PHYSICAL GEODESY

ENGE 254

Lecture	**: 3**	**Year : II**
Tutorial	**: 0**	**Part : II**
Practical	**: 0**	

Course Objectives:

The objective of this course is to provide fundamental understanding of Earth's gravity systems and its rotation and revolution, which are essential for establishing coordinate systems, datum, and reference ellipsoids. It also introduces relative horizontal and vertical positioning systems, equipping students with the foundational knowledge necessary to navigate and apply geodetic concepts effectively.

1 Introduction (3 hours)

1.1 Geodesy and its types
1.2 Historical development of geodesy
1.3 Organization of geodesy; International collaboration
1.4 Geodesy in Nepal
1.5 Geodetic and gravimetric networks

2 Reference System and Reference Frame (6 hours)

2.1 Reference coordinate system
2.2 Rotation and reflection matrices
2.3 Transformation between systems with different origins and orientations
2.4 Transformation between local and global systems
2.5 International reference systems and reference frames
2.6 International earth rotation and reference system service

3 Gravity Field of the Earth (6 hours)

3.1 Gravity and gravity potential
3.2 Equipotential surfaces and plumb line
3.3 The geoid
3.4 Mean sea level and mean dynamic topography
3.5 Height systems used in geodesy
3.6 Geopotential number
3.7 Dynamic heights
3.8 Orthometric heights
3.9 Normal heights

4 Geodetic Astronomy and Time Systems (6 hours)

4.1 Celestial sphere
4.2 Horizon system
4.3 Right ascension system
4.4 Hour angle system
4.5 Ecliptic system
4.6 Transformations between celestial systems
4.7 Time and motion
4.8 Sidereal time
4.9 Universal (Solar) time
4.10 Conversion of time

5 Mathematical Concepts of Geodesy (6 hours)

5.1 Basic ellipsoidal geometry
5.2 The concept of a best-fitting ellipsoid
5.3 Common reference ellipsoids
5.4 Normal section
5.5 Ellipsoid-meridian and parallel arcs

6 Gravity Reduction and Gravity Field Determination (9 hours)

6.1 Residual gravity field
6.2 Fundamentals of gravity field modelling
6.3 Local and regional gravity field modelling
6.4 Gravity reduction to the geoid
6.5 Deflection of vertical and Laplace equation
6.6 Ellipsoid, geoid, and anomaly of the gravity
6.7 Correction due to the heights of the points
6.8 Free air anomaly
6.9 Boyger anomaly
6.10 Isotasy
6.11 Earth tide correction
6.12 Global gravity field modelling
6.13 Satellite gravity field modelling

7 Gravity Measurement Methods (6 hours)

7.1 Atmospheric, tropospheric and ionospheric refraction
7.2 Satellite observations
7.3 Direction, range, and range-rate (Doppler, DORIS) measurements
7.4 Laser distance measurement
7.5 Satellite gravity missions
7.6 Very long baseline interferometry
7.7 Gravimetry

7.8 Absolute and relative gravimeters
7.9 Quantum gravimetry
7.10 Gravity reference systems and gravity standard
7.11 Gravity gradiometry
7.12 Continuous gravity measurement

8 Geodesy Challenges and Future Perspectives (3 hours)

8.1 Challenges and goals
8.2 Scientific challenges and future perspectives
8.3 Technological development of observing systems
8.4 Methodology, analysis and modelling
8.5 Data products and applications
8.6 Way forward and Nepalese context

Final Exam

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapters	Hours	Marks distribution*
1 and 8	6	8
2	6	8
3	6	8
4	6	8
5	6	8
6	9	12
7	6	8
Total	**45**	**60**

* There may be minor deviation in marks distribution.

References

1. Wolfgang, T., Jurgen, M., Roland, P. (2012). Geodesy. De Gruyter 2012.
2. Krakiwsky, E.J., Wells, D.E. (1971). Coordinate Systems in Geodesy.
3. Bomford, G. (1971). Geodesy. Clarendon Press.
4. Hofmann-Wellenhof, B., Moritz, H. (2006). Physical Geodesy. Springer.
5. Strang, G. (1997). Linear Algebra, Geodesy, and GPS. U.S.: Wellesley-Cambridge Press.
6. Vermeer, M. (2010). Physical Geodesy. Aalto University