Note: (i) Attempt ALL questions.

(ii) All questions carry Equal marks.

(iii) Be Precise in your answer.

1. Attempt any four out of the following. \((4\times5=20)\)

   a) Calculate the minimum sight distance required to avoid head-on collision of two cars approaching from opposite directions at 90 kmph and 60 kmph. Assume a reaction time of 2.5 seconds, coefficient of friction 0.7 and brake efficiency of 50% in either case.

   b) Explain camber. What are the objectives of camber? Discuss the factors on which camber depends.

   c) Calculate the length of national highways and state highways required in a district with total area 8200 km² developed, semi-developed and undeveloped areas being 30.45 and 25 percent respectively. The number of towns with population 1, 0.5-1, 0.2-0.5 and 0.1-0.2 lakhs are 3, 7, 12 and 20 respectively in the district.
Use the following formulas

\[ NH = \frac{A}{64} + \frac{B}{80} + \frac{C}{96} \times 32K + 8M \] + D

\[ NH+SH = \frac{A}{20} + \frac{B}{24} + \frac{C}{32} + 48k + 24M + 11.2N + 1.6P \] + D

d) Enumerate the steps for practical design of super elevation.
e) Explain the salient features of Bombay road plan

2. Attempt any four out of the following. (4x5=20)

a) Give the classification of roads according to Nagpur road plan

b) What are the factors on which stopping sight distance depends? Explain briefly.

c) Write down the construction steps for water bound macadam road.

d) Define Overtaking Sight Distance.

e) Explain various types of failures of cement concrete pavement and their causes.

Attempt any two out of the following. (2x10=20)

a) Write short notes on

   i. Thirteenth highest hourly traffic volume
   ii. Desire lines
   iii. Traffic signal system
   iv. Before and after studies
   v. Passenger car unit
b) Calculate the stress at interior, edge and comer region of a cement concrete pavement using Westergard's equation. Use following data.

Wheel load \( P = 5100 \text{ kg} \)

Modulus of elasticity of concrete \( E = 3.0 \times 10^5 \text{ kg/cm}^2 \)

Pavement thickness, \( h = 18 \text{ cm} \)

Poisson Ratio, \( \mu = 0.15 \)

Modulus of subgrade, \( k = 6.0 \text{ kg/cm}^2 \)

c) The speed of overtaking and overtaken vehicles are 70 and 40 km/m respectively on two way traffic road. If the acceleration of overtaking vehicle is \( 0.99 \text{ m/sec}^2 \).

(i) Calculate safe overtaking sight distance

(ii) Mention the minimum length of overtaking zone

(iii) Draw a sketch of overtaking zone and show the position of the sign posts.

4. Attempt any two out of the following. \((2 \times 10 = 20)\)

   a) Explain CBR test procedure and how are the results of the test obtained and interpreted?

   b) Explain desirable properties of aggregate to be used in different types of pavement construction.

   c) List various types of transition curves used in highways. What is an ideal transition curve? Explain.
5. Attempt any two out of the following. (2x10=20)

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

b) What are the various types of traffic Islands used? Explain the use of each.

c) Enumerate the steps for practical design of super elevation. Design the rate of super elevation for a horizontal highway curve of radius 500m and speed 100kmph.