GWANDA STATE UNIVERSITY

FACULTY OF ENGINEERING AND ENVIRONMENT

DEPARTMENT OF GEOMATICS AND SURVEYING

Adjustment of Surveying Measurements

EGS 5204

Final Examination Paper

This examination paper consists of 4 pages

Time Allowed : 3 hours

Total Marks : 100

Examiner's Name : Mr. J B MANYATI

INSTRUCTIONS

1. Answer ALL 5 questions
2. Each question carries 20 marks
3. Use of calculators is permissible, but programmable calculators are not allowed in the exam

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1	(a)		What fundamental condition is enforced by the method of the weighted least squares?	[2]
	(b)		What are the advantages of the method of least squares over other methods of adjustment?	[3]
	(c)		Three horizontal angles were observed around the horizon of station A. Their values are 165.07.54, 160.25.36 and 34.26.36.	
		(i)	Assuming equal weighting, what are the most probable values for the three angles?	[6]
		(ii)	What are the standard deviations of the adjusted values?	[3]
		(iii)	The standard deviations of the three angles are ±1.5 seconds, ±3.0 seconds and ±4.9 seconds, respectively. What are the most probable values for the three angles?	[6]
2	(a)		With reference to survey measurements and observations, what is meant by the following terms:	
		(i)	Precision and relative precision	[1]
		(ii)	Internal reliability and external reliability	[1]
		(iii)	Parts per million	[1]
	(b)		Write brief notes on the application and relationship of the following models in designing of geodetic networks:	
		(i)	Stochastic model	[4]
		(ii)	Functional model	[4]
		(iii)	Mathematical model	[3]
	(c)		If a certain EDM instrument has an accuracy capability of ±(1 mm + 2 ppm),what is the precision of measurements , in terms parts-per-million, for the lengths of:	
		(i)	30.000 m	[2]
		(ii)	300.000 m	[2]
		(iii)	3000.000 m	[2]
3	(a)		The mean square error(M^2) is defined by	
			$$M^2 = E[(X-t)]^2$$ Where t is the true value, Given the Bias (β) as $\beta = \mu - t$ Show that $M^2 = \delta^2 + \beta^2$	[5]
	(b)		An angle is measured 16 times with a theodolite the measured values are:	

1	52.35.24	**5**	52.35.25	**9**	52.35.24	**13**	52.35.29
2	52.35.28	**6**	52.35.29	**10**	52.35.29	**14**	52.35.26
3	52.35.22	**7**	52.35.18	**11**	52.35.35	**15**	52.35.30
4	52.35.20	**8**	52.35.26	**12**	52.35.31	**16**	52.35.31

It is suspected that the instrument was disturbed between the 8th and 9th measurement. Construct a 90 % confidence interval for the means for the first 8 and last 8 measurements.
Is there evidence that the theodolite was disturbed? [10]

	(c)		Given the following inverse matrix and a standard deviation of unit weight of 1.45, determine the parameters of the error ellipse. $(A^TWA)^{-1} = \begin{bmatrix} q_{xx} & q_{xy} \\ q_{xy} & q_{yy} \end{bmatrix} = \begin{bmatrix} 0.0004894 & 0.0000890 \\ 0.0000890 & 0.0002457 \end{bmatrix}$	[3]
			Compute S_X and S_Y	[2]
4			The use of Lagrange multiplies in the expression; $E = V^TG^{-1}V - 2k^T[AV + B\Delta - f]$ Can lead to a unique solution of the combined (general) least squares case.	
		(i)	Prove that a solution may be found from $\Delta = N^{-1}t$ Where; $N = B^TG_e^{-1}B$ $t = B^TG_e^{-1}f$ Δ is vector of unknown parameters B is matrix of known coefficients G_e is the cofactor matrix for equivalent observations f is the vector of constants	[8]
		(ii)	Give an expression that can be used for $\bar{l}$,the vector of adjusted observations.	[2]
		(iii)	Show that $G_{ll} = G - G_{vv}$	[10]
5			Two uncorrelated measurements l_1 and l_2 with variances 0.5 and 2 respectively are represented by the following linear conditions (conditions and constraints). $\begin{bmatrix} v_1 \\ v_2 \end{bmatrix} + \begin{bmatrix} -3 & 1 & -1 \\ 1 & -4 & -2 \end{bmatrix}\begin{bmatrix} X \\ Y \\ Z \end{bmatrix} = \begin{bmatrix} 2 \\ 18 \end{bmatrix}$ $\begin{bmatrix} -1 & 1 & 1 \\ 1 & -3 & 1 \end{bmatrix}\begin{bmatrix} X \\ Y \\ Z \end{bmatrix} = \begin{bmatrix} 2 \\ 26 \end{bmatrix}$	
		(i)	Evaluate least square values of $\overline{l_1}$ and $\overline{l_2}$.	[8]
		(ii)	Evaluate variance and covariance matrix $\overline{l_1}$ and $\overline{l_2}$.	[12]

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