BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI, PILANI

First Semester 2023 – 2024

CE G549 (Rural Roads Technology) Mid-Semester (Closed Book)

Instructor In-Charge : Dr. Nishant Bhargava

Max. Marks : 25   **Duration : 90 minutes**

1. Fill in the blanks **[0.5]**
    a. Recommended depth of penetration of primer into base course is _____. **each**
    b. Minimum recommended 28-days flexural strength of concrete to be used for construction of rigid pavement in rural roads is _____.
    c. In order to determine the safety of high embankments against excessive settlement, assessment of _____ properties are important.
    d. Maximum allowable Flakiness Index for sub-base course is higher than that of base course. The statement is _____ (True/False).

2. List the design criteria used for thickness evaluation of rigid pavements for low volume roads. **[1]**

3. What are the general recommendations for the design of intersection where a rural road meets or crosses another road of higher category? **[1]**

4. For the figure provided below, determine whether Village A should be connected with Village B or Village C. **[2]**
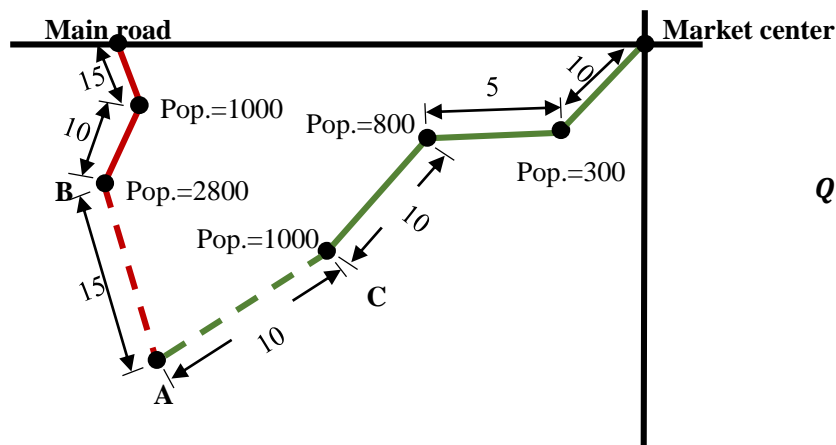
$$Q = p + m/\sqrt{d} + \sum_{i=1}^{n} q_i/r_i$$

5. Define bitumen as per IS 334 (2023). What are the requirements of bituminous binder for its application in rural road. **[2]**

6. Determine the vehicle damage factor for laden HCV, where load on rear axle and front axle is 10.2 tonnes and 5 tonnes, respectively. Assume that 10% of laden HCV is overloaded by 20%. **[2]**

7. Draw a typical illustration of concrete block pavement showing its different layers and recommended thickness as per IRC SP 63. **[2]**

8. List and explain in brief the four stages of engineering surveys to be carried out for finalizing the alignment of rural road. **[2]**

9. List at least four controls to be kept in mind while designing a combination of vertical and horizontal alignment? **[2]**

10. Describe the core network concept used for planning of PMGSY roads. What is the purpose of through routes and link routes in a core network? **[2]**

11. 24-hour traffic counts over a period of 3 days taken on a single lane rural road during the lean non-harvesting season. The average daily traffic results are:

Animal-drawn carts (Pneumatic-Tyred)	*20*
Bicycles	*290*
Full-sized trucks	*10*
Agricultural Tractor-Trailers and Jugads	*50*
Cars and Jeeps	*30*

[3]

There are two harvesting seasons in the area, each having a duration of 2 months, the harvesting season traffic remaining at its peak for 12 days. The above traffic count data was collected 3 years before opening the road to traffic. Assuming that the traffic in peak harvesting season is 3 times the traffic in non-harvesting season, compute the cumulative ESAL application. Use VDF as 2.86, 0.31, 0.34 and 0.02 for HCV laden, HCV unladen, MCV laden and MCV unladen respectively. Assume all the other design values as per IRC SP 72 (2015).

12. Cement concrete pavements are to be designed for Rural Roads in Bihar having traffic volume of 100 CVPD (temperature differential for 175 mm slab thickness = 16°C). Soaked CBR of subgrade soil = 5% and corresponding modulus of subgrade reaction is 42 MPa/m. Adopt 28-day compressive strength of 30 MPa. Provide 150 mm WBM-III over 100 mm GSB. Determine whether the design is safe for slab thickness of 175 mm and joint spacing of 3.5 m. Assume all the other design values as per IRC SP 62 (2014). **[4]**

Values of C_x and C_y (y-axis), Values of L_x/l and L_y/l (x-axis)
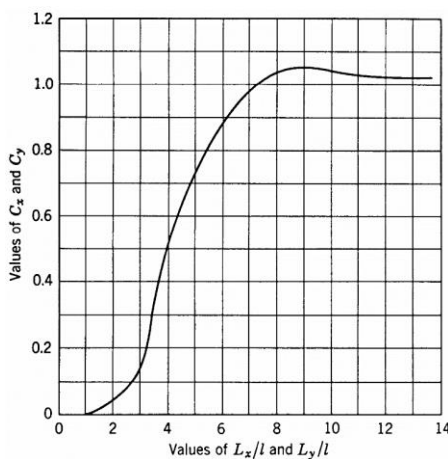
$$\sigma_e = \frac{0.803\,P}{h^2}\left[4\,log\left(\frac{l}{a}\right) + 0.666\left(\frac{a}{l}\right) - 0.034\right]$$

$$l = \left[\frac{E\,h^3}{12\,K\,(1-\mu^2)}\right]^{1/4}$$

$$\sigma_{te} = \frac{E\alpha t}{2}C$$

$$a = \sqrt{\frac{0.8521\,P_d}{q\,\pi} + \frac{S_d}{\pi}\sqrt{\frac{P_d}{0.5227\,q}}}$$