to 1 (B) 0.4 to 1.2
   (C) 0.4 to 1 (D) 0.1 to 1.2

11. Which of the following control measure is not a space-based provisions at any intersections? — 1 2 3 2
   (A) Interchange (B) Rotary
   (C) Channelization (D) Traffic signal

12. The flow ratio for the traffic signal design is determined by _____. — 1 1 3 2
   (A) Normal flow / saturation flow (B) Saturation flow / normal flow
   (C) Normal flow + saturation flow (D) Normal flow × saturation flow

13. The property that is not considered for grading the bitumen as per IS73 is _____. — 1 1 4 1
   (A) Specific gravity (B) Softening point
   (C) Ductility (D) Kinematic viscosity

14. The Elastic Modulus based on the recoverable strain under repeated load is called _____. — 1 1 4 2
   (A) Dynamic modulus (B) Shear modulus
   (C) Bulk modulus (D) Resilient modulus

15. The standard axle load considered for the design of pavement is _____ with dual wheel configuration. — 1 1 4 2
   (A) 65 kN (B) 80 kN
   (C) 148 kN (D) 224 kN

16. The contact radius for a wheel load of 50 kN and type pressure of 0.5 MPa is _____ mm. — 1 2 4 2
   (A) 0.2 (B) 200
   (C) 1.78 (D) 178

17. The effective length of load transfer action of dowel bar is — 1 1 5 2
   (A) 1 time radius of relative stiffness (B) 1 time radius of slab length
   (C) 1.2 times radius of relative stiffness (D) 1.2 times radius of slab length

18. During day time, the nature of curling (or) temperature stress at the top of the concrete pavement is — 1 1 5 2
   (A) Compressive (B) Tensile
   (C) Neutral (D) No stress

19. The strength of concrete that is preferred for design of rigid pavement is — 1 1 5 3
   (A) Compressive strength (B) Flexural strength
   (C) Tensile strength (D) Axial strength

20. The soil characteristic used in the design of rigid pavement is — 1 1 5 1
   (A) CBR (B) UCC
   (C) Modulus of subgrade reaction (D) Resilient modulus

PART – B (5 × 4 = 20 Marks)
Answer ANY FIVE Questions

	Marks	BL	CO	PO

21. Justify the following statements with proper reasons — 4 3 1 1
   (i) Transition curve must be introduced between the straight and horizontal alignment
   (ii) A valley curve is designed for head light sight distance

22. Sketch the attainment of extra-widening on the horizontal alignment. — 4 1 1 1

23. Discuss the various fundamental traffic stream parameter. — 4 1 2 1

24. Draw the conflict diagram on a cross type intersection carrying only left and straight traffic movement. — 4 2 3 2

25. List out any four or five test to be carried out on a bituminous binder to conforms the grade it belongs to. — 4 1 4 1

26. Discuss the impact of wheel load on the pavement at various depth due to a dual wheel assembly. — 4 2 4 2

27. Distinguish between longitudinal and transverse joints in rigid pavement with neat sketch. — 4 2 5 2

PART – C (5 × 12 = 60 Marks)
Answer ALL Questions

	Marks	BL	CO	PO

28. a. Design the safe super elevation required on a National Highway with horizontal curve of radius 75 m and land width of 7 m for a design speed of 40 kmph in snow-bound hilly terrain. Also determine the length of transition curve required for this curve if the pavement is rotated about inner edge at a rate of 1 in 60. Take the length of longest wheel base as 6 m. — 12 3 1 3,4

(OR)

   b. A vehicle moving at a speed of 70 kmph attempts the overtaking operation on another vehicle at 40 kmph while the oncoming vehicle at a distance of 360 m approaching at 65 kmph. If the reaction time of the driver in fast moving vehicle is 2 seconds and accelerating at 2.5 kmph/sec, evaluate the distance between the overtaking vehicle and oncoming vehicle after completing the overtaking operation. — 12 5 1 2

29. a. The spot speed study was conducted in Anna salai near Guindy with a sample size of 15 and the data is presented in the following table. Analyse the data and give your inference on various speed characteristics: — 12 4 2 3,4

Vehicle sample	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Speed (kmph)	47	43	39	51	38	22	24	50	37	70	59	74	49	39	37

(OR)