Reg. No.										

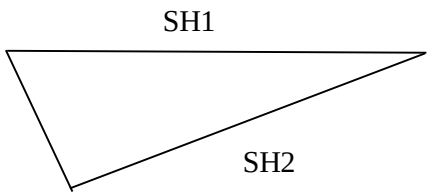
MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
A Constituent Institution of Manipal University

V SEMESTER B.TECH. (CIVIL ENGINEERING)
END SEMESTER EXAMINATIONS, NOV/DEC 2017
SUBJECT: HIGHWAY ENGINEERING [CIE 3104]
REVISED CREDIT SYSTEM
(/ /2017)

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions. Draw the neat sketch wherever necessary.
- Missing data may be suitably assumed.
- Code books are not allowed only the design charts and tables are permitted.

1A.	Why it is undesirable to have much steeper cross slope?	**2 marks**
1B.	Derive an equation for an absolute minimum sight distance on a sloping ground.	**4 marks**
1C.	The two state highway intersect at an angle 80^0 as shown in below figure. One of the side of sight triangle is 175m. The design speed on the highway one is 100kmph. Find the maximum speed that can permitted on the second highway. Take the coefficient of friction as 0.35 and the reaction time as 2.5sec 	**4 marks**
2A.	Describe the design considerations required for a Valley curve and for a summit curve.	**2 marks**
2B.	What are the requirement of an ideal transition curve? Enumerate different types of transition curves available.	**2 marks**
2C	With a neat sketch derive an equation for an extra widening. Calculate the length of a transition curve and shift required on a National highway on a plain terrain with a curve of radius of 225m and a design speed of 75kmph. Take pavement width including extra widening as 7.5m with an allowable rate of introduction of super elevation rotated about the Centre line as 1 in 50.	**6 marks**
3A.	What is highway alignment? What are the basic requirements of an idle alignment? Mention the necessity of change in alignment.	**5 marks**
3B.	A road 60kms in length need improvements, involving widening, resurfacing, etc... Following are the details of the project. (i) Cost of total improvements =10lacs per km. (ii) Vehicle operating cost = Rs. 1.5 per km per vehicle on existing road. (iii) Vehicle operating cost = Rs. 1.0 per km per vehicle on improved road. (iv) Traffic volume = 2000veh/day (v) Cost of maintenance on the existing road is Rs. 6000/km which shall be Rs. 8000/km on improved road. Show by economic analysis if, this project is worth undertaking assuming	**5 marks**

Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
A Constituent Institution of Manipal University

<table>
<tr><td></td><td>analysis period of 20years at an interest rate of 10 percent.</td><td></td></tr>
<tr><td>4A.</td><td>Using the given data determine whether the assumed thickness of the rigid pavement is adequate or not. Ignore the corner stress due to wheel load.
Location: Andhra Pradesh; Road Type: NH, Traffic volume = 2992CVPD, effective modulus of subgrade reaction = 8kg/cm^2/cm, grade of concrete = M40, Poisson's ratio = 0.15, coefficient of thermal expansion = 10 X 10^{-6}/^{0}C, tyre pressure = 8kg/cm^2, growth factor = 7.9%, design period = 20 years. Assumed thickness of pavement = 30cm. At the given location, axle load survey was conducted and the details are as below.
<table>
<tr><td colspan="2">Load on single axle</td><td colspan="2">Load on tandem axle</td></tr>
<tr><td>Axle load (Tonnes)</td><td>% axle loads</td><td>Axle load (Tonnes)</td><td>% axle loads</td></tr>
<tr><td>20</td><td>0.58</td><td>36</td><td>0.27</td></tr>
<tr><td>18</td><td>1.57</td><td>32</td><td>0.29</td></tr>
<tr><td>16</td><td>4.39</td><td>28</td><td>0.56</td></tr>
<tr><td>14</td><td>10.42</td><td>24</td><td>1.78</td></tr>
<tr><td>12</td><td>21.79</td><td>20</td><td>1.51</td></tr>
<tr><td>10</td><td>23.11</td><td>16</td><td>0.51</td></tr>
<tr><td><10</td><td>31.01</td><td><16</td><td>2.21</td></tr>
<tr><td>Total</td><td>92.87</td><td></td><td>7.13</td></tr>
</table></td><td>6 marks</td></tr>
<tr><td>4B.</td><td>A longitudinal channel with a trapezoidal cross section is to be constructed in a cut section. The soil is clay, with Manning's Rugosity Coefficient of 0.024. The max. allowable velocity is 0.6m/sec. Design the channel for the discharge of 3m^3/sec. The bottom width of the channel can be taken as 4.57m. The side slope of the channel is 1.0 vertical to 2.0 horizontal.</td><td>4 marks</td></tr>
<tr><td>5A.</td><td>Explain the Level of service (LOS) concept while deciding the design capacity of a road?</td><td>5 marks</td></tr>
<tr><td>5B.</td><td>Determine: a) The upper and lower values of speed limits for regulation of mixed traffic flow and b) The design speed for checking the geometric design elements of the highway.
<table>
<tr><th>Speed group (kmph)</th><th>No. of vehicles</th></tr>
<tr><td>0 to 10</td><td>45</td></tr>
<tr><td>10 to 20</td><td>69</td></tr>
<tr><td>20 to 30</td><td>168</td></tr>
<tr><td>30 to 40</td><td>189</td></tr>
<tr><td>40 to 50</td><td>444</td></tr>
<tr><td>50 to 60</td><td>500</td></tr>
<tr><td>60 to 70</td><td>200</td></tr>
<tr><td>70 to 80</td><td>187</td></tr>
<tr><td>80 to 90</td><td>169</td></tr>
<tr><td>90 to 100</td><td>89</td></tr>
</table></td><td>5 marks</td></tr>
</table>