KATHMANDU UNIVERSITY
End Semester Examination
February/March, 2018

Marks Scored:

Level : B.E.
Year : III

Course : GEOM 317
Semester: I

Exam.Roll No.:

Time: 30 mins.

F.M. : 10

Registration No.:

Date FEB 2 6 2018

SECTION "A"

[20 Q ×0.5=10 marks]

Average Radius of the Earth$=6371\ km$
Gravitational Constant$=6.67\times10^{-11}\ Nm^2/kg^2$
Semi-major axis of WGS84 Ellipsoid $=6378137.0\ m$
Inverse flattering of WGS84 Ellipsoid$=298.257223663$
Inverse flattering of EVS1830 Ellipsoid$=300.80172554$

Choose the best alternative among the given choices. The symbols carry their usual meanings.

1. The geoidal height (N) is the distance between the goid and a reference ellipsoid, measured along an ellipsoidal normal. Mathematically N is given by:
   a. N= h +H b. N=h-H c. N=H-h d. N= h × H

2. Gravity (g) with altitude (h) is given by the formula:
   a. $g_h = g\left(\frac{R_e}{R_e+h}\right)^2$ b. $g_h = g\left(\frac{R_e}{R_e-h}\right)^2$
   c. $g_h = g\left(\frac{R_e+h}{R_e}\right)^2$ d. $g_h = g\left(\frac{R_e-h}{R_e}\right)^2$

3. Poisson Equation is given by the formula:
   a. $\Delta V = 4\pi G\rho$ b. $\Delta V = -4\pi G\rho$ c. $\Delta V = 2\pi G\rho$ d. $\Delta V = -2\pi G\rho$

4. The Legendre function $P_1(x)$ is equivalent to
   a. 0 b. 1 c. x d. x^2

5. ITRS stands for
   a. International Translation and Rotation Service
   b. International Terrestrial Rotation Service
   c. International Translation Reference System
   d. International Terrestrial Reference System

6. The function is said to be harmonic if
   a. Laplace Equation is equal to one
   b. Laplace Equation is equal to constant
   c. Laplace Equation is equal to zero
   d. Laplace Equation is equal to non-zero

7. The Centrifugal force is given by the formula:
   a. $F = mr\omega^2$ b. $F = mr\omega$ c. $F = -mr\omega^2$ d. $F = -mr\omega$

8. Which of the formulae is correct for an ellipse?
   a. $e = \sqrt{1 - b^2/a^2}$ b. $e = \sqrt{1 + b^2/a^2}$
   c. $e = \sqrt{1 - a^2/b^2}$ d. $e = \sqrt{1 + a^2/b^2}$

9. The Earth gravity potential (W) is related to its gravitational potential (V) and centrifugal potential (Q) as:
   a. W=V+Q b. W=V-Q c. W+V=Q d. W+Q=V

10. If the distance between two masses is increased by a factor 2 then the gravitational force of attraction between them will be
   a. Reduced by a factor of 2 b. Increased by a factor 2
   c. Remains same d. Reduced by a factor 4

11. a (1-f) is equal to:
   a. 1 b. e^2 c. e d. b

12. Polar radius of ellipsoid is given by the formula:
   a. a^2/b b. b2/a c. a/b d. b/a

13. The degree of freedom in Projectivity transformation is:
   a. 3 b. 4 c. 5 d. 6

14. A reference system is described by:
   a. Polar coordinate System
   b. Cartesian Coordinate System
   c. 3 dimensional coordinate System
   d. Spherical Coordinate System

15. For an elliposoid, $(1-e^2)(1+e^2)$ is equal to:
   a. 2 b. 1 c. a d. f

16. IERS stands for
   a. International Earth Rotation and Reference Systems Service
   b. International Earth Rotation Service Systems
   c. International Earth Rotation Station Systems
   d. International Earth Reference Service Systems

17. The number of parameters used in Similarity Transformation is equal to:
a. 1 b. 2 c. 3 d. 4

18. Which of the following is true for an oblate ellipsoid?
a. a =b > c b. a>b =c c. a=b=c d. a=b<c

19. If the distance between the Earth and a satellite is doubled, the value of Gravitational potential
a. Increased by 50 % to the previous value
b. Increased by 100 % to the previous value
c. Decreased by 100 % to the previous value
d. Decreased by 50 % to the previous value

20. ECEF coordinate System is a kind of:
a. Polar Coordinate System
b. Cartesian Coordinate System
c. Spherical Coordinate System
d. Geodetic Coordinate System

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SECTION "B"
(Short answer question)
[6 Q.×4=24 marks]

Attempt *ANY SIX* questions.

1. Derive the formula for the radius of curvature of ellipse. [4]

2. Solve the Smigliana's gravity formula in its simple form. [4]

$$\Gamma = \frac{b\gamma_p \sin^2\phi + a\gamma_e \cos^2\phi}{\sqrt{a^2\cos^2\phi + b^2\sin^2\phi}}$$

3. There is a point P located at the boundary of an ellipse whose distance is (r) from the origin. If the semi-latus rectum of the ellipse is given by (l) then derive the relation between r and l. [4]

4. Derive the formulae for relative gravity measurement using pendulum method. [4]

5. Given coordinates of a point in WGS72 is P (3657660, 255767, 3888951) meters, transform the point WGS84 coordinate system by using Busra-Wolf model. The transformation parameters from WGS72 to WGs84 are:
Tx=0.001m Ty=0.003m Tz= 0.002m, S=1, Rx=0°, Ry= -0.002°. Rz = 0.001° [4]

6. Solve the four Legendre functions for $P_0(x)$, $P_1(x)$, $P_2(x)$ and $P_3(x)$ [1+1+1+1]

7. State the Symmetric fall gravity experiment. Also derive the relation for symmetric fall gravity. [1+3]

SECTION "C"

(Long answer question)

[2 Q.×8=16 marks]

Attempt *ANY TWO* questions. The symbols carry their usual meanings.

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8. Prove that the gravitational potential satisfies the law of harmonic function. [8]

9. Prove that for the geometry of an ellipse is

$$W = \frac{a}{b}V \qquad [8]$$

10. Prove that the Legendre functions $P_n(x)$ and $P_n(y)$ are orthogonal where $m \neq n$. [8]