Question Paper

Exam Date & Time: 24-Apr-2019 (02:00 PM - 05:00 PM)



MANIPAL ACADEMY OF HIGHER EDUCATION

INTERNATIONAL CENTRE FOR APPLIED SCIENES IV SEMESTER B.Sc.(Applied Sciences) IN ENGINEERING END SEMESTER THEORY EXAMINATION-APRIL/MAY 2019

HIGHWAY ENGG. [ICE 241 - S2]

Marks: 100

Duration: 180 mins.

Answer 5 out of 8 questions.

- Explain the different necessities that the realignment of roads are carried (4) out.
 A)
 B) With a neat sketch derive an equation for safe sight distance on a sloping (8)
 - With a neat sketch derive an equation for safe sight distance on a sloping (8) ground in standard format.
 - C) A vehicle moving with a speed of 60kmph on an ascending gradient. The (8) lag distance is 1.2 times the braking distance. Calculate the gradient of the road if the coefficient of friction is 0.36 and the reaction time is 2.5sec.
- With a neat sketch prove the conditions required for a vehicle to avoid transverse skidding on a curve about the outer wheel.
 - ^{B)} If the acceleration of the overtaking vehicle is 0.92m/sec² and the speed of ⁽¹⁰⁾ the overtaking and the over taken vehicles are 80kmph and 50kmph respectively on a two lane two way traffic road. Calculate the overtaking site distance draw the neat sketch of overtaking zones showing minimum length and sign posts.
 - ^{C)} With a neat sketch explain curve resistance for a vehicle moving on curve. ⁽⁴⁾
- ³⁾ Derive an equation for super elevation for a vehicle moving on a curved (8) track.
 A)
 - Find the compensated gradient on a curve of radius 90m on a state highway ⁽⁴⁾ with a ruling gradient of 6%.
 - Calculate the setback distance and extra widening for a two lane both way ⁽⁸⁾ traffic on NH on a curve of 4.5⁰ for a design speed of 75kmph.
- ⁴⁾ A Valley curve is to be designed at a junction of downward gradient of 1 in ⁽⁸⁾

- A) 30 and a level stretch from head light consideration. Calculate the length of the valley curve.
- B) On a circular curve rate of super elevation is 'e' and the coefficient of friction ⁽⁶⁾ is 'f'. While negotiating a curve a vehicle comes to stop. What is the condition required that the stopped vehicle does not slide inwards.
- C) A road is being designed for a speed of 100kmph on a horizontal curve with ⁽⁶⁾ super elevation of 7%. If the coefficient of side friction is 0.1, calculate the minimum radius required for a safe vehicle movement.
- ⁵⁾ Calculate the length of a transition curve for a NH on a curve of radius 700m ⁽⁶⁾ for a design speed of 80kmph by rate of change of acceleration
 ^{A)} method.
 - B) Describe the floating car method adopted for speed and delay studies ⁽⁶⁾

 Calculate the ESWL for a dual wheel assembly carrying 2050kg load on each wheel for a pavement thickness of 8cm and 15cm with a centre line spacing between the tyres is 30cm and clear distance between the tyres is 12cm

- ⁶⁾ Define i) Time head way ii) Space head way iii) Possible capacity and iv) (5) basic capacity
 A)
 - ^{B)} With a neat sketch explain different layers in the flexible system of ⁽⁵⁾ pavement.
 - ^{C)} Calculate the expected repetition for the following data

(10)

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Single axle load	% of the axle	Tandem axle	% of the axle
(ton)	load	load(ton)	load
19-21	0.6	34-38	0.3
17-19	1.5	30-34	0.3
15-17	4.8	26-30	0.6
13-15	10.8	22-26	1.8
11-13	22	18-22	1.5
9-11	23.3	14-18	0.5
Less than 9	30	Less than 14	2.0

Type of road-cement concrete with two lane two way NH Traffic-total of the two way traffic is 3000 commercial vehicle at the end of the construction period, Rate of traffic increase-7.5%, Design life-20 years.

- 7)
- A cement concrete road is being constructed in the state of Karnataka. (8) Check the adequacy of the slab against temperature stresses with the following details.Width of the slab-3.5m, Spacing of contraction joint-4.5m, Thickness of slab-33cm, Elastic modulus of concrete 3x10⁵kg/cm², Effective modulus of subgrade reaction of the DLC -8kg/cm², coefficient of thermal expansion of concrete -10x10⁻⁶/⁰C, Highest axle load stress 24.1kg/cm².

- ^{B)} Design the spacing between the two contraction joint if maximum tensile ⁽⁴⁾ stress in concrete is 0.8kg/cm² and coefficient of friction is 1.5.
- Calculate the spacing between contraction joints when the dowel bars are (8) used by using the following data:
 Width of slab-4.52m, thickness of slab-25cm, coefficient of friction-1.5, allowable tensile stress in steel-1400kg/cm², Diameter of the bar-12mm, spacing between bar-400mm.
- ⁸⁾ Cement concrete pavement has a thickness of 24cm and has two lane of ⁽⁸⁾ width 7.2m with a longitudinal joint in between. Design the dimension and the spacing of the tie bar using the following data; Allowable tensile stress in steel-1400kg/cm², unit weight of concrete-2400kg/m³, Coefficient of friction-1.5, bond stress between steel bar and concrete-24.6kg/cm².
 - ^{B)} Compare the annual costs of a two lane highway per km for two types of pavement structure

WBM with bituminous WMM base with WBM Description surface binder course and bituminous concrete surface Total cost Rs.135 lakhs/km Rs.200 lakhs/km Life 5years 15years 10% Interest 8% Rs.20 lakhs after Rs.55 lakhs after 15 Salvage value 5years years Rs. 0.45 lakhs Rs. 0.90 lakhs Maintenance cost/km

^{C)} On a clayey soil discharge expected in one of the drains is 0.57m³/sec. ⁽⁶⁾
 Assuming the trapezoidal section of bottom width 1m and cross slope
 1.5:1, design the cross section and longitudinal slope of the drain. The allowable velocity in the drain is 0.6 m/sec. and Manning regular coefficient is 0.02[.]

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(6)