NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
FACULTY OF ENGINEERING
DEPARTMENT OF CIVIL AND WATER ENGINEERING
TRANSPORTATION ENGINEERING II
TCW 3208

Main Examination Paper

March 2025

This examination paper consists of **4** pages

Time Allowed:	3 Hours
Total Marks:	100
Examiner's Name:	M. ZHOU

INSTRUCTIONS

1. Answer any **FOUR** Questions of your choice. All questions carry equal marks.
2. Use of calculators is permissible.
3. Supplementary information is provided at the end of the Examination Paper. Candidates are advised to make reasonable assumptions where the given information appears inadequate.
4. Illustrate your answers with clearly well-labelled sketches where applicable.

MARK ALLOCATION

QUESTION	MARKS
1.	25
2.	25
3.	25
4.	25
5.	25

QUESTION 1

a) In the process of selecting a suitable railway track alignment, discuss the factors influencing the choice of a particular alignment. **[7 marks]**

b) Describe in brief any four (4) basic requirements of a good railway track alignment. **[8 marks]**

c) List the various engineering surveys that need to be undertaken for the construction of a new railway line and outline their essential objectives. **[10 marks]**

QUESTION 2

a) With the aid of a neat sketch, illustrate the principle of 'coning of wheels'. Explain the necessity and effects of the coning of wheels. **[6 marks]**

b) Rail expansion joints are subject to operational deterioration due to creep. Define the following and explain how they contribute to creep development in rails.

Wave Motion Theory

Percussion Theory

Drag Theory **[9 marks]**

c) Outline any 4 ways of detecting creep in rails and briefly discuss the possible ways of adjusting the creep that occurs on an operational track. **[10 marks]**

QUESTION 3

a) Briefly discuss the principle of equilibrium superelevation and why it is necessary to provide superelevation on a curved alignment of a railway track. **[5 marks]**

b) Determine the superelevation and the maximum permissible speed for a 2° BG transitioned curve on a high-speed route with a maximum sanctioned speed of

110km/h. The speed for calculating the equilibrium superelevation as decided by the Chief Engineer is 80km/h and the booked speed of goods trains is 50km/h.**[10 marks]**

c) Calculate the maximum permissible train load that can be pulled by a locomotive with four pairs of driving wheels having an axle load of 28.42t each on a BG track with a ruling gradient of 1 in 200 and a maximum curvature of 3°, travelling at a speed of 48.3km/h. Assume the coefficient of friction to be 0.2. **[10 marks]**

QUESTION 4

a) Briefly explain the importance of grade compensation and gauge widening on horizontal curves. **[8 marks]**

b) To what extent should a ruling gradient of 1 in 150 on a broad gauge line be downgraded to accommodate a 3° curve? **[7 marks]**

a) Determine the total widened gauge on a board gauge track along a 5° curve given that the wheel base of the vehicle is 6m, wheel diameter of 1.524m and the depth of the flange below the top of the rail is 32mm. **[10 marks]**

QUESTION 5

a) 'Level crossings are potential accident sites'. Comment. **[5 marks]**

b) Derailments are the most common of all the various types of railway accidents. Discuss the two (2) main types of derailments and their probable causes.**[10 marks]**

c) Discuss the different train resistances that a locomotive has to overcome in hauling a train under adverse circumstances. **[10 marks]**

EQUATIONS

$$e = \frac{GV^2}{127R}$$

$$e = (\frac{V}{10})^2 \; x \; \frac{D}{13}$$

$$V = 0.347\sqrt{(C_a + C_d)R}$$

$$V = 0.27 \sqrt{(C_a + C_d) R}$$

$$V = 3.65 \sqrt{R - 6}$$

$$R_1 = 0.0016W$$

$$R_2 = 0.00008WV$$

$$R_3 = 0.0000006WV^2$$

$$R_4 = W(\%ge \; slope/100)$$

$$R_5 = 0.0004WD$$

$$R_{6start} = 0.15W_1 + 0.005W_2$$

$$R_{6acc} = 0.028aW$$

$$L = 0.02\sqrt{h^2 + Dh}$$

$$w = \frac{13(B+L)^2}{R}$$

$$L = RQ$$

$$L = 0.008C_a \; X \; V_m = \frac{C_a \; X \; C_d}{125}$$

$$L = 0.008C_d \; X \; V_m = \frac{C_d \; X \; V_m}{125}$$

$$L = 0.72C_a$$