

Sixth Semester B.E. Degree Examination, Dec.2018/Jan.2019
Highway Engineering

Time: 3 hrs.

Max. Marks: 80

Note: Answer any FIVE full questions, choosing one full question from each module.

Module-1

- 1 a. Explain various characteristics of Road Transport. (05 Marks)
 b. Explain briefly the salient features of third twenty year road development plan. (05 Marks)
 c. There are three alternate proposals of road plans for a district in Karnataka state. Suggest the order of priority for planning road based on the maximum utility approach. Assume utility units of 0.5, 1.0, 2.0 for the three population ranges and utility of 1.0 and 10.0 per 1000 tonnes of agricultural and industrial products served.

Proposal	Road length in km	Number of villages served pollution range			Productivity in 1000 tonnes	
		<2000	2001-5000	>5000	Agriculture	Industrial
A	200	80	40	10	90	12
B	250	75	45	12	105	22
C	300	85	50	18	110	26

(06 Marks)

OR

- 2 a. Explain the role of transportation in social and economic development of the country. (05 Marks)
 b. Explain briefly the following :
 (i) Jayakar Committee (ii) Indian Road Congress (IRC) (iii) Central Road Fund (CRF) (05 Marks)
 c. The area of a certain district in India is 13,400 sq.km and there are 12 towns as per 1981 census. Determine the lengths of different categories of roads to be provided in third twenty year road development plan. (06 Marks)

Module-2

- 3 a. What are the basic requirements of an ideal highway alignment? List and explain briefly. (05 Marks)
 b. Briefly explain the role of pavement surface characteristics in highway geometric design. (05 Marks)
 c. Calculate the safe stopping sight distance for design speed of 50 kmph. For (i) Two way traffic on two lane road (ii) Two way traffic on a single lane road. Assume $f = 0.37$ and reaction time, $t = 2.5$ sec. (06 Marks)

OR

- 4 a. Briefly explain how MAP study is helpful in the alignment of new highway. (05 Marks)
 b. Give the details of drawings to be prepared in highway project and discuss briefly. (05 Marks)
 c. The radius of a horizontal circular curve is 100 m. The design speed is 50 kmph and the design co-efficient of lateral friction is 0.15.
 (i) Calculate the super elevation required if full lateral friction is assumed to develop
 (ii) Calculate the co-efficient of friction needed if no super elevation is provided.
 (iii) Calculate the equilibrium super-elevation if the pressure on inner and outer wheels should be equal. (06 Marks)

Module-3

- 5 a. List and explain the desirable properties of subgrade soil. (05 Marks)
 b. List and explain the various design factors to be considered for pavements. (05 Marks)
 c. A load penetration values of CBR tests conducted on a specimen of a soil sample are given below. Determine the CBR value of soil, if 100 divisions of load represents 190 kg and in the calibration chart of proving ring. (06 Marks)

Penetration of plunger, in mm	0.0	0.5	1.0	1.5	2.0	2.5	3.0	4.0	5.0	7.5	10.0	12.5
Load dial readings (Divisions)	0	8	15	23	29	34	37	43	48	57	63	67

OR

- 6 a. Explain the desirable properties of aggregates to be used in pavement construction. (05 Marks)
 b. Explain the significance of ESWL in pavement design. (05 Marks)
 c. Calculate the stresses at interior, edge and corner regions of a cement concrete pavement using Westergaard's stress equation. Use the following data; wheel load, $P = 5100$ kg, Modulus of elasticity, $E = 3 \times 10^5$ kg/cm², Pavement thickness, $h = 18$ cm, Poisson's ratio of concrete, $\mu = 0.15$, Modulus of subgrade reaction, $k = 6$ kg/cm³, Radius of contact area, $a = 15$ cm. (06 Marks)

Module-4

- 7 a. Briefly explain the different types of pavement construction. (08 Marks)
 b. Explain the construction steps for cement concrete pavement slab. (08 Marks)

OR

- 8 a. Explain the construction steps for water bound macadam roads. (08 Marks)
 b. Write a short note on the following :
 (i) Bituminous macadam (ii) Bituminous concrete (iii) Prime coat (iv) Seal coat (08 Marks)

Module-5

- 9 a. What are the requirements of highway drainage system? (05 Marks)
 b. Explain the various road user benefits of highway improvements. (05 Marks)
 c. The maximum quantity of water expected in one of the open longitudinal drain on clayey soil is 0.9 m³/sec. Design the cross-section of trapezoidal drain, assuming the bottom width of the trapezoidal section to be 1 m and cross slope to be 1 vertical to 1.5 horizontal. The allowable velocity of flow in the drain is 1.2 m/sec. (06 Marks)

OR

- 10 a. Briefly explain the types of cross drainage structures. (05 Marks)
 b. Describe the various methods of economic analysis of a highway. (05 Marks)
 c. Compare the annual costs of two types of pavement structures (i) WBM with thin bituminous surface at total cost of Rs.2.2 lakhs per km, life of 5 years, interest at 10%, salvage value of Rs.0.9 lakhs after 5 years; Annual average maintenance cost of Rs. 0.35 lakhs per km and (ii) Bituminous macadam base and bituminous concrete surface, total cost of Rs. 4.2 lakhs per km, life of 15 years, interest at 8%, salvage value of Rs. 2 lakhs at the end of 15 years ; Annual average maintenance cost Rs.0.25 lakhs per km. (06 Marks)

Sixth Semester B.E. Degree Examination, Dec.2019/Jan.2020
Highway Engineering

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- Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
 2. Assume any missing data suitably.*

Module-1

- 1 a. Explain the various characteristics of Road Transport. (04 Marks)
 b. What are the objectives of IRC and Central Road Research Institute [CRRI] (08 Marks)
 c. What are the advantages and disadvantages of airways? (04 Marks)

OR

- 2 a. Explain the saturation system of Road Planning. (04 Marks)
 b. Write a short note on KSHIP and its projects. (04 Marks)
 c. Four new road links A, B, C & D are to be constructed during a 5 year plan period. 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 population ranges and 2, 2 and 5 units per 1000 tonnes of agricultural, raw material and industrial products from the following data:

Road link	Length km	No. of villages with Pop ⁿ range				Productivity served		
		<500	501-1000	1001-2000	>2000	Agricultural	Raw materials	Industrial Product
A	75	30	15	10	3	8000	3000	1000
B	35	20	08	06	3	5000	1000	1600
C	40	15	06	05	5	6000	2000	3200
D	50	40	04	03	2	3000	7000	500

(08 Marks)

Module-2

- 3 a. What are the main objectives of preliminary survey and steps followed in the preliminary survey by conventional method [Name the steps]. (06 Marks)
 b. Briefly explain the map study is the alignment of a highway project. (04 Marks)
 c. Define camber. Discuss the factors on which the amount of camber to be provided depends. Specify, the recommended ranges of camber for different types of pavement surfaces. (06 Marks)

OR

- 4 a. Explain the PIEV theory with a neat diagram. (06 Marks)
 b. Calculate the minimum sight distance required to avoid a head on collision of two cars approaching from the opposite directions at 90 and 60 kmph. Assume a reaction time of 2.5 seconds, coefficient of friction 0.7 and brake efficiency of 50% in either case. (06 Marks)
 c. Explain briefly the steps of superelevation design. (04 Marks)

Module-3

- 5 a. Distinguish between Bitumen and Tar. (04 Marks)
b. Explain the various properties of Road aggregates. (06 Marks)
c. Define the modulus of subgrade reaction. With the sketch explain the plate load test for determining the k value. (06 Marks)

OR

- 6 a. Explain ESWL. How is it determined for dual wheel assembly? (04 Marks)
b. Explain the steps involved in the design of slab thickness of rigid pavement as per IRC 58:2002. (06 Marks)
c. The properties of the subgrade soil are given below:
Passing 75 micron IS sieve = 80%
Liquid limit = 58%
Plasticity index = 25%
Classify the soil by HRB system with group index value. (06 Marks)

Module-4

- 7 a. Write down the construction steps for wet mix macadam base course. (06 Marks)
b. Explain in detail the requirements specifications of materials and the construction steps / methods for Bituminous Concrete [BC] layer. (06 Marks)
c. Briefly explain the Rothfuch's method of proportioning of materials. (04 Marks)

OR

- 8 a. Explain in brief the construction of cement concrete pavements. (08 Marks)
b. Explain in brief the specifications of materials for WBM pavement. (08 Marks)

Module-5

- 9 a. What are the requirements of highway drainage system? (04 Marks)
b. Explain briefly the design of filter material used in subsurface drains. (08 Marks)
c. Explain the cross drainage structures in brief. (04 Marks)

OR

- 10 a. Explain in brief any three methods of economic evaluation of highway projects. (06 Marks)
b. Explain in brief the various factors affecting the vehicle operation cost. (06 Marks)
c. Explain BOOT with respect to highway financing. (04 Marks)

Sixth Semester B.E. Degree Examination, June/July 2019
Highway Engineering

Time: 3 hrs.

Max. Marks: 80

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

- 1 a. Mention different modes of transportation. Explain the characteristics of road transport in comparison with other systems. (08 Marks)
- b. Determine the length of different categories of roads in a state in India by the year 2021 as per 3rd year road plan formulae. The area of state is 3,08,000 km². Number of Towns as per 1981 census was 276. Overall road density aimed at 82km per 100km². (08 Marks)

OR

- 2 a. What are the types of roads and its classification? Briefly outline classification of urban roads. (08 Marks)
- b. Three new roads A, B and C are to be completed in a district during a five year plan period. Workout the order of priority for phasing the plan programme by maximum utility principle, from the data given below. Adopt utility unit of 1.0 for serving a village with population range 2000-5000, for catering for 1000T of agricultural products or per 100T of industrial products. Assume any other required data suitably.

Road	Length km	Number of village served population			Productivity 1000T	
		<2000	2000 – 5000	>5000	Agricultural	Industrial
A	15	10	8	3	15	1.2
B	12	16	3	1	11	0.0
C	18	20	10	2	20	0.8

(08 Marks)

Module-2

- 3 a. Clarify the features of ideal alignment and enumerate factors affecting alignment. (08 Marks)
- b. Write a brief outline on engineering surveys. (08 Marks)

OR

- 4 a. With neat sketches illustrate different cross section elements. (08 Marks)
- b. The speed of overtaking and overtaken vehicles are 70 and 40 kmph respectively on a two way traffic road. If the acceleration of overtaking vehicle is 0.99 m/sec².
- Calculate safe overtaking sight distance.
 - Mention the minimum length of overtaking zone
 - Draw a neat sketch of the overtaking zone and show the positions of the sign posts.

(08 Marks)

Module-3

- 5 a. With neat sketches illustrate conduction of plate load test to determine modulus of subgrade reaction. (08 Marks)
- b. Distinguish between :
- Tar and Bitumen
 - Cutback and Emulsion.

(08 Marks)

OR

- 6 a. Enumerate different types of pavements with their component parts and functions of each component. (08 Marks)
- b. Calculate ESWL of a dual wheel assembly carrying 2004 kg each for pavement thickness of 15, 20 and 25 cms. Centre to centre tyre spacing = 27cm and distance between the walls of the tyres = 11cm. Use graphical method. (08 Marks)

Module-4

- 7 a. Briefly outline the design procedure of soil aggregate mixes by Rothfuch's method. (08 Marks)
- b. Explain the procedure of marshall mix design of Bituminous mixes. (08 Marks)

OR

- 8 a. Enumerate in detail the requirements, specifications of materials and the construction steps for a wet mix macadam (WMM) layer. (08 Marks)
- b. Explain in detail the requirements, specifications of materials and the construction steps for pavement quality concrete. (08 Marks)

Module-5

- 9 a. Explain with sketches how the subsurface drainage system is provided to lower the water table. (08 Marks)
- b. The maximum quantity of water expected in one of the open longitudinal drains on clayey soil is $0.9 \text{ m}^3/\text{sec}$. Design the cross section and longitudinal slope of trapezoidal drain assuming the bottom width of the trapezoidal section to be 1.0m and cross slope to be 1.0 vertical to 1.5 horizontal. The allowable velocity of flow in the drain is 1.2 m/sec and $n = 0.02$. (08 Marks)

OR

- 10 a. Briefly describe the different methods of economic analysis of a highway. (08 Marks)
- b. Calculate the annual cost of a stretch of a highway from the following particulars:

Item	Total cost (Rs. in lakh)	Estimated life (years)	Rate of interest (%)
Land	12	100	6
Earthwork	9.0	40	8
Bridges and culverts	7.5	60	8
Pavement	14	15	10

(08 Marks)

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Note: Answer any FIVE full questions, choosing one full question from each module.

Module-1

- 1 a. Explain the various characteristics of road transport. (08 Marks)
- b. What are the significant recommendations of Jayakar committee report? Explain how it is implemented in the road development of a country. (08 Marks)

OR

- 2 a. Briefly explain about planning surveys for a highway project. (08 Marks)
- b. The area of a district is 13400 sq km and there are 12 towns as per 1981 census. Determine the length of different categories of roads to be provided in the district by the year 2001. Assume over all density of road length is 82 km per 100 sq km area. (08 Marks)

Module-2

- 3 a. Explain with sketches the various factors controlling the alignment of a road. (08 Marks)
- b. What are the objectives of preliminary survey for highway alignment? Enumerate the details to be collected and the various steps to be followed in the conventional method. (08 Marks)

OR

- 4 a. Derive an expression for finding the extra widening required on horizontal curve. (08 Marks)
- b. The speeds of overtaking and over taken vehicles are 70 kmph and 40 kmph respectively on a two way traffic road. The average acceleration during overtaking may be assumed as 0.99 m/sec². Calculate safe overtaking sight distance and show the details of overtaking zone with sketch. (08 Marks)

Module-3

- 5 a. What are the desirable properties of sub grade soil? Enumerate the identification and classification tests of soils. (08 Marks)
- b. Design a flexible pavement for a two lane undivided carriage way using the following data: Design CBR value of subgrade 5.0% initial traffic on completion of construction is 300 C.V/day. Average growth rate is 6.0% per year. Design life is 10 years VDF value is 2.5. Lane distribution factor is 0.75. (08 Marks)

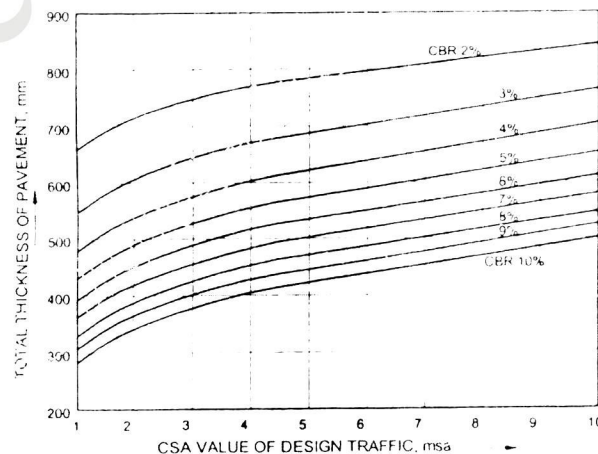


Fig.5(b) CBR design chart for determination of total pavement thickness for traffic with CSA of 1.0 to 10 msa.

OR

- 6 a. What are the desirable properties of road aggregates? What tests are conducted for judging the desirable properties? Mention the significance of each test. (08 Marks)
- b. A plate load test was conducted on a soaked sub grade during monsoon using a plate diameter of 30cm. The load values corresponding to the mean settlement dial readings are given below. Determine the modulus of sub grade reaction for the standard plate. (08 Marks)

Mean settlement values, mm	0.0	0.24	0.52	0.76	1.02	1.23	1.53	1.76
Load values kg	0.0	460	900	1180	1360	1480	1590	1640

Module-4

- 7 a. What are the desirable properties of Bituminous mixes? Discuss briefly. (08 Marks)
- b. What are the essential requirements of soil properties suitable for the construction of highway sub grade? Explain the method of construction of highway sub grade. (08 Marks)

OR

- 8 a. Explain the method of construction of water Bound Macadam base. (08 Marks)
- b. What are the functions of granular material sub base? Explain the construction method of granular sub base. (08 Marks)

Module-5

- 9 a. Discuss the importance of highway drainage. (08 Marks)
- b. The maximum quantity of water expected in longitudinal drains on clayey soil is $0.9 \text{ m}^3/\text{sec}$. Design the cross section and longitudinal slope of trapezoidal drain assuming the bottom width of the trapezoidal section to be 1.0m and cross slope to be 1.0 vertical to 1.5 horizontal. The allowable velocity of flow in the drain is 1.2 m/sec and Manning's roughness coefficient is 0.02. (08 Marks)

OR

- 10 a. Discuss the various components of quantifiable and non-quantifiable benefits to the road users due to highway development project. (08 Marks)
- b. Calculate the annual cost of a stretch of highway from the following particulars:

Item	Total cost lakhs	Estimated life years	Rate of interest
Land	35.0	100	6%
Earthwork	40.0	40	8%
Bridges, culverts, drainage	50.0	60	8%
Pavement	100.0	15	10%
Traffic signs and road appurtenance	15.0	5	10%

The average cost of maintenance of the road is Rs.1.5 lakhs per year. (08 Marks)

CBCS SCHEME

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(08 Marks)

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Module-3

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- b. Distinguish between :
- Tar and Bitumen
 - Cutback and Emulsion. (08 Marks)

1 of 2

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
 2. Any revealing of identification, appeal to evaluator and/or equations written eg. 42-8 = 50, will be treated as malpractice.

15CV63

OR

- 6 a. Enumerate different types of pavements with their component parts and functions of each component. (08 Marks)
- b. Calculate ESWL of a dual wheel assembly carrying 2004 kg each for pavement thickness of 15, 20 and 25 cms. Centre to centre tyre spacing = 27cm and distance between the walls of the tyres = 11cm. Use graphical method. (08 Marks)

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Module-5

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(08 Marks)
