FACULTY OF EXPLORATION AND EARTH SCIENCES

BACHELOR OF ENGINEERING DEGREE IN GEOMATICS AND SURVEYING

PHYSICAL GEODESY

MODULE CODE: EGS 2108

FINAL EXAMINATIONS: SEPTEMBER/ OCTOBER 2023

DURATION : 3 HOURS

TOTAL MARKS : 100

EXAMINER : O. MUROMO

INSTRUCTIONS

1. Answer **ALL** questions
2. Scientific calculators may be used
3. Modified Clarke 1880 Constants:

Semi- Major axis,	a= 6378 249.145326m
Semi- Minor axis,	b= 6356 514.966721m
Flattening f=(a-b)/a,	f =1/293.466307656
First Numerical eccentricity $e^2=(a^2- b^2)/ a^2$,	e^2=0.006803481018883
Second numerical eccentricity $e'^2=(a^2- b^2)/ b^2$,	e'^2=0.006850085445147

1			**HISTORICAL DEVELOPMENT OF GEODESY (TOTAL 25 MARKS)**	
	a)		Describe and explain the following observation techniques in geodesy:	
		(i)	Astronomical measurement techniques	3
		(ii)	Terrestrial measurement techniques	3
		(iii)	Space measurement techniques	3
	b)		From the fundamental definitions, derive the following;	
			$e^2 = 2f - f^2$	4
			$e^2 = \frac{e'^2}{1+e'^2}$	5
	c)		With the aid of well annotated diagrams, define the following:	
		(i)	The Sphere	3
		(ii)	The Geoid	4
2			**GEOMETRY OF AN ELLIPSE (TOTAL 25 MARKS)**	
	a)		Describe three modern ways of determining global best fit ellipsoids	5
	b)		A point P on the Modified Clarke 1880 ellipsoid and at Latitude of 76˚34′15″ north and Longitude of 67˚43′51″ east, calculate the following:	
		(i)	Radius of curvature in the Meridian	3
		(ii)	Radius of curvature in the Prime Vertical	3
		(iii)	Gaussian Mean Radius of curvature	4
		(iii)	Radius of curvature in the direction 56˚23′19″	5
		(iv)	The length of arc from a Latitude of 87˚55′52″	5
3			**GEODETIC PROBLEMS (TOTAL 25 MARKS)**	
	a)	(i)	Advise a topographical Surveyor in what circumstances to use the Gauss Mid latitude formular	5
		(ii)	Differentiate between the direct and inverse problems for the Bowring formular. Include illustrations	5

	b)		Using the data given below, compute good approximate coordinates for 161/P and the reverse azimuth using the Bowring formula 160/P $\phi = 17^\circ 36' 37''$ $\lambda = 31^\circ 10' 25''$ 160/P – 161/P $\alpha = 222^\circ 31' 56''$ s = 13547.934m	15
4			**COORDINATE SYSTEMS AND COORDINATE TRANSFORMATIONS (TOTAL 25 MARKS)**	
	a)		With the aid of well annotated diagrams, describe and explain the following coordinate systems:	
		(i)	Space-Fixed Coordinate Systems	5
		(ii)	Earth-Fixed coordinate Systems	5
		(iii)	Topocentric coordinate Systems	5
	b)		Given the following: $\phi = 17^\circ 46' 50''$, $\lambda = 31^\circ 02' 57''$, h= 1530.65m Transform these to X, Y, Z (Use the given values for Modified Clarke 1880)	10

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