

# CBCS SCHEME



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15CV63

## Sixth Semester B.E. Degree Examination, July/August 2022 Highway Engineering

Time: 3 hrs.

Max. Marks: 80

- Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.  
2. Use of IRC codes and charts are permitted.*

### Module-1

- 1 a. What are the important recommendations of Jayakar committee? How were these implemented? (08 Marks)  
b. Enumerate the salient features of Vision 2021. (08 Marks)

OR

- 2 a. List and explain different planning survey required for Highway planning. (08 Marks)  
b. There are three alternate road plans for a district in Karnataka state. Suggest the order of priority for planning road based on maximum utility approach. Assume utility units of 0.5, 1.0, 2.0 for three population ranges and utility units of 1.0 and 5.0 per 1000 tonnes of agricultural and industrial products served.

Proposal	Road Length (km)	Number of Towns/Villages served with Population Range			Productivity served in 1000 t	
		< 2000	2001-5000	5001-10,000	Agriculture	Industrial
A	500	100	150	40	150	20
B	700	270	350	82	300	35
C	900	290	430	96	430	45

(08 Marks)

### Module-2

- 3 a. Explain briefly necessity of Re-alignment of existing road in highway project. (06 Marks)  
b. A state highway passing through a rolling terrain has a horizontal curve of radius equal to the ruling minimum radius.  
i) Design all the geometric features of this curve assuming suitable data.  
ii) Specify the minimum set-back distance from the centre line of the two lane highway on the inner side of the curve upto which the buildings etc. obstructing vision should not be constructed so that intermediate sight distance is available throughout the circular curve. Assume length of circular curve greater than the sight distance. (10 Marks)

OR

- 4 a. What are obligatory points? Discuss how these control the highway alignment. (06 Marks)  
b. Explain PIEV theory. (04 Marks)  
c. An ascending gradient of 1 in 100 meets a descending gradient of 1 in 120. A summit curve is to be designed for a speed of 80 kmph so as to have an overtaking sight distance of 470m. (06 Marks)

### Module-3

- 5 a. List and explain the desirable properties of road aggregates. Also list the tests to be conducted in order to decide suitability of road stones for use in construction. (06 Marks)  
b. Briefly explain HRB soil classification. (04 Marks)



- c. Design the flexible pavement as per IRC:37-2001 using the following data:  
 Number of commercial vehicles as per last count = 1000 commercial vehicles  
 Construction period = 3 years  
 Annual growth rate = 8%  
 Design CBR of soil = 10%  
 Category of Road = NH, 2 lane single carriageway  
 Design life = 10 years  
 Vehicle Damage Factor (VDF) = 2.5  
 Lane Distribution factor (LDF) = 75%  
 Calculate the overall thickness and thickness of individual pavement layer using following pavement design catalogue for traffic range 10-150 Msa and CBR 10%

Cumulative Traffic (Msa)	Total Pavement Thickness (mm)	Pavement Composition		
		Bituminous Surfacing		Granular Base and Sub-base (mm)
		B.C. (mm)	DBM (mm)	
10	540	40	50	Base=250 Sub-Base=200
20	565	40	75	
30	580	40	90	
50	600	40	110	
100	630	50	130	
150	650	50	150	

(06 Marks)

OR

- 6 a. Explain significance of ESWL in pavement design. (04 Marks)  
 b. What is modulus of subgrade reaction? Explain briefly plate load test and corrections for 'k' made for different plate size and for accounting worst moisture condition. (06 Marks)  
 c. Calculate the stresses at interior edge and corner regions of cement concrete pavement using Westergaard's stress equations. Use the following data:  
 Wheel load,  $P = 5100 \text{ kg}$   
 Modulus of elasticity of cement concrete,  $E = 3 \times 10^5 \text{ kg/cm}^2$   
 Pavement thickness,  $h = 18 \text{ cm}$   
 Poisson's ratio of cement,  $\mu = 0.15$   
 Modulus of subgrade reaction,  $k = 6.0 \text{ kg/cm}^3$   
 Radius of contact area,  $a = 15 \text{ cm}$  (06 Marks)

**Module-4**

- 7 a. Explain Rothfutch's method for proportioning soil aggregate mixes. (08 Marks)  
 b. Explain in detail the requirements, specifications of materials and construction steps/methods for Bituminous concrete (BC) layer. (08 Marks)

OR

- 8 a. Write down the construction steps for Wet Mix Macadam (WMM) base course. (08 Marks)  
 b. Explain the following terms:  
 (i) Prime coat  
 (ii) Tack coat  
 (iii) Seal coat  
 (iv) Bituminous surface dressing (08 Marks)

**Module-5**

- 9 a. Explain briefly importance of highway drainage. (08 Marks)



15CV63

- b. Estimated details of cost and life for three proposals are given below, assuming rate of interest as 8% and annual maintenance cost Rs.5000/km, analyse the economies by (i) Annual cost method (ii) Benefit cost ratio method.

Element	Estimated Useful Life (Years)	Cost in Thousand Rupees		
		Proposal A	Proposal B	Proposal C
Right of way	100	0	270	310
Grading	50	150	290	330
Structures	50	160	250	290
Pavement	10	310	1550	1450

Given: Annual Road User cost

$$\text{Proposal A} = R_A = 3081,330$$

$$\text{Proposal B} = R_B = 2491,125$$

$$\text{Proposal C} = R_C = 2377,245$$

Length of Road

$$A = 21 \text{ km}$$

$$B = 17.5 \text{ km}$$

$$C = 16.7 \text{ km}$$

(08 Marks)

OR

- 10 a. Maximum quantity of water expected in one of the open longitudinal drains on clayey soil is  $0.9 \text{ m}^3/\text{sec}$ . Design cross-section and longitudinal slope of trapezoidal drain assuming bottom width of trapezoidal section to be 1.0m and cross slope to be 1.0 vertical to 1.5 horizontal. The allowable velocity of flow in drain is 1.2 m/sec and Manning's roughness coefficient is 0.02 (06 Marks)
- b. Explain the following :  
i) NPV (04 Marks)  
ii) IRR (06 Marks)
- c. Explain the concept of BOOT and BOT, in financing highway project. (06 Marks)

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