

**NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY**  
**DEPARTMENT OF CIVIL AND WATER ENGINEERING**  
**BACHELOR OF ENGINEERING ( HONOURS ) DEGREE**  
**PART II SECOND SEMESTER EXAMINATION – MAY 2014**  
**ENGINEERING SURVEY II TCW 2204**

**INSTRUCTIONS**

Answer any four questions

Time : 3hrs.

Total marks : 100

**QUESTION 1**

- ( a ) Explain the concept of working from the known to the unknown in survey. **( 3 marks)**
- ( b ) What do you understand by working from the whole to the part in survey. **(3 marks)**
- ( c ) List any three methods of transferring control points to a construction site. **( 3 marks)**
- ( d ) Sketch four types of triangulation schemes used in surveying. **( 4 marks)**
- ( e ) What do you understand by face left and face right readings . **( 4 marks)**
- ( f ) What are the geometrical relationships that must be fulfilled by the axes of good working theodolite **( 4 marks)**
- (g) List any four permanent adjustments of a theodolite. **(4 marks)**
- ( 25 marks)**

## **QUESTION 2**

Fig. 2 shows a triangulation scheme . Given the following information

Coordinates ( m )

P + 516,113                      + 1 015,432

Q + 640,227                      + 1 444,251

S + 973,096                      + 1 396,215

Observed horizontal angles

PQR =  $55^{\circ} 46' 10''$

QRP =  $71^{\circ} 15' 55''$

QPR =  $52^{\circ} 57' 55''$

SRT =  $73^{\circ} 55' 00''$

RST =  $330 13' 00''$

Calculate the coordinates of R and T.

**( 25 marks)**

## **QUESTION 3**

Fig. 3 shows a braced quadrilateral .

Given the following observed horizontal angles:

Angle	Observed value
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1	$28^{\circ} 36' 49''$
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2	$50^{\circ} 08' 26''$
---	-----------------------

3	$44^{\circ} 18' 09''$
---	-----------------------

4	$56^{\circ} 56' 34''$
---	-----------------------

5	$47^{\circ} 43' 05''$
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**QUESTION 3 continued**

Angle	Observed value
6	31° 01' 58"
7	60° 40' 19"
8	40° 34' 38"

Adjust the observed horizontal angles for geometrical consistency . **( 25 marks)**

**QUESTION 4**

Two railway curves , one the reverse of the other are to be joined by a straight length of track as shown in fig.4. Given :

Coordinates ( m)		Radius ( m)
A -1 103,690	-138,650	450
B -742,120	-988,370	300

Calculate the coordinates of T1 and T<sub>2</sub> and length T<sub>1</sub> – T<sub>2</sub> . **( 25 marks)**

**QUESTION 5**

AB , BC and CD are three lengths of straight piping. It is proposed to build a circular dam so that the pipes will be tangential to the dam at points E , F and G.

Given :

Coordinates ( m )	
B -178,760	-79,340
C -108,39	-207,97

**QUESTION 5 continued**

Bearings

$$B - A = 294^{\circ} 58' 00''$$

$$C - D = 234^{\circ} 24' 00''$$

Calculate the radius of the dam. **( 25 marks)**

**QUESTION 6**

( a ) Explain the following terms associated with vertical curves :

(i) stopping sight distance( SSD) **( 6 marks)**

(ii) full overtaking sight distance ( FOSD) **( 3 marks)**

(iii) crest curve **( 3 marks)**

( iv ) sag curve **( 2 marks)**

(b) A parabolic vertical curve is to connect a -2,5% gradient to a +3,5% gradient on a high way designed for a speed of 100km/hr as show in fig. 6. The K-value for the highway is 26 and the minimum required length is to be used. The reduced level and through chainage of the intersection point of the gradients are 1000,000m and 617,490 respectively and in order to meet particular site conditions the through chainage of the entry tangent point is to be 553,170m;

Calculate

(i) the reduced levels of the tangent points **( 4 marks)**

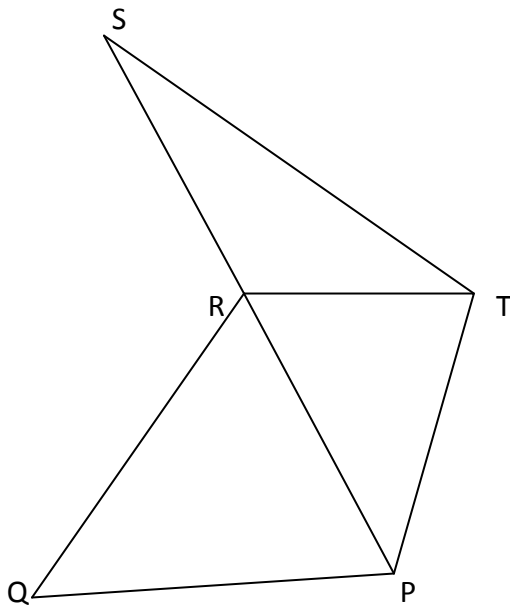
(ii) the tangent lengths ( L1 and L2 ) **(4 marks)**

(iii) gradient BCD. **( 3 marks)**

**( 25 marks)**

**DIAGRAMS**

**Fig.2**



**Fig.3**

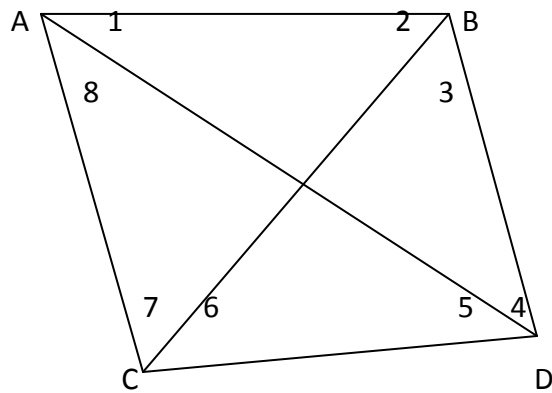


Fig.4

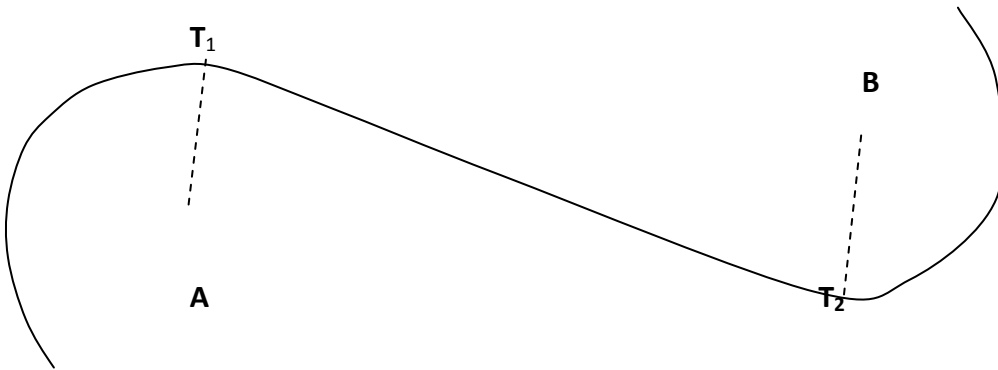
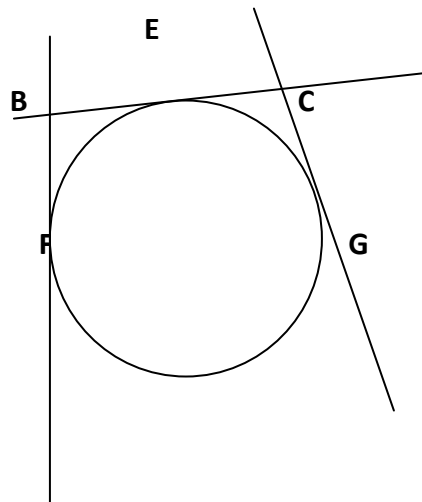
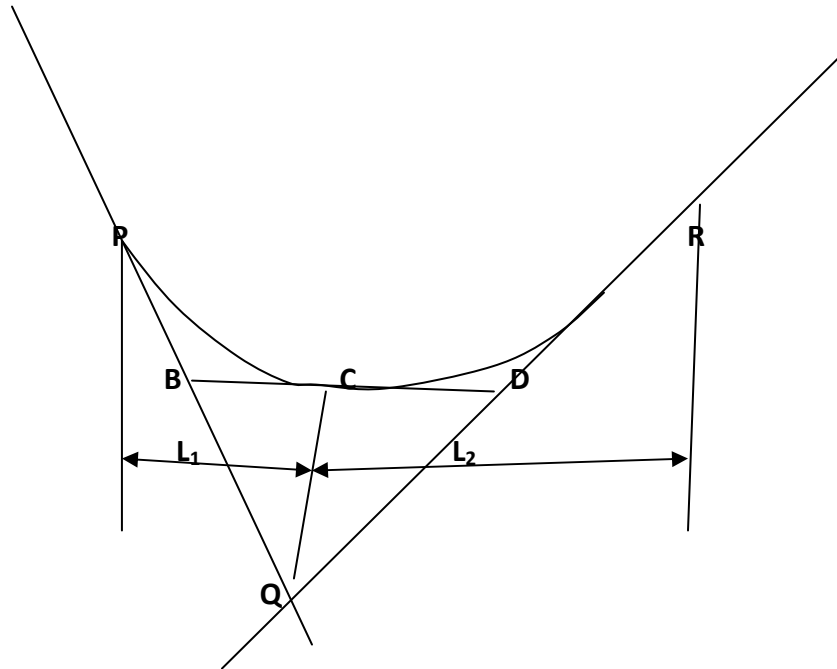


Fig.5



**Fig.6**



**List of formulae**

$$A = (-m) - (+n)$$

$$\min L_v = K \cdot A$$

$$RL = RL + \frac{\pm m \times \text{tangent length}}{100}$$

$$\text{Gradient} = \frac{-n L_1 + (+m) L_2}{L_v}$$