Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

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A Constituent Institution of Manipal University

V SEMESTER B.TECH. (CIVIL ENGINEERING)

END SEMESTER EXAMINATIONS, NOV/DEC 2016

SUBJECT: HIGHWAY ENGINEERING [CIE 3104]

REVISED CREDIT SYSTEM

(/ /2016)

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitably assumed.
- Code books are note allowed only the design charts and tables are permitted

1A.	Explain maximum and minimum super-elevation.	**3MARKS**	**CO3**
1B.	A radius of 250m has to be provided at a locality due to site restrictions in a NH on plain terrain. Design the super-elevation. Should there be restriction in speed?	**3MARKS**	**CO3**
1C.	The overtaking sight distance required on a highway is 250m. Find the required clearance of obstruction from center line of a circular curve of radius 350m and length 180m. Assume two lane highway.	**4MARKS**	**CO3**
2A.	Calculate the length of transition curve for a design speed of 80kmph at horizontal curve of radius 300m in a rural area. Assume suitable data.	**5MARKS**	**CO3**
2B.	Discuss the importance of gross wheel load and contact pressure in stress distribution pattern and in pavement design. Illustrate with stress distribution diagram.	**5MARKS**	**CO4**
3A.	What is warping? With a neat sketch explain briefly the stress induced due to warping of slab during the day and night.	**5MARKS**	**CO4**
3B.	The design thickness of a rigid pavement is 30cm considering the 98^{th} percentile load of 12,000kg on a single axle and M-40 concrete, design the dowel bar. Use the following data: Elastic modulus of dowel bar steel is $2X10^6$ kg/cm^2, modulus of dowel-concrete interaction is 41,000kg/cm^3, joint width is 1.8cm, modulus of subgrade reaction is 30kg/cm^2/cm, modulus of elasticity of concrete is $3X10^5$ kg/cm^2 and Poisson's ratio is 0.15.	**5MARKS**	**CO4**
4A.	With a neat sketch describe the concept of level of service.	**5MARKS**	**CO2**
4B.	The maximum quantity of water to be discharged by two side drains on a highway section is 1.4 m^3/sec. design the side drains for the following conditions: Silty loam soil with maximum permissible velocity of flow = 0.8m/sec and roughness coeff. = 0.03.	**5MARKS**	**CO4**
5A.	Explain the various stages of preliminary survey.	**5MARKS**	**CO1**
5B.	Compare the annual costs of a 2-lane highway per km for two types of pavement structures:	**5MARKS**	**CO5**

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Description	WBM with thin bituminous surface	WMM base with WBM binder course and bituminous concrete surface
Total cost	Rs.135 lakhs per km	Rs.220 per km
Life	5 years	15 years
Interest	10%	8%
Salvage value	Rs.20lakhs after 5 years	Rs.55 lakhs after 15 years
Annual avg. maintenance cost per km	Rs.0.45 lakhs	Rs.0.90 lakhs