FINAL EXAMINATION
AUTUMN SESSION 2004

SCHOOL of ENGINEERING & INDUSTRIAL DESIGN

Student Name: 
Student Number: 
Course: Bachelor of Engineering (……………………..)

Unit Name: Surveying for Engineers
Unit Number: 85003
Time Allowed: Three (3) hour/s plus ten (10) minutes reading time.
Number of Questions: 4
Total Number of Pages: 4
Lecturer’s Name: Phil Ronaldson

INSTRUCTIONS
PLEASE READ CAREFULLY BEFORE PROCEEDING

1. Write your name and student number on the top of this examination paper and on each answer booklet that you use.
2. This is a CLOSED book examination.
3. B.Eng. (Civil) should answer questions 1, 2 & 3 in the Answer Booklet provided
4. B.Eng. (Building) should answer questions 1, 2 & 4 in the Answer Booklet provided
5. The value of each question is stated beside it.
6. Non-programmable calculators are allowed

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Notes for Candidates

$$y = \frac{p^{n} + q^{n}}{4A} x^3$$

where \( p \) is the incoming gradient and \( q \) is the outgoing gradient,
\( A \) is half the length of the chord from the start to the finish of the curve
\( y \) is the offset from the chord to the design surface
\( x \) is the distance along the chord from the incoming tangent

$$2A = \left(P^{n} + q^{n}\right) \cdot \frac{v^2}{100 \cdot f}$$

where \( v \) is the velocity of the vehicle
\( f \) is the centrifugal acceleration
\( A \) is the half length of the curve

$$y = \sqrt{(R^2 - x^2)} - R \cdot \cos\left(\frac{\theta}{2}\right)$$

where \( y \) is the offset from the main chord of the circular curve
\( x \) is the distance along the chord, with \( x = 0 \) at the midpoint.

$$\delta = \frac{\text{short arc}}{L} \cdot \frac{\theta}{2}$$

where \( L \) is the length of the circular curve

\[ \text{short chord} = 2R \cdot \sin \delta \]

\[ L = \frac{3 \cdot v^2}{R} \]

where \( L \) is the length of the transition curve in metres,
\( v \) is the velocity in m/sec,
\( R \) is the radius of the circular curve in metres.
\( 3 \) is a constant related to the radial acceleration in \( \text{sec}^2/\text{m} \)

Shift \( S = \frac{L^2}{24R} \)

where \( L \) is the length of the transition curve and
\( R \) is the radius of the circular curve

\[ IT = (R + S) \cdot \tan\left(\frac{\theta}{2}\right) + \frac{L}{2} \]

where \( IT \) is the distance from the intersection point to the transition tangent
\( \theta \) is the deflection angle
\( L \) is the length of the transition curve
\( R \) is the radius of the circular curve, and
\( S \) is the shift in position of the circular curve after introduction of the transition
Notes for Candidates (cont’d)

\[ \delta_t = \left( \frac{32}{R} \right) \left( \frac{\lambda^2}{Rl} \right) \text{ degrees of arc} \]

where
- \( \delta_t \) is the transition curve deflection angle from the tangent
- \( \lambda \) is the distance along the transition from the tangent
- \( l \) is the length of the transition
- \( R \) is the radius of the circular curve

\[ \delta_c = 28.65 \cdot \frac{c}{R} \text{ degrees} \]

where
- \( \delta_c \) is the deflection angle on the circular curve
- \( c \) is the circular arc chord length

\[ L_{arc} = R(\theta - 2\Phi) \cdot \frac{\pi}{180} \]

where
- \( L_{arc} \) is the length of the circular arc between transition curves
- \( R \) is the radius of the circular curve
- \( \theta \) is the angle of intersection
- \( \Phi \) is the angle subtended by the transition curve at the centre of the circular curve
1. Establish the setting out table of a circular curve, using offsets from the chord at intervals of 50 metres, where:
   i) The chainage of the intersection point (I) is 2,687.25 m
   ii) The radius of the circular curve is 560 m
   iii) The angle of intersection at I is 67° 40'

(30 marks)

2. Establish the setting out table for a vertical curve where:
   a. the chainage of the intersection point (crest) is 3,542.65
   b. the gradient of the incoming (left-hand side) slope is +4.0%
   c. the gradient of the outgoing (right-hand side) slope is -5.6%
   d. the design speed is 110 kmph

(30 marks)

3. To be answered by Civil Engineering students only

Develop the setting out tables for incoming and outgoing transition curves and intermediate circular curve to fit between an incoming straight at 53° 20' and an outgoing straight at 135° 40' 00", where:
   i) the radius of the circular curve is to be 580 metres
   ii) the design speed is 110 kmph
   iii) the chainage of the intersection point is 1,289.35 m

Note: use \[ L = \frac{3L^3}{R} \]

(40 marks)

4. To be answered by Building Engineering students only

a) Describe in detail the survey components of the construction of a highrise commercial building in the centre of a city. Assume that your involvement is from the stage of conceptual design before acquisition of the site on which stands a medium-rise commercial building.

b) Comment on any differences that would be necessary if the proposed building was to be a residential building.

(40 marks)

THIS IS THE END OF THE EXAM PAPER