

October 2024

Marks

<u>Value</u>	<u>Earned</u>
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1.	With several applications in geodetic positioning requiring different observations and utilizing different equipment, it is inevitable to work with different coordinate systems including local and global ones. This also involves performing different coordinate transformations among these systems. a) What is meant by local and global geodetic coordinate systems? In your explanation, include the origin, axes, associated coordinates and the relationship between the two systems. b) List common local and global geodetic coordinate systems used by surveyors. c) To establish a geodetic baseline in an area that has only one available control station (station S) with known geodetic coordinates ($\varphi_S, \lambda_S, h_S$), a surveyor was tasked with the establishment of a new geodetic control station (station P) and obtaining its geodetic coordinates ($\varphi_P, \lambda_P, h_P$) in NAD83 (CSRS). With no access to GPS equipment, only a total station, the surveyor occupied station S with the total station and obtained the following: - zenith angle θ_P - slope distance d_{SP} - geodetic azimuth α_{SP}. Describe the detailed approach with equations how to compute the coordinates ($\varphi_P, \lambda_P, h_P$). In your approach, you can neglect the effect of the deflections of the vertical.	6 6 14	
2.	Astronomic observations are important in geodetic positioning and the related highly accurate applications. This is especially true for azimuth determination and the establishment of geodetic networks. Accurate time measurements are also implemented. a) Discuss the procedure of the observation and computation of astronomic azimuth using Polaris and the Sun. Explain the differences between observing Polaris and the Sun. Give the equation and explain its parameters. Indicate which parameters are known, observed, or unknown. b) What is the typical accuracy of the astronomic azimuth determination using the method you used in a) above? c) What are the main factors affecting such value and how can you improve it?	16 3 6	

3.	Depending on the application, either the 3D Cartesian geocentric coordinates (x, y, z) or the Ellipsoidal coordinates (ϕ , λ , h) are used. Hence, it is always a common practice to perform transformations between them.		
	a) Define each of the Ellipsoidal coordinates (ϕ , λ , h). Then, draw a figure of the ellipsoid, showing the (ϕ , λ , h) and the 3D Cartesian geocentric coordinates (x, y, z) of a single point.	8	
	b) Write down the equations to transform from Ellipsoidal coordinates (ϕ , λ , h) to 3D Cartesian geocentric coordinates (x, y, z). Explain all parameters used.	8	
	c) Write down the equations to transform from 3D Cartesian geocentric coordinates (x, y, z) to Ellipsoidal coordinates (ϕ , λ , h). Explain all parameters used and the implemented procedure.	8	
4.	One of the classic definitions of Geodesy was “ <i>Geodesy is the determination of the Earth’s gravity field potential function</i> ”. Another one was “ <i>Geodesy is the measurement and representation of the Earth and its gravity field</i> ”.		
	a) What is the relationship between the gravity potential and the gravity vector?	5	
	b) What are the components that constitute the Earth’s gravity vector? What causes each component? Which component is the largest? What are the locations on the Earth’s surface where each component has its smallest and largest value?	7	
	c) Define a level surface and discuss its properties in detail. Give examples of known level surfaces used in geodetic positioning and how each one was/is obtained.	7	
	d) How is the geopotential number defined? How are geopotential numbers used to obtain different types of heights? Which quantity (or parameter) will govern the obtained height type?	6	
	Total Marks:	100	