KATHMANDU UNIVERSITY
End Semester Examination
February/March, 2019

Marks Scored:

Level : B.E.
Year : IV

Course : GEOM 417
Semester : I

Exam Roll No. :

Time: 30 mins.

F. M. : 10

Registration No.:

Date : FEB 2 1 2019

SECTION "A"
[20 Q. × 0.5 = 10 marks]

Choose and encircle the most appropriate answer among the given options.

1. The fundamental frequency of GPS L2 is _____.
   a. 1227.60 MHz b. 10.23 MHz c. 1575.42 MHz d. 1023 MHz

2. The distance dependent terms in DD measurements are _____.
   a. eliminated b. reduced c. neglected d. omitted

3. Multipath for satellites from GLONASS exhibits _____ pattern over subsequent days.
   a. strange b. time-shifted c. non-uniform d. repeated

4. Which of the following is frequency independent source of error?
   a. Phase centre variation c. Phase wind-up
   b. Troposphere d. Ionosphere

5. The aim of Kalman Gain is to _____.
   a. maximize the gain
   b. minimize the difference between observed and measured
   c. minimize the observation
   d. minimize the noise and modelled values

6. The weightage of measurements is inherited in _____.
   a. Confusion matrix c. Covariance matrix
   b. Innovation Matrix d. Kalman Gain

7. A white noise means _____.
   a. zero mean, zero standard deviation c. zero mean, certain standard deviation
   b. certain mean and standard deviation d. certain mean and variance

8. The time required for GPS satellites to complete a cycle around the Earth is _____.
   a. one sidereal day c. 12 hours
   b. half sidereal day d. 15 hours

9. Which of the following is not the property of noise in GNSS signal?
   a. White noise c. Gaussian
   b. Random noise d. Thermal noise

10. The line of sight vector in GNSS observation is directed from _____.
    a. receiver to receiver c. receiver to satellite
    b. satellite to receiver d. satellite to satellite

11. In receiver-to-receiver single differencing, _____ are eliminated.
    a. receiver dependent errors c. satellite dependent errors
    b. receiver and satellite dependent errors d. noises

12. The precise position of satellite at the time of signal broadcast is obtained from _____.

a. catalogue b. almanac c. ephemeris d. code

13. The noise in double differencing is _____ times larger than that of the original measurement.

a. equal to b. two c. three d. four

14. The multipath effect can be _____.

a. eliminated by single differencing
b. eliminated by triple differencing
c. eliminated by double differencing
d. cannot be eliminated

15. Cycle slips can be of half integers due to _____.

a. multipath effect
b. integer ambiguity
c. missed satellite message
d. satellite position error

16. For short baseline with significant height differences, _____.

a. troposphere and ionosphere delays are negligible
b. only ionospheric delay is negligible
c. only tropospheric delay is negligible
d. multipath effect is eliminated

17. For mid-latitude regions, the ionospheric activity is maximum around _____.

a. noon b. 1 pm c. 2 pm d. 3 pm

18. According to US Standard Atmosphere model, the total tropospheric zenith delay is approximately _____.

a. 2.37 mm b. 2.37 cm c. 2.37 m d. 37 cm

19. The slant tropospheric delay at 30° elevation is approximately _____ greater than that at zenith.

a. 2 times b. 3 times c. 4 times d. 5 times

20. The electron density is maximum at the _____ in the ionosphere.

a. D-layer b. E-layer c. F1-layer d. F2-layer

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SECTION "B"
[6 Q. × 4 = 24 marks]

All of the GNSS constellations (NAVSTAR GPS, GLONASS, Galileo, BeiDou, NavIC) are broadcasting GNSS signals on multiple frequencies. However, they all broadcast signals at a common L1 band (1575.42 MHz). GNSS receivers capable of tracking signals of multiple frequencies and from multiple constellations generally provide better positioning results. For precise point positioning using GNSS technology, either we estimate all the unknowns or the unknowns are derived from existing models.

Answer *ANY SIX* questions.

1. Consider the L1 frequency for Galileo satellites. Express the observation equation for carrier phase observation. Mention the sources of errors included. [2+2= 4]

2. Consider the multi-frequency (L1, L2) GNSS observations. Express the observation equation for pseudorange observation. Mention the sources of frequency dependent sources of errors. [2+2= 4]

3. Discuss the factors affecting the multipath and tropospheric delay. [2+2= 4]

4. GNSS is emerging as a promising Remote Sensing technique. Do you agree with this statement? Justify with appropriate examples. [4]

5. Describe error budget and mapping function. [2+2=4]

6. Why is integer ambiguity resolution essential for precise positioning? Express the mathematical relation that provides the least squares of solution of integer ambiguity. [2+2=4]

7. Describe multipath effect. Explain how a sidereal filtering can be applied in multipath estimation for GPS signals. [2+2 = 4]

SECTION "C"
[2 Q. × 8 = 16 marks]

8. Consider a multi-frequency GNSS observation for GPS and Galileo over a short baseline (~1km) with significant height differences (~2 km) that has effect of baseline, integer ambiguities, troposphere, multipath effect and the remaining sources of errors accumulated as noise. Express the complete observation model in matrix-vector notation. [8]

9. What is the purpose of linear combination of multi-GNSS observations of multiple frequencies? Discuss geometry-free, widelane and Melbourne-Wübbenna linear combinations. [2+2+2+2 =8]

OR

GNSS is a promising technology for several applications other than Positioning Navigation and Timing PNT applications. However, the technology has several limitations due to the signal and receiver architecture. Discuss such technique based sources of errors for GNSS technology. How can the network of CORS stations be helpful to make the weather forecasts more accurate? [6+2=8]