(Make up)

# MANIPAL INSTITUTE OF TECHNOLOGY

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**MANIPAL INSTITUTE OF TECHNOLOGY**

**SIXTH SEMESTER B.TECH (CIVIL ENGINEERING)**

**END SEMESTER EXAMINATION, MAY 2023**

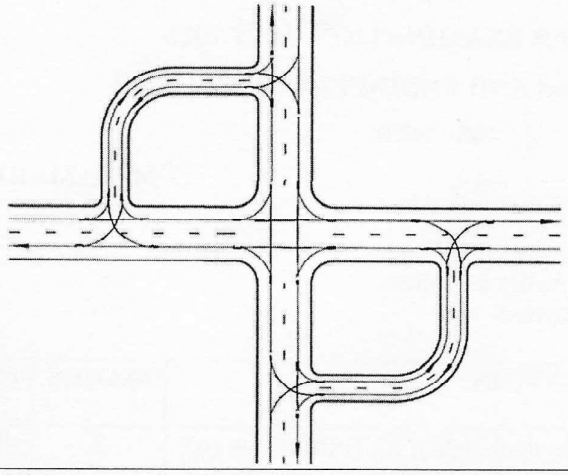
**TRAFFIC SYSTEMS AND ENGINEERING (CIE 4070)**

**( - 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**

| Q. NO | QUESTION | MARKS | CO | BL |
|---|---|---|---|---|
| 1A | Define the following: i) Traffic density(K); ii) Traffic flow (q); iii) Traffic capacity; iv) Traffic Basic capacity; v) Annual Average Daily Traffic (AADT); vi) Average Annual Weekday Traffic (AAWT) | 3 | 1 | 1 |
| 1B | Determine the queue length formed due to congestion and the congestion intensity on a road segment of 5 km having 2 lanes. The features of the road segment are given below:<br>a. Capacity = 1400 veh/hr.<br>b. storage density = 22 veh/meter<br>c. demand = 2000 veh/hr<br>d. analysis sub period = 30 minutes.<br>e. mean speed = 14 km/hr,<br>f. free flow speed = 28 km/hr,<br>g. average vehicle occupancy = 1.2 person/vehicle. | 3 | 1 | 5 |
| 1C | The maximum capacity of a 2 lane carriageway of a 4 lane dual carriageway is 2000 veh/hr. Due to pipe laying operations the width of the 2 lane carriageway is reduced, restricting the maximum capacity to 1100 veh/hour. When the flow upstream beyond the influence of the bottleneck is reasonably steady and free flowing at 1500 veh/hour, Estimate:<br>i) The mean speed of traffic in the bottleneck<br>ii) The rate at which the queue of congested conditions outside bottleneck grows. The mean space headway when the vehicles are stationary is 8 m. The relation between speed and concentration is linear. | 4 | 2 | 5 |

<table>
<tr><td>2A</td><td>One lane of a four-lane divided carriageway is closed for repairs. Draw the Q-K curve for the above road and explain the application of Lighthill and Whitham's theory in dealing with bottlenecks when<br>i) traffic flow is less than the capacity of the bottleneck.<br>ii) traffic flow is equal than the capacity of the bottleneck.</td><td>4</td><td>2</td><td>5</td></tr>
<tr><td>2B</td><td>Identify the conflict points and mark them on the figure below<br>  </td><td>3</td><td>2</td><td>3</td></tr>
<tr><td>2C</td><td>What are grade separated intersection and at-grade intersections? List out the factors influencing the selection among the grade separated and at-grade intersections.</td><td>3</td><td>3</td><td>1</td></tr>
<tr><td>3A</td><td>What are the coordinated controlled traffic signal system and list out the different types of it. Illustrate the warrants required for the installation of traffic signals.</td><td>3</td><td>3</td><td>2</td></tr>
<tr><td>3B</td><td>A fixed time 2 phase signal is to be provided at an intersection having a North-South and an East-West road where only straight-ahead traffic is permitted. The design hour flows from the various arms and the saturation flows for these arms are given in the following table:
<table>
<tr><th></th><th>North</th><th>South</th><th>East</th><th>West</th></tr>
<tr><td>Design hour flow (q) in PCU/hr</td><td>700</td><td>400</td><td>950</td><td>1200</td></tr>
<tr><td>Saturation flow (s) in PCU/hr</td><td>2800</td><td>2400</td><td>3200</td><td>3500</td></tr>
</table>
Evaluate the optimum cycle time and green times for the minimum overall delay. The inter-green time should be the minimum necessary for efficient operation. The time lost per phase due to starting delays can be assumed to be 2 seconds. The value of the amber period is 2 seconds and red-amber period is 2 seconds. Sketch the timing diagram for each phase.</td><td>4</td><td>3</td><td>5</td></tr>
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<tr><td>3C</td><td>The number of accidents in a metropolitan city for the year 1989 is 400 per 300 million veh-km and in 1973 it was 700 per 450 million veh-km. Analyze whether there is any significant increase in the accident rates in four years.</td><td>3</td><td>5</td><td>4</td></tr>
<tr><td>4A</td><td>It is observed that road accidents and type of road are inter-dependent from the data provided below:
<table>
<tr><td rowspan="2"></td><td rowspan="2"></td><td colspan="4">Road type</td></tr>
<tr><td>NH</td><td>SH</td><td>MDR</td><td>OTHER</td></tr>
<tr><td rowspan="3">Accident severity</td><td>Fatal</td><td>20</td><td>12</td><td>8</td><td>4</td></tr>
<tr><td>Grievous Injury</td><td>25</td><td>35</td><td>22</td><td>24</td></tr>
<tr><td>Minor Injury</td><td>12</td><td>10</td><td>30</td><td>42</td></tr>
</table>
Test whether there is any significant relationship between the accident severity and the type of road using the statistical methods.</td><td>4</td><td>5</td><td>4</td></tr>
<tr><td>4B</td><td>It has been found that on an average 1 in 50 drivers in a bus company are involved in an accident every year. If there are 100 drivers in the company, examine the probability of exactly 4 drivers involved in an accident during a year?</td><td>2</td><td>5</td><td>4</td></tr>
<tr><td>4C</td><td>What are objectives of road accident studies? Explain the causes of road accidents.</td><td>4</td><td>5</td><td>2</td></tr>
<tr><td>5A</td><td>Explain the road lighting system at tunnels.</td><td>5</td><td>5</td><td>2</td></tr>
<tr><td>5B</td><td>Estimate the spacing between the lighting units for the following data: Street width = 15 m; Mounting height = 7.5 m; Lamp size = 7000 lumen; Luminaire type = II; Coefficient of utilization = 0.64; Maintenance factor = 0.75; Average Lux = 7</td><td>2</td><td>5</td><td>5</td></tr>
<tr><td>5C</td><td>Demonstrate the advantages and disadvantages of on-street and off-street parking.</td><td>3</td><td>4</td><td>2</td></tr>
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