

**NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY**

**DEPARTMENT OF CIVIL & WATER ENGINEERING**

**FACULTY OF INDUSTRIAL TECHNOLOGY**

**BACHELOR OF ENGINEERING (HONOURS) DEGREE**

**PART III SUPPLEMENTARY EXAMINATION – AUGUST 2014**

**TRANSPORTATION ENGINEERING & PLANNING II – TCW 3202**

**INSTRUCTIONS:**

**Time allowed: 3 hours**

**Answer FOUR questions. All questions carry 25 marks each.**

**QUESTION 1**

- a) Briefly describe the operation of two **fail-safe** types of signalling  
**(6 marks)**
- b) Using sketches where appropriate, illustrate the principle of negative superelevation and give an example of its application **(10 marks)**
- c) With the aid of a neat sketch, illustrate the principle of ‘coning of wheels’ and explain the need for the flange of the wheel to be clear of the running rail.  
**(9 marks)**

**Question 2**

- a) On a track section 15, 22, 8 and 5 trains run at respective speeds of 55, 65, 72 and 80km/h. If the curvature of the track is 2 degrees and the gauge is broad ( $G = 1.676\text{m}$ ), calculate the equilibrium speed, equilibrium superelevation and cant deficiency.  
**(25 marks)**

### Question 3

Calculate the following elements required to set out a 1 in 10 turnout taking off from a Broad Gauge (BG) track from the toe of the switch and tangential to the gauge face and passing through the Theoretical Nose of Crossing (TNC):  
(express your answers in mm)

- Curve Lead (CL)
- Outer Radius ( $R_o$ )
- Radius of turnout (R)
- Switch Lead (SL)

Data: CL = 2GN

N =  $\cot \phi$

BG = 1.676m

The Heel Divergence (d) = 11.4cm

**(25 marks)**

#### **QUESTION 4**

- a) What are the aims and objectives of the International Civil Aviation Organisation (ICAO)?  
**(5 marks)**
- b) Describe the responsibilities and functions of the Civil Aviation of Zimbabwe (CAAZ)  
**(8 marks)**
- c) Each runway should have at least one exit taxiway.
- i. What does the term 'exit taxiway' refer to and what is the function of an exit taxiway?  
**(2 marks)**
  - ii. List the four layouts of exit taxiways  
**(4 marks)**
- d) Describe the runway threshold markings  
**(6 marks)**

#### **QUESTION 5**

- c) You have been given the task of designing the runway length for a proposed airport in Gwanda. Define the critical aircraft for the design of an airport runway length?  
**(2 marks)**
- d) ICAO specifications for Field Runway Length specify 'Declared Distances' as TORA, TODA, ASDA and LDA. What does TORA, TODA, ASDA and LDA stand for and what is the relationship between each declared distance?  
**(7 marks)**
- e) With the aid of neat sketches, explain and show the ICAO specifications for Field Runway Length, the 'Declared Distances' which are TORA, TODA, ASDA and LDA, for the following cases
- i) when a runway is not provided with either a clearway or stopway, and with no displaced threshold
  - ii) when runway is provided with a clearway and with no displaced threshold
  - iii) when runway is provided with a stopway and a displaced threshold
  - iv) when runway is provided with a clearway, stopway and a displaced threshold  
**(16 marks)**

### **QUESTION 6**

a) You have been tasked with designing a proposed aerodrome in Mutoko.

i) What are the basic runway configurations you can consider?

**(4 marks)**

ii) Calculate the runway length that should be provided at the proposed aerodrome in Mutoko given the following data:

1. Runway length required for landing at sea level in standard atmospheric conditions = 2100m
2. Runway length required for take-off at a level site at sea level in standard atmospheric conditions = 2500m
3. Aerodrome elevation = 900m
4. Aerodrome reference temperature = 24°C
5. Temperature in the standard atmosphere at 900m elevation = 14.025°C
6. Runway slope = 0.5%
7. Temperature correction increase rate = 1% for every 1°C rise in aerodrome reference temperature above temperature in the standard atmosphere for the aerodrome elevation
8. Gradient correction ( increase rate = 20% for each 1% of effective gradient), (where the basic length determined by take-off requirements is 900m or over, increase rate = 10% for each 1% of the runway slope)
9. Elevation correction increase rate = 7% per 300m rise above sea level

**(15 marks)**

iii) List six specific lighting systems you would install at the proposed aerodrome in Mutoko.

**(6 marks)**

THE END