U.S.N | | | | | | | | | | |

P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belgaum)

Fifth Semester, B.E. - Civil Engineering

Semester End Examination; Dec - 2016/Jan - 2017

Highway Engineering

Time: 3 hrs *Max. Marks: 100*

***Note**: i) Answer **FIVE** full questions, selecting **ONE** full question from each unit.*
ii) Missing data, if any, may suitably assume.

UNIT - I

1 a. What are the different modes of transportation? Explain the characteristics of road transport in comparison with other modes of transport. 5

b. How roads are classified in India as per Nagpur road plan and Lucknow road plan? 5

c. Determine the length of different categories of roads in a district in India using Third road Development formula with the following data,

Total area of the district : 13400 sq.km

Total number of towns : 12

Overall road density : 82 km per 100 sq km

The length of the existing express ways = 100 km

The length of railway track = 150 km. 10

2 a. What are the significant recommendations of Jayakar committee? Mention how this helped road development in India. 5

b. Explain with sketches the various factors controlling the alignment of roads. 5

c. Four new road links A, B, C and D are to be constructed during a five year plan. Suggest the order of priority for phasing the road construction programme based on maximum utility approach. Assume utility units of 0.5, 1.0, 2.0 and 4.0 for the four population ranges and 2, 2 and 5 units per 1000 tons for agricultural, raw material and industrial products from the following data, 10

Road link	Length km	No. of villages served				Productivity served, tons		
		<500	501 – 1000	1001 – 2000	>2000	Agricultural	Raw Material	Ind. Products
A	75	30	15	10	3	8000	3000	1000
B	35	20	8	6	3	5000	1000	1600
C	40	15	6	5	5	6000	2000	3000
D	50	40	4	3	2	3000	7000	500

Contd...2

UNIT - II

3 a. What is Camber? Why it is provided? List any two demerits of providing excess camber. 5

b. Calculate the SSD for a design speed of 60 kmph. What is the SSD, if a rising gradient of 1 in 40 is encountered? Assume $f = 0.35$. 5

c. A radius of 250 m has to be provided at a locality due to site restriction in a NH, with design speed of 100 kmph. Design the super elevation for mixed traffic condition. Should there be restriction in speed? If so, what is its value? Take $f = 0.15$. 10

4 a. Draw a typical cross-section of a 2 lane rural highway in embankment indicating width of pavement, road way width and land width. 5

b. Determine the off-tracking of a vehicle with wheel base of 6.0 m while negotiating a horizontal curve of radius 100 m. 5

c. The radius of a two lane horizontal curve is 390 m. If the design speed is 100 kmph, design,
i) Super elevation ii) Extra widening
iii) Transition curve length based on comfort conditions. 10

UNIT - III

5 a. What are the desirable properties of sub grade soil? Explain. 5

b. State the important requirements of good road aggregates. 5

c. The load penetration values of CBR test conducted on sample are given below. Determine the CBR of soil if 100 divisions of load dial represents 190 kg in the calibration chart. 10

Penetration mm	0	0.5	1.0	1.5	2.0	2.5	3.0	4.0	5.0	7.5
Load gauge reading	0	8	15	23	29	34	37	43	48	57

6 a. What are the sources of tar and bitumen? Mention the differences between tar and bitumen. 5

b. Write down the construction steps for water bound macadam road. 5

c. A plate load test was conducted on a soaked sub grade during monsoon reason using a plate diameter of 300 mm. The load values corresponding to the mean settlement dial readings are given below. Determine the modulus of sub grade reaction for the standard plate. 10

Mean settlement, mm	0	0.24	0.52	0.76	1.02	1.23	1.53	1.76
Load values, kN	0	4.6	9	11.8	13.6	14.8	15.9	16.4

UNIT - IV

7 a. Draw a sketch of flexible pavement cross-section and show the component parts. Enumerate the functions of each component of the pavement. 5

b. What are the various factors to be considered in pavement design? Discuss the significance of each. 5

Contd...3

c. Define warping stresses. Determine warping stress at the edge region of a 25 cm thick concrete pavement with transverse joints at 11 m interval and longitudinal joints at 3.6 m interval. Assume temperature differential for day condition to be 0.6ºC per cm slab thickness. Indicate the nature of warping stresses at top and bottom of slab with the help of a neat sketch. Assume K = 6.9 kg/cm^3, e = 10x10^{-6}/ºC, μ = 0.15 and E = 3x10^5 kg/cm^2. 10

8 a. Explain flexible and rigid pavements and bring out the points of difference. 5

b. Explain ESWL and the concept in the determinations of the equivalent wheel load. 5

c. The maximum increase in temperature is expected to be 26ºC after the construction of a CC pavement. If the expansion joint gap is 2.2 cm, design the spacing between the expansion and contraction joints. Assume PCC construction, with α = 10x10^{-6}/ºC, unit weight = 2400 kg/m^3, allowable stress in tension during initial period of curing = 0.8 kg/cm^2 and the coefficient of friction of the interface = 1.4. 10

UNIT - V

9 a. What are the general causes of pavement failures? 5

b. Write a brief note on need for highway maintenance and classification of maintenance works for bituminous roads. 5

c. Explain various types of failures in cement concrete pavements and their causes. 10

10 a. What are the requirements of a good highway drainage system? 5

b. Discuss how the problem of road construction in water logged areas may be solved. 5

c. The maximum quantity of water expected in one of the open longitudinal drains on clayey soil is 0.9 m^3/s. Design the cross section and longitudinal slope of trapezoidal drain assuming the bottom width of the trapezoidal section to be 1.0 m and cross slope to be 1V: 1.5H. The allowable velocity of flow in the drain is 1.2 m/s and n = 0.02. 10

* * *