Explain your answers with neat sketches whenever possible. If not clearly stated, assume that all computations are made on Helmert1906 (a = 6378.2 km, $f = \frac{1}{298.3}$). Also, mean radius of the earth is R = 6371 km.

Assignment (4) – Spherical Excess

1. With your own words, explain briefly the geometric and gravimetric effects on geodetic observations.
2. Tabulate the major similarities/differences between the plane and spherical triangles.
3. Why does the sum of internal angles of a spherical triangle exceed 180°?
4. Why does spherical excess increase as the size of the triangle increases?
5. What is the significance of spherical excess in geodesy?
6. **Comment on the following statements:** -
   a. Spherical excess is a function of the square area of the triangle.
   b. The sum of internal angles of a spherical triangle exceeds 180°.
   c. The value of ellipsoidal excess is mainly derived from its corresponding spherical excess.
   d. The measurement of spherical excess helps to account for the magnetic anomalies.
7. Perform a numerical analysis based on the square area of the geodetic triangle to conclude when to consider/disregard the spherical excess in geodetic computations. Tested triangle areas should at least include: 1 km², 10 km², 25 km², 50 km², 100 km², 200 km², 300 km², 400 km², 500 km². Plot your results using appropriate visualizations. Interpret your results to guide surveying engineers in different project scenarios.
8. A spherical triangle ABC in which the geodetic coordinates of stations B and C are (23° 56′ 51", 32° 54' 20" E), (23° 56′ 51"N, 32° 30'10" E) respectively. Also, the internal angles B and C are 56° 26′18" and 48° 06′ 58" respectively. Compute the value of spherical excess.
9. In a geodetic triangle, the observed angles are A = 75° 34' 18" and B = 80° 44' 28". The length of side AB is 18455 meters. Calculate the spherical excess.
10. ABC is a geodetic triangle such that $\angle A = 65° 45' 48"$, $\angle B = 85° 15' 25"$, $\angle C = 29° 58' 45"$, and length of side AC = 167 km. Compute the ellipsoidal excess assuming the mean latitude is $\varphi = 45° 40' 08"$.
11. The following observations have been conducted for a triangle ABC: a = 69194 m, b = 105973 m, c = 84941 m, $\angle A = 40° 39' 30"$, $\angle B = 86° 13' 59"$, and $\angle C = 53° 06' 46"$. Compute the spherical excess and angular closing error.