

JK LAKSHMIPAT UNIVERSITY, JAIPUR

INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Examination May 2019
B. Tech. in Civil Engineering, Semester VI

Roll No.....

CE 511: Transportation Engineering

Time: 3 hours

Max. Marks: 60

Instructions to students:

1. Do not write anything other than your roll number on question paper.
 2. Assume suitable data wherever required and mention it clearly.
 3. Writing appropriate units, nomenclature, and drawing neat sketches/schematics/ flow chart wherever, required are an integral part of the answer.
 4. In order to solve complex mathematical forms, Casio fx-991 MS or fx-991 ES or fx-991 ES Plus shall be permitted, however **programmable calculators** are strictly not entertained.
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Q.1A Short answer type questions (Attempt any 4 questions @ 2.5 marks each) 10

Comment, validate and support your answer

- i. What total cross area of longitudinal reinforcing steel is required for a cement concrete pavement slab 3.75 m wide, 15 m long and 200 mm thick? The concrete weighs 2400 kg/m^3 , Working stress in the steel is 1400 kg/cm^2 . Coefficient of friction is 1.5.
- ii. For a given section of road, relationship between speed and density is obtained as $U = 56 - 0.49k$, where 'U' is speed in kmph and 'k' is density in vehicle/km. Estimate the mean speed and mean density.
- iii. Determine the equivalent single Wheel load factor or VDF for the Light commercial vehicle with rear axle load of 2.0 t in terms of the standard axle load of 8.16 t.
- iv. Explain "PIEV" theory and the importance.
- v. Determine the minimum non-passing sight distance that should be provided for a vehicle coming down a 6 per cent gradient, Using the following data:
 1. Design speed, $V = 56 \text{ kmph}$
 2. Reaction time of the driver = 2 seconds
 3. Coefficient of friction between tyre and Road surface = 0.5

Q.2A Determine the warping stress at interior edge and corner of a 25 cm thick cement 05

concrete pavement with transverse points at 5m interval and longitudinal Joints at 3.6 m intervals. The modulus of subgrade reaction k is 6.9 kg/cm^3 . Assume Max. temperature differential during day to be 0.6°C per cm slab Thickness (for warping stress at interior and edge) and max temp. Differential of 0.4°C per slab thickness during night (for warping stress at the corner). Additional data given.

$(e = 10 \times 10^{-6} \text{ per } ^\circ\text{C})$,

$E = 3 \times 10^5 \text{ kg/cm}^2$

$\mu = 0.15$,

$$C_x = 0.88,$$

$$C_y = 0.54)$$

- Q.2B Using the data given below, calculate the wheel load stresses at (a) interior (b) edge and (c) corner region of a cement concrete pavement using Westergaard's stress equation. Also determine the probable location where the crack is likely to develop due to corner loading.

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Wheel load = 5200kg

Modulus of elasticity of cement concrete, $E = 3.0 \times 10^5 \text{ Kg/cm}^2$

Pavement thickness, $h = 18 \text{ cm}$

Poisson ratio of concrete $\mu = 0.15$

Modulus of subgrade reaction, $K = 6.0 \text{ Kg/cm}^3$

- Q.3A A driver travelling at the speed limit of 50 kmph was cited for crossing an intersection. He claimed that the duration of the amber display was improper and consequently a dilemma zone existed at that location. Using the following data, determine whether the driver's claim was correct.

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(i) amber duration = 4.5 sec

(ii) perception reaction time = 1.5sec

(iii) Comfortable deceleration = 3 m/sec^2

(iv) car length = 4.6 m

(v) Intersection Width = 15m

- Q.3B Calculate the length of National highway, State highway, MDR, ODR & Village Road by Bombay Road Development Plan for area 16,500sq.km, agricultural and developed area 5000sq.km, and undeveloped area 2200sq.km.

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Population Range	No. of Towns
<500	150
500-1000	200
1000-2000	650
2000-5000	280
5000-10,000	120
10,000-20,000	70
20,000-50,000	15
50,000-1,00,000	20
>1,00,000	7

OR

- Q.3B On a two way traffic road speed of overtaking and overtaken vehicle are 65 and 45 kmph respectively. If the average acceleration of overtaking vehicle is 0.92 m/s^2 . determine

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(i) safe overtaking sight distance indicating the details of overtaken operation by sketch, and

(ii) The minimum length of overtaking zone and show the details of the overtaking zone by neat sketch.

- Q.4A A cement concrete pavement has a thickness of 24 cm and has two lanes of total

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width 7.2 m, with a longitudinal joint. Design the dimension and spacing of the Bars, Using the following data :

(i) Allowable working stress in steel in tension = 1400 kg/cm^2

(ii) Unit weight of concrete = 2400 kg/m^3

(iii) Coefficient of friction = 1.5

(iv) Allowable bond stress in concrete = 24.6 kg/cm^2

Q.4B A road intersection has five legs designated as 1,2,3,4 and 5. Leg 1 is in N-S direction and others are marked clockwise. The traffic volume in terms of PCU(V_{ij}) per hour during peak period are given below as :

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V_{12}	37	V_{31}	466	V_{41}	182	V_{51}	45
V_{13}	303	V_{32}	122	V_{42}	54	V_{52}	132
V_{14}	64	V_{34}	47	V_{43}	18	V_{53}	62
V_{15}	52	V_{35}	657	V_{45}	116	V_{54}	15

Find the Weaving ratio between ratio between the legs 2 and 3. Draw a sketch showing the terrific volume between legs.

Q.5A The traffic studies and axle load distribution studies carried out during project preparations indicate that there are (i) 5600 commercial Vehicle per day with rear axle loads in the range of 2500 to 3500 kg and growth rate of 6.5 % p.a. and (ii) 1900 heavy commercial vehicles with rear axle loads in the range 11,000 to 13,000 kg and growth rate 4.5%. The road pavement is expected to be constructed in a period of 4.0 years after this study and the flexible pavement structure is to be designed for a life of 18 years. Determine value of CSA for design.

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Q.5B A truck with CG at $X = 1.4 \text{ m}$ and $Y = 1.7 \text{ m}$ is traveling on curved road of radius 200 m and super elevation as 0.05. Determine the maximum safe speed to avoid both slipping and overturning, assuming that the coefficient of sliding friction is 0.15. Sketch , explain and derive the expression for the conditions when overturning is likely to happen.

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OR

Q.5B An express way of four lane divided passing through a flat terrain has a horizontal curve of radius equal to ruling minimum radius. If the design speed if 120 kmph ,Calculate the following elements of the curve :

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(i) Ruling minimum radius

(ii) Super elevation

(iii) Extra Widening and,

(iv) Length of transition curve

Suggest the best suitable shape of the transition curve.

