KATHMANDU UNIVERSITY
End Semester Examination[C]
July, 2017

JUL 12 • 2017

Level : B.E.
Year : III
Time : 2 hrs. 30 mins.

Course : GEOM 317
Semester : I
F. M. : 40

SECTION "B"

Average Radius of the Earth = *6371km*
Gravitational Constant = $6.67 * 10^{-11} Nm^2/kg^2$
Semi-major axis of GRS80, WGS84, ETRS89 Ellipsoid = *6378137.0 m*
Semi-major axis of EVS1830; OSGB36 Ellipsoid = *6377299.365 m; 6377563.396 m*
Inverse flattening of GRS80, ETRS89 Ellipsoid = *298.257222101*
Inverse flattening of EVS1830;ETRS89 = *300.80172554; 298.257222101*

Attempt *ALL* questions. Assume suitable data if necessary.

1. What do you mean by harmonic functions? Give an example of harmonic function other than gravitational potential. Show that gravitational potential is a harmonic function i.e.
$$\nabla^2 V = \frac{\partial^2 V}{\partial x^2} + \frac{\partial^2 V}{\partial y^2} + \frac{\partial^2 V}{\partial z^2} = 0$$ [1+1+3]

2. Derive an expression for the computation of length of normal terminating on major axis of a rotational ellipsoid. Finally use thus obtained expression for finding the length of normal terminating on major axis given the geocentric latitude(Ψ) on GRS80 ellipsoid is 60^0. [3+2]

3. What are the solutions of Laplace equation called? Solve for $\frac{\partial^2 f}{\partial x^2}$ in the Laplacian equation given as: $\nabla^2 f = \frac{\partial^2 f}{\partial x^2} + \frac{\partial^2 f}{\partial y^2} + \frac{\partial^2 f}{\partial z^2}$ in spherical coordinates. [1+4]

4. Show that the area of the ellipsoid surface 'A' between longitudes λ_1 and λ_2 and geodetic coordinates ϕ_1 and ϕ_2 is given by
$$A = b^2(\lambda_2 - \lambda_1) \int_{\phi_1}^{\phi_2} \frac{cos\phi d\phi}{(1 - e^2 sin^2\phi)^2}$$
where the symbols have their usual meaning in Geodesy. Also write the expression for computing the arc length on that reference ellipsoid surface. [4+1]

5. What do you mean by Geodesics? Starting with the semi-major axis and flattening for the **Geodetic Reference System GRS80** ellipsoid; Compute the different parameters on the given ellipsoid:
   a. Polar radius
   b. 3rd flattening
   c. W
   d. V where the symbols has usual meanings in physical Geodesy [1+4]

6. Write short notes on *ANY FIVE* of the following: [1×5 = 5]
   a. Legendre polynomial
   b. Vernal equinox
   c. Zonal Harmonics
   d. Flattening of Ellipse
   e. Celestial Poles
   f. Geocentric latitude

OR

Briefly explain the various method of measurement of gravity. What are the reasons behind the gravity corrections? [4+1]

7. Define coordinate transformation with clear figure. Derive an expression for the Bursa Wolf Transformation equation using Helmert Transformation equation. Use the Helmert transformation to transform ETRS89 coordinates to OSGB36 given the three translation, rotation and scale factors. **The source coordinate system of a point P in ETRS89 system is (3790644.900, -110149.210, 5111482.970) meter.** [1+2+2]

Parameters	*Estimated Values*
$t_x(m)$	-446.448
$t_y(m)$	+125.157
$t_z(m)$	-542.060
$r_x(sec)$	-0.1502
$r_y(sec)$	-0.2470
$r_z(sec)$	-0.8421
s (ppm)	+20.4894

where symbols have got usual meanings in Physical Geodesy.

OR

How do you transform the geodetic coordinates to rectangular/geocentric coordinate system and vice versa? Show with the mathematical expression.
The software for a GPS receiver gives positions in terms of geodetic latitude, longitude, and height above the ellipsoid GRS80 (the ellipsoid for WGS84). For $\varphi = 40^0$, $\lambda = -83^0$, and h = 200m, compute the equivalent geocentric coordinates(X,Y,Z) of the point. [2+3]

8. Mention two applications of least square adjustment technique in surveying.
The diagram below shows the level network of height differences observed between BM's707, 726, 727 and TBM X (shown as points A, B, C and X). The arrowson the diagramindicate the direction of rise. The table shows the heightdifference (in meters) for each line of the network and the distance (in meters) of each level run.Compute the most probable elevation values of X, B and C given the elevation of the first order BM at A is 1427.751m. Also find the residuals associated with them. [1+4]

Line	*Height Difference (m)*	*Distance (m)*
1	0.89650	99
2	0.10980	130
3	0.29355	215
4	1.18899	264
5	0.18418	365
6	1.00653	113