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**10CV56**

# Fifth Semester B.E. Degree Examination, June/July 2019
## Transportation Engineering - I

Time: 3 hrs.                                                                 Max. Marks:100

**Note:1.** *Answer any FIVE full questions, selecting atleast TWO questions from each part.*
    **2.** *Assume missing data suitably.*

## PART – A

1    a.  "Roads are the red carpets on which Prosperity and Civilization Spread". Comment and discuss.                                                                **(06 Marks)**
     b.  What are the objectives and activities of the Indian Roads Congress (IRC)?   **(06 Marks)**
     c.  What are the important policies mentioned in Vision : 2021 document?   **(08 Marks)**

2    a.  What are the different types of classification of roads in India?    **(06 Marks)**
     b.  List and explain briefly Fact Finding Surveys (Planning Surveys).    **(06 Marks)**
     c.  Determine the length of different categories of roads in a state in India using the 3$^{rd}$ 20 year road development plan formula and the following data :
         Total area of state = 80000 Sq.km   ;   Total number of towns = 86  ;
         Overall road density = 82 km per 100 sq. km area.                   **(08 Marks)**

3    a.  What are the conditions which necessitate taking up a realignment project of a highway?
                                                                              **(06 Marks)**
     b.  In a district , where the rainfall is heavy, two types of road pavement are to be constructed :
         i)  Two lane state highway with bituminous concrete surface  ii)  Major district road of WBM pavement, 3.8mt wide. What should be the height of the crown with respect to the edges in these two cases? Assuming straight line camber.                 **(06 Marks)**
     c.  Calculate the safe overtaking sight distance for a highway having design speed of 96 kmph. The acceleration of overtaking vehicle A = 2.5 kmph/sec. Assume all other data suitably.
                                                                              **(08 Marks)**

4    a.  A national highway having ruling design speed V = 80 kmph has a horizontal curve of radius 500 mts. Design the length of transition curve assuming following data :
         Normal pavement width , W = 7.0 mts
         Allowable rate of introduction of super elevation = 1 in 150. Pavement to be rotated about the inner edge to effect better drainage in heavy rainfall area.           **(12 Marks)**
     b.  A valley curve is formed by a descending grade of 1 in 25 meeting an ascending grade of 1 in 30. Design the length of valley curve to fulfill both comfort condition and Headlight sight distance requirement for a design speed of 80 kmph. Assume allowable rate of change of centrifugal acceleration C = 0.6m/sec$^3$.                             **(08 Marks)**

## PART – B

5    a.  What are the desirable properties of road aggregates and list the tests which are generally carried out for judging the desirable properties and suitability of stone aggregates. **(06 Marks)**
     b.  Discuss the desirable properties of a soil as a highway material.    **(06 Marks)**

c. The index properties of subgrade soil are given below :
Passing 0.074mm sieve = 55% ; Liquid limit = 50% ; Plastic limit = 41%.
Classify the soil by revised HRB system with group Index value. [Refer Fig.Q5(c)]
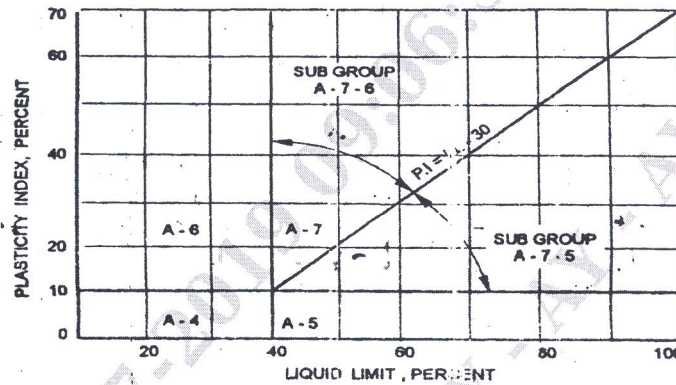(08 Marks)



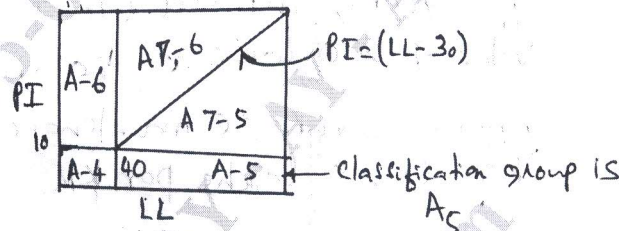Fig. 6.3 Chart for classifying fine grained soil by HRB system



Fig.Q5(c)

6  a. Design the flexible pavement for a construction of new highway as per IRC – 37 – 2001.
With the following data :
Number of commercial vehicles as per last count = 1000 CVPD.
Period of construction = 3 years ; Annual traffic growth rate = 8% ;
Design CBR of subgrade soil = 10% ; Vehicle damage factor = 3.5 ;
Lane distribution factor = 0.75 ; Design life in years = 15 for NH.    (10 Marks)

IRC:37-2001

**PAVEMENT DESIGN CATALOGUE**
**PLATE 2 – RECOMMENDED DESIGNS FOR TRAFFIC RANGE 10-150 msa**

| Cumulative Traffic (msa) | Total Pavement Thickness (mm) | PAVEMENT COMPOSITION | | |
|---|---|---|---|---|
| | | Bituminous Surfacing | | Granular Base & Sub-base (mm) |
| | | BC (mm) | DBM (mm) | |
| 10 | 540 | 40 | 50 | |
| 20 | 565 | 40 | 75 | |
| 30 | 580 | 40 | 90 | Base = 250 |
| 50 | 600 | 40 | 110 | |
| 100 | 630 | 50 | 130 | Sub-base = 200 |
| 150 | 650 | 50 | 150 | |

b. Using the data given below, calculate the wheel load stresses at   i) Interior  ii) Edge
iii) Corner region of a cement concrete pavement using Westergaard's stress equations.
Wheel load = 5100 kgs.
Modulus of elasticity of cement concrete, $E = 3.0 \times 10^5$ kg/cm$^2$.
Pavement thickness, h = 18cms  ;   Poisson's ratio of concrete $\mu = 0.15$.
Modulus of subgrade reaction, K = 6.0 kg/cm$^3$ ;  Radius of contact area a = 15cms.
(10 Marks)
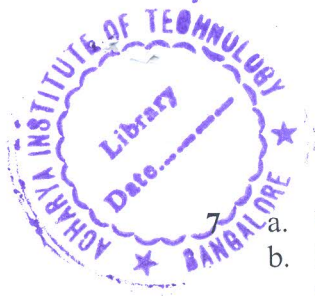
7 a. Write down the construction steps for Wet mix Macadam base course. (06 Marks)

   b. Explain briefly step by step construction procedure of Bituminous Concrete (BC) pavements and also mention the specifications for the materials used. (08 Marks)

   c. Explain briefly the significance of highway drainage. (06 Marks)

8 a. Briefly explain the various highway user benefits. (06 Marks)

   b. Briefly describe the different methods of economic analysis of a highway. (06 Marks)

   c. Compare the annual cost of two types of pavement structures.

   I) WBM with thin bituminous surface at cost of Rs 2.21 lakhs per KM ; life of 5 years, interest at 10% and salvage value of Rs 0.90 lakhs after 5 years. Annual average maintenance cost of Rs 0.35 lakhs per km.

   II) Bituminous Macadam base and bituminous concrete surface, Total cost of Rs 4.2 lakhs, Life of 15 years, interest rate at 8% ; Salvage value of 2.0 lakhs at the end of 15 years. Annual average maintenance cost of Rs 0.25 lakhs per km. (08 Marks)

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