FACULTY OF ENGINEERING AND THE ENVIRONMENT

BACHELOR OF SCIENCE (HONORS) DEGREE IN GEOMATICS AND SURVEYING

PHYSICAL GEODESY

MODULE CODE: ESG 2108

SEASONAL EXAMINATIONS NOVEMBER 2024

DURATION: 3 HOURS

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			**INTRODUCTION TO PHYSICAL GEODESY (TOTAL 25 MARKS)**	
	a)		Explain the **THREE** basic observation techniques that are used in Geodesy	**7**
	b)	(i)	With the aid of a well-annotated diagram, describe the geometry of the sphere	**5**
		(ii)	From the geometric relationships on the sphere, Prove that the surface area of a zone between latitudes, S= πR^2 $(sin\varphi_1 - \varphi_2)$	**6**
		(iii)	Find the surface area for a portion of the earth defined by 30^0 N, 50^0 N, 70^0 W and 120^0 W. Assume a mean radius of the earth of 6 370 000. 00m	**7**
2			**GEODETIC REFERNCE SYSTEMS (TOTAL 25 MARKS)**	
	a)		Explain how Global Navigation Satellite Systems (GNSS) interact with geodetic reference systems.	5
	b)		Explain the concept of a reference ellipsoid and how different reference ellipsoids affect geodetic measurements.	**6**
	c)		Discuss the role of the International Terrestrial Reference Frame (ITRF) in global geodesy.	**5**
	d)		You are tasked with monitoring ground deformation in an earthquake-prone region. Geodetic measurements are collected using both local and global reference systems.	
		(i)	Discuss how you would handle the coordinate transformation of these measurements.	**6**
		(ii)	What factors would you consider to ensure the accuracy of the data used in your analysis?	**3**
3			**GEODETIC DATUMS AND CONTROL NETWORKS (TOTAL 25 MARKS)**	

	a)	(i)	Define a geodetic datum	2
		(ii)	Explain the significance of a geodetic datum in geospatial applications.	**3**
		(iii)	Discuss how a datum affects the accuracy of spatial data.	4
		(iv)	Compare and contrast horizontal and vertical datums.	6
		(v)	Explain the concept of a geodetic control network including how it is established, its roles in surveying and geodesy.	10
4			**GEODETIC PROBLEMS (TOTAL 25 MARKS)**	
	a)		Given that the geodetic latitude of a station HILL is 21˚35'44,3" on the Clarke 1880 Ellipsoid, compute the geocentric latitude of the same point, after deriving the expression relating the geodetic to the geocentric latitude	10
	b)		Using the data given below, compute good approximate coordinates for 161/P and the reverse azimuth using the Bowring formula 160/P $\varphi = 17^0\,36'\,37''$ $\lambda = 31^0\,10'\,25''$ 160/P- 161/P $\alpha = 222^0\,31'\,56''$ $s = 13547.934$m Use Modified Clarke 1880 ellipsoid constants	15

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