

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT  
SUMMER SEMESTER – END TERM TEST (JULY 2016)

Course Code: **10B11CE511**  
Course Name: **Highway Engineering**  
Course credit: 4

Max. Marks: **50**  
Max. Time: **2 hrs**

**Note:** All questions are compulsory. Assume suitable data if required. Notation has its usual meaning.

**Q1.** Spot speed studies were carried out at certain stretch of a highway with mixed traffic flow and the consolidated data collected are given below.

Speed range (kmph)	No. of vehicles observed	Speed range (kmph)	No. of vehicles observed
0-10	12	50-60	255
10-20	18	60-70	119
20-30	68	70-80	43
30-40	89	80-90	33
40-50	204	90-100	9

Determine (1) the upper and lower values of speed limits for installing speed regulation sign at this road stretch and (2) the design speed for checking the geometric design elements of the highway. [8]

**Q2.** The 15 minute traffic counts on cross roads 1 and 2 during peak hours are observed as 178 and 142 vehicles per lane respectively approaching the intersection in the direction of heavier traffic flow. If the amber times required are 3 and 2 sec respectively for the two roads based on approach speeds, design the signal timings by trial cycle method. Assume average time headway as 2.5 seconds during green phase. [8]

**Q3.** Using the data given, calculate the wheel load stresses at (a) interior, (b) edge and (c) corner regions of a cement concrete pavement using Westergaard's stress equations. Also determine the probable location where the crack is likely to develop due to corner loading. [8]

Wheel load,  $P = 5100$  kg,  
Modulus of elasticity  $E = 3 \times 10^5$  kg/cm<sup>2</sup>,  
Pavement thickness  $h = 18$  cm,  
Poisson's ratio of concrete  $\mu = 0.15$   
Modulus of subgrade reaction  $K = 6$  kg/cm<sup>3</sup>  
Radius of contact area  $a = 15$  cm

**Q4.** A cement concrete pavement has thickness of 18 cm and has two lanes of 7.2 m with a longitudinal joint along the centre. Design the dimensions and spacing of tie bar. Use the following data: [5]

Allowable working stress in steel in tension,  $S_s = 1400$  kg/cm<sup>2</sup>  
Unit weight of concrete  $W = 2400$  kg/m<sup>3</sup>  
Coefficient of friction  $f = 1.5$   
Allowable bond stress in deformed bars in concrete,  $S_b = 24.6$  kg/cm<sup>2</sup>

**Q5.** Draw a typical cross section of a highway on embankment and show the various flexible pavement layers. List the functions of each component. [7]

**Q6.** What do you understand by low volume roads? What are the general features of gravel roads? Write the construction steps of gravel road. [7]

**Q7.** Write short notes on any two of the following. [7]

- (a) Maintenance of WBM roads
- (b) Causes and types of pavement deterioration
- (c) Road user characteristics