MANIPAL INSTITUTE OF TECHNOLOGY
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MANIPAL INSTITUTE OF TECHNOLOGY

SIXTH SEMESTER B.TECH (CIVIL ENGINEERING)

END SEMESTER EXAMINATION, MAY 2023

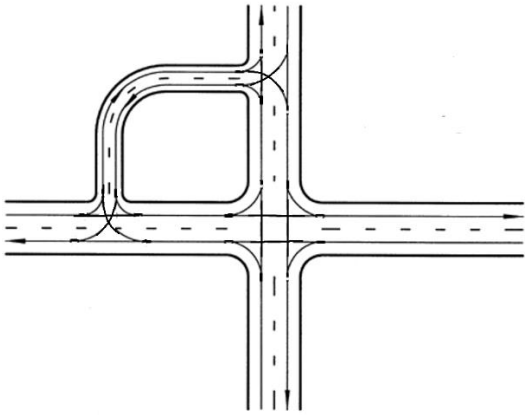
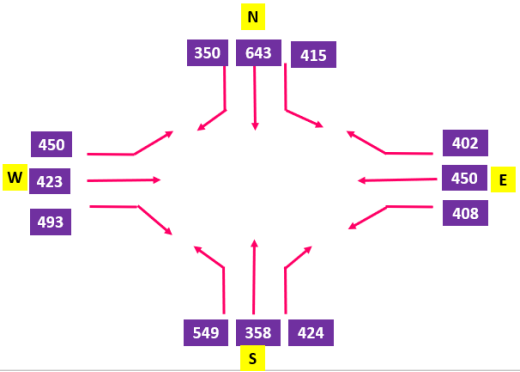
TRAFFIC SYSTEMS AND ENGINEERING (CIE 4070)

(- 05 - 2023)

TIME: 3 HRS. **MAX. MARKS: 50**

Note: 1. Answer all questions.
2. Any missing data may be suitably assumed.
3. Use of Formula book is permitted

<table>
<tr><th>Q. NO</th><th>QUESTION</th><th>MARKS</th><th>CO</th><th>BL</th></tr>
<tr><td>1A</td><td>The maximum traffic flow occurs when traffic density is half the jam density and speed is half the free flow speed. Explain this statement with a neat sketch to explain the fundamental relationship of traffic flow.</td><td>2</td><td>1</td><td>2</td></tr>
<tr><td>1B</td><td>The Following table gives the particulars collected for a section of road 0.8km long during the course of a moving observer study:
<table>
<tr><th rowspan="2">Trip No</th><th rowspan="2">Direction</th><th rowspan="2">Journey time (min)</th><th rowspan="2">Stopped time (min)</th><th colspan="3">No. of Veh. in opposite direction</th><th colspan="2">No. of veh. in the same direction</th></tr>
<tr><th>car</th><th>bus</th><th>Truck</th><th>Over-taking</th><th>Over-taken</th></tr>
<tr><td>1</td><td>N-S</td><td>1.01</td><td>0.04</td><td>11</td><td>0</td><td>5</td><td>1</td><td>0</td></tr>
<tr><td>2</td><td>S-N</td><td>0.92</td><td>0.10</td><td>13</td><td>0</td><td>0</td><td>2</td><td>1</td></tr>
<tr><td>3</td><td>N-S</td><td>0.77</td><td>0.08</td><td>19</td><td>2</td><td>11</td><td>1</td><td>1</td></tr>
<tr><td>4</td><td>S-N</td><td>0.03</td><td>0.14</td><td>14</td><td>2</td><td>4</td><td>1</td><td>0</td></tr>
<tr><td>5</td><td>N-S</td><td>0.84</td><td>0.08</td><td>2</td><td>0</td><td>11</td><td>0</td><td>1</td></tr>
<tr><td>6</td><td>S-N</td><td>1.06</td><td>0.13</td><td>19</td><td>1</td><td>7</td><td>2</td><td>1</td></tr>
</table>
Determine the flow in PCU per hour assuming an equivalency factor of one car, 3.5 for bus and 4 for trucks. Calculate the journey speed and running speed.</td><td>4</td><td>1</td><td>5</td></tr>
<tr><td>1C</td><td>A road consists of 4 lanes, 2 in each direction. The maximum capacity of 2 lanes in one direction is 1500 vehicle/hour. When vehicles are stationary in a jamming condition, the average length occupied by a vehicle is 5.25 m. During a period of observation, the actual volume of traffic in one direction is steady at the rate of 800 vehicles/hour. This flow is brought to a halt when a traffic signal turns red and a queue develops.</td><td>4</td><td>2</td><td>5</td></tr>
</table>

	Estimate the time in seconds which elapses from the moment the signal turns red until the stationary queue reaches another intersection 100m from the signal. Assume a linear relationship between speed and concentration.			
2A	One lane of a four-lane divided carriageway is closed for repairs. Discuss the application of Lighthill and Whitham's theory for the above road to deal with bottlenecks when traffic flow is greater than the capacity of the bottleneck.	**4**	**2**	**6**
2B	Identify the conflict points and mark them on the figure below 	**3**	**2**	**3**
2C	What are staggered intersections? Draw the layout of a left/right and right/left staggered intersections with central waiting area.	**3**	**3**	**2**
3A	The normal flow of traffic on crossroads A and B are 400 and 250 vehicles per hour respectively. The saturation flow for roads A and B are estimated as 1250 and 1000 vehicles per hour respectively. The all-red time for pedestrians to cross is 12 seconds and lost time at each phase is 2 seconds. Design a two-phase traffic system by Webster's method?	**3**	**3**	**6**
3B	Traffic flow in terms of number of vehicles at the intersection of two highways are given below:  The highways at present intersect at right angles and have a carriageway width of 15 m. The entry and exit width at rotary are 10 m. Evaluate the capacity of the rotary intersection making suitable assumptions.	**4**	**3**	**5**

<table>
<tr><td>3C</td><td>What are the types of traffic sign boards? Explain.</td><td>3</td><td>5</td><td>2</td></tr>
<tr><td>4A</td><td>Assess whether there is any relationship between the accident severity and the age of drivers using suitable statistical test for the data given below:
<table>
<tr><td rowspan="2"></td><td rowspan="2"></td><td colspan="3">Age group of drivers</td><td rowspan="2">Total Accidents</td></tr>
<tr><td>18-30</td><td>30-50</td><td>Above 50</td></tr>
<tr><td rowspan="4">Accident severity</td><td>Fatal</td><td>12</td><td>8</td><td>16</td><td>36</td></tr>
<tr><td>Grievous Injury</td><td>25</td><td>14</td><td>41</td><td>80</td></tr>
<tr><td>Minor Injury</td><td>48</td><td>35</td><td>70</td><td>153</td></tr>
<tr><td>Total Accidents</td><td>85</td><td>57</td><td>127</td><td>269</td></tr>
</table></td><td>4</td><td>5</td><td>5</td></tr>
<tr><td>4B</td><td>The accident records for three consecutive years at an uncontrolled junction indicate the following number of accidents:
<table>
<tr><th>Year</th><th>No. of accidents</th></tr>
<tr><td>1999</td><td>11</td></tr>
<tr><td>2000</td><td>25</td></tr>
<tr><td>2001</td><td>18</td></tr>
</table>
Estimate the probability of 10 accidents occurring per year at the site.</td><td>2</td><td>5</td><td>6</td></tr>
<tr><td>4C</td><td>Define the following: i) Luminous Flux ii) Illumination iii) Death rate based on population iv) Accident involvement Rate</td><td>4</td><td>5</td><td>1</td></tr>
<tr><td>5A</td><td>Explain the road lighting system at a rotary intersection.</td><td>5</td><td>5</td><td>2</td></tr>
<tr><td>5B</td><td>For a street lighting system, having the following conditions: Street width = 15 m; Mounting height = 7.5 m; Lamp size = 5000 lumen; Luminaire type = II; Coefficient of utilization = 0.54; Maintenance factor = 0.85. Determine is the spacing between lighting units to produce average Lux = 7?</td><td>2</td><td>5</td><td>5</td></tr>
<tr><td>5C</td><td>What is off-street parking? With a neat figure explain the design features of off-street parking.</td><td>3</td><td>4</td><td>2</td></tr>
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