MANIPAL INSTITUTE OF TECHNOLOGY

III SEMESTER B. TECH (CIVIL ENGINEERING)

END SEMESTER EXAMINATION, DEC 2022

HIGHWAY ENGINEERING (CIE 2152)

(/ / 2022)

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

Note: 1. Answer all questions.
2. Any missing data may be suitably assumed.

<table>
<tr><th>Q. NO</th><th>QUESTION</th><th>MARKS</th><th>CO</th></tr>
<tr><td>1A</td><td>Define Stopping Sight Distance (SDD). List the factors that affect SDD.</td><td>2</td><td>2</td></tr>
<tr><td>1B</td><td>With a neat sketch, derive the expression for Overtaking Sight Distance (OSD)</td><td>3</td><td>2</td></tr>
<tr><td>1C</td><td>Determine the length of the transition curve for a speed of 100kmph if the radius of a horizontal curve is 400m, the total pavement width at curve is 7.6m and super elevation is 0.07. Assume pavement to be rotated about the inner edge.</td><td>5</td><td>2</td></tr>
<tr><td>2A</td><td>List the various quantifiable benefits of a well-maintained highway.</td><td>2</td><td>5</td></tr>
<tr><td>2B</td><td>Describe with a neat sketch the measurement of spot speed by Enoscope.</td><td>3</td><td>3</td></tr>
<tr><td>2C</td><td>The consolidated data obtained from the speed and delay study using floating car method is given below. The study was conducted on a road structure of 5 km. Determine the average values of volume, journey speed and running speed of traffic stream along both directions.
<table>
<tr><th rowspan="2">Sl. No</th><th rowspan="2">Direction of trip</th><th colspan="2">Journey Time</th><th colspan="2">Total stopped delay</th><th colspan="3">No. of vehicles</th></tr>
<tr><th>Min.</th><th>Sec.</th><th>Min.</th><th>Sec.</th><th>overtaking</th><th>overtaken</th><th>opp. direction</th></tr>
<tr><td>1</td><td>E-W</td><td>5</td><td>45</td><td>2</td><td>30</td><td>3</td><td>4</td><td>238</td></tr>
<tr><td>2</td><td>W-E</td><td>6</td><td>45</td><td>3</td><td>22</td><td>4</td><td>3</td><td>220</td></tr>
</table></td><td>5</td><td>3</td></tr>
<tr><td>3A</td><td>List the requirements of a pavement structure.</td><td>2</td><td>4</td></tr>
<tr><td>3B</td><td>Describe with a neat sketch the process of formation of ruts in flexible pavement.</td><td>3</td><td>4</td></tr>
</table>

<table>
<tr><td>3C</td><td>Determine the cumulative number of standard axles on a dual three lane carriageway for a design period of 20 years. The traffic flow data of commercial vehicles prior to the commencement of construction is given in the table below. Highway is planned to be opened after 3 years of the last count. Highway passes through Plain terrain. Assume traffic growth rate as 7.5%, lane distribution factor = 0.60, vehicle damage factor = 4.5
<table>
<tr><th colspan="4">Axle Load Survey Data in one direction</th></tr>
<tr><td>Type/Date</td><td>Day 1</td><td>Day 2</td><td>Day 3</td></tr>
<tr><td>Single Axle</td><td>350</td><td>440</td><td>380</td></tr>
<tr><td>2 Axle</td><td>270</td><td>290</td><td>250</td></tr>
<tr><td>MAV</td><td>160</td><td>175</td><td>190</td></tr>
<tr><td>LCV</td><td>1200</td><td>1290</td><td>1050</td></tr>
</table></td><td>5</td><td>4</td></tr>
<tr><td>4A</td><td>Describe briefly the different types of pavements.</td><td>2</td><td>4</td></tr>
<tr><td>4B</td><td>With a neat sketch describe briefly the failure of rigid pavement due to mud pumping.</td><td>3</td><td>4</td></tr>
<tr><td>4C</td><td>Describe the types of joints and spacings provided in the rigid pavement.</td><td>5</td><td>4</td></tr>
<tr><td>5A</td><td>List the various sources of highway revenue.</td><td>2</td><td>5</td></tr>
<tr><td>5B</td><td>Describe the rate of return method of economic evaluation of highway projects.</td><td>3</td><td>5</td></tr>
<tr><td>5C</td><td>Calculate the annual cost of a stretch of highway using the data given below.
<table>
<tr><th>Item</th><th>Total cost, Rs. (lakhs)</th><th>Estimated life (years)</th><th>Rate of interest (%)</th></tr>
<tr><td>Land</td><td>875</td><td>100</td><td>8</td></tr>
<tr><td>Earth work</td><td>95</td><td>40</td><td>8</td></tr>
<tr><td>Bridges, culverts and drainage</td><td>210</td><td>60</td><td>10</td></tr>
<tr><td>Pavement</td><td>1320</td><td>15</td><td>10</td></tr>
<tr><td>Traffic signs and road appurtenances</td><td>85</td><td>5</td><td>12</td></tr>
</table></td><td>5</td><td>5</td></tr>
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