HIGHWAY AND TRAFFIC ENGINEERING (CIVL 2204)

B.TECH/CE/4TH SEM/CIVL 2204/2022

Time Allotted : 3 hrs

Full Marks: 70

 $10 \times 1 = 10$

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and <u>any 5 (five)</u> from Group B to E, taking <u>at least one</u> from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A (Multiple Choice Type Questions)

- 1. Choose the correct alternative for the following:
 - (i) Warping stresses occur at the top and bottom of cement concrete pavement because of the variation in

 (a) wheel loads
 (b) day night temperature
 (c) seasonal temperature
 (d) all of these.
 - (ii) The equilibrium condition for danger of overturning to occur is when centrifugal ratio attains a value of
 (a) Wb/h
 (b) b/2h
 (c) P/W
 (d) v²/gR.
 - (iii) The maximum limit of superelevation in plain and rolling terrain as per IRC has been fixed to
 (a) 10%
 (b) 8%
 (c) 12%
 (d) 7%.
 - (iv) After subjecting the aggregate specimen to impact test, the disintegrated aggregate is to be sieved through IS sieve
 (a) 4.75 mm
 (b) 1.7 mm
 (c) 1.18 mm
 (d) 2.36 mm.
 - (v) If given wheel load is P₁ and standard wheel load is P, the equivalent wheel load factor can be computed by

(a) $\left(\frac{P}{P_1}\right)^4$	(b) $\left(\frac{P_1}{P}\right)^4$	(c) $\left(\frac{P_1}{P}\right)^{\frac{1}{4}}$	(d) $\left(\frac{P}{P_1}\right)^{\frac{1}{4}}$

(vi) The shape of "Give Way" sign in the traffic signal is
(a) Rectangle
(b) Octagonal
(c) Circle
(d) Inverted Triangle.

- (vii) Maximum number of vehicles that can pass a given point on a lane during one hour without creating unreasonable delay
 - (a) Practical Capacity (c) Traffic Density

- (b) Basic Capacity
- (d) Probable Capacity.

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- (viii) Identify the survey work carried out to generate "Desire Lines" in traffic engineering
 - (a) traffic volume survey
 - (c) origin and destination survey
- (b) spot speed survey
- (d) accident studies.
- (ix) The type of transition curve that is generally provided on hill road is
 (a) circular
 (b) cubic parabola
 (c) lemniscate
 (d) spiral
- (x) Bottom most layer in pavement is known as
 (a) wearing course
 (b) base course
 (c) sub-base course
 (d) subgrade.

Group – B

- 2. (a) Determine the extra width required for a two-way two lane undivided road on a horizontal curve of radius 360 m. Design speed of the road is 90 kmph and the length of wheel base may be assumed as 6.1 m. [(CO1)(Evaluate/HOCQ)]
 - (b) A grade of -1/30 is intersecting with another grade of +1/25 to form a vertical curve. If design speed is 80 kmph then design the length of vertical curve for all the required conditions. [(CO1)(Evaluate/HOCQ)]
 - (c) Classify Roads as per the third 20 years road development plan.

[(CO1)(Understand/LOCQ)]

4 + 6 + 2 = 12

3. (a) A two way two lane undivided highway is passing through a hilly terrain. Determine the minimum sight distance on 4% descending gradient for ruling design speed of 60 kmph. Assume required data as per IRC recommendations.

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[(CO1)(Analyse/IOCQ)]
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- (b) Write a short note on 'road margins'.
- (c) What are the various factors that control highway alignment?

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[(CO1)(Understand/LOCQ)]
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[(CO1)(Understand/LOCQ)]

5 + 4 + 3 = 12

Group - C

4. (a) Determine the tensile stress developed in CC pavement due to contraction using the following data:

Coefficient of friction between the bottom of the pavement and the supporting layer is 1.2, the unit weight of CC is 2400 kg/cm³. [(CO3)(Analyse/IOCQ)]

- (b) Explain the significance of the shapes of the aggregates for flexible pavement. [(CO2)(Understand/LOCQ)]
- (c) Briefly discuss about any three tests to be conducted on bitumen.

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[(CO2)(Understand/LOCQ)]
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5. (a) Design a new flexible pavement of a four lane divided highway as per IRC guidelines. It is estimated that the initial traffic to be 2500 commercial vehicle (CV) per day just after the completion of construction of above mentioned road. Use the following data

Design life: 15 years; CBR : 8%; Growth rate of CV : 7.5%; VDF: 4.0. Design table is given below:

CBR	CSA, msa	Total	Granular sub-	Granular	DRM	BC surface
		Pavement	base course,	Base course,		
		Thickness, mm	mm	mm	111111	course, mm
8%	10	550	200	250	60	
	20	575			85	40
	30	590			100	40
	50	610			120	
	100	640			140	50
	150	660			160	

[(CO3)(Evaluate/HOCQ)]

(b) Briefly discuss about test to determine toughness property of road aggregate.

[(CO2)(Understand/LOCQ)] [(CO3)(Understand/LOCQ)]

(c) What is modulus of subgrade reaction?

6 + 4 + 2 = 12

Group - D

- 6. (a) Write short notes on:
 (i) Earth road
 (ii) Gravel road. [(C)
 - (ii) Gravel road. [(CO4)(Understand/LOCQ)](b) What are the general causes of Pavement failures? [(CO4)(Remember/LOCQ)]

 $(3 \times 2) + 6 = 12$

7. (a) Explain briefly the Hydrologic Analysis which is used in the design of surface drainage system. [(CO4)(Remember/LOCQ)]
(b) Write a short note on Road Safety Audit. [(CO4)(Remember/LOCQ)]

6+6=12

Group - E

- 8. (a) What are the design factors that are taken into consideration while designing a traffic rotary? [(CO5)(Remember/LOCQ)]
 - (b) What do you mean by Passenger Car Unit (PCU)? What are the factors that affect the PCU values? [(CO5)(Remember/LOCQ)]

6 + (2 + 4) = 12

- 9. (a) Write short notes on the following:
 - (i) Parking Studies
 - (ii) Origin and Destination Study.

[(CO6)(Remember/LOCQ)]

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(b) The 15 minutes traffic count on cross roads 1 and 2 during peak hour are observed as 276 and 250 vehicles per lane respectively approaching the intersection in the direction of heavier traffic flow. If the amber times required are 4 and 3 seconds respectively for two roads based on approach speeds, design the signal timings by trial cycle method. Assume an average time headway of 2.5 seconds during green phase. [(CO6)(Apply/IOCQ)]

(3+3)+6=12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	67.70	15.63	16.67

Course Outcome (CO):

After the completion of the course students will be able to

- 1. Plan highway networks and Design highway geometrics.
- 2. Characterize the properties of soil, aggregate, bitumen, and bituminous mixes.
- 3. Analyze and design rigid and flexible pavement (IRC Method).
- 4. Understand the principles of construction, maintenance and safety of highways.
- 5. Conduct traffic studies, analyze traffic data and design intersections.
- 6. Design traffic signal and analyze parking & accidents. Conduct traffic studies, analyze traffic data and design traffic signals.

*LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question