KATHMANDU UNIVERSITY
End Semester Examination
09 - January 2024

Marks Scored:

Level : B.E.
Year : IV

Course : GEOM 417
Semester : I

Exam Roll No. :

Time: 30 mins.

F. M. : 10

Registration No.:

Date :

SECTION "A"
[20Q. × 0.5 =10 marks]

Encircle the most appropriate option from each set of choices.

1. The relationship between observations and true geometric range is expressed by
   a. Observation equation
   b. Differential measurement
   c. Integer phase ambiguities
   d. Differential equation

2. Direct observables of PPP is:
   a. Ephemerides
   b. Carrier phase
   c. Stream correction
   d. Clock correction

3. Which of the following is the NOT the component of GNSS signal?
   a. Pseudorandom code
   b. Navigation message
   c. Carrier signal
   d. Precise ephemeris

4. What technique describes the method of transporting multiple signals at the same time on the same carrier in the form of a complex signal?
   a. Multiplexing b. Demultiplexing c. Spreading codes d. Signal modulation

5. Which of the following is FALSE about signal modulation?
   a. The phase of carrier wave is modulated according to data wave
   b. The data wave is modulated according to the phase of carrier wave
   c. Phase Shift Keying (PSK) is a method of modulating digital wave
   d. Binary Phase Shift Keying is a modulation technique

6. Ionospheric error is negative for the phase and positive for the pseudorange due to dispersive nature of the ionosphere. This property is known as
   a. ionospheric divergence
   b. ionospheric convergence
   c. pseudorange divergence
   d. phase divergence

7. Which of the following combination of GNSS observation is used in detection of possible cycle slips between two epochs?
   a. Single differences
   b. Double differences
   c. Triple Differences
   d. Quadruple differences

8. In which of the following single differences of GNSS observation, same receiver tracks different satellites and eliminates receiver dependent errors?
   a. Receiver to Receiver SD
   b. Satellite to Satellite SD
   c. Receiver to Satellite SD
   d. Satellite to Receiver SD

9. Which of the following is FALSE about PPP?
   a. The observation equation of any individual point is a part of global network solution.
   b. PPP should be fully consistent with the network.
   c. Any inconsistency in the network shall degrade the PPP results.
   d. PPP based station coordinates do not join the datum realization of original network.

10. The changes in the observed frequency and time of signals due to the effects of special and general relativity in GNSS solutions are called as
   a. Relativistic effects
   b. Tidal effects
   c. Time effects
   d. Frequency effects

11. Choke ring antennas are notable for their ability to
   a. provide time correction
   b. eliminate site displacement
   c. reject multipath signals from the source
   d. eliminate orbital error

12. The displacement of station coordinated due to tectonic, gravitational, rotational forces and loading effects are called
   a. Site displacement
   b. Antennae displacement
   c. Propagation delay
   d. Phase wind

13. Which of the following are a combined variety of inseparable effects, such as hardware delays, model inaccuracies, multipath, etc.?
   a. Uncalibrated signal delays
   b. Calibrated signal delays
   c. Antennae offset
   d. Site displacement

14. Which of the following linear combination gives information about ionospheric variation for different frequencies?
   a. Geometry-preserving linear combination
   b. Geometry-free linear combination
   c. Ionosphere-preserving linear combination
   d. Ionosphere-free linear combination

15. The linear combination is the difference between the carrier phase widelane and the pseudorange widelane linear combination?
   a. Widelane linear combination
   b. Melbourne-Wübbena
   c. Ionosphere-preserving linear combination
   d. Geometry-preserving linear combination

16. With which linear combination we can eliminate ρ' and I from the pseudorange observation equations?
   a. Widelane linear combination
   b. Multipath linear combination
   c. Ionosphere-preserving linear combination
   d. Geometry-preserving linear combination

17. The state-space model in matrix vector notation can be expressed as:
   a. $w_n = \varphi_{n-1} x_{n-1} + x_n$
   b. $w_n = \varphi_n x_n + x_n$
   c. $x_n = \varphi_n x_n + w_n$
   d. $x_n = \varphi_{n-1} x_{n-1} + w_n$

18. Which phase of Kalman filter is used to estimate the corresponding values of variables in state vector for current epoch based on the estimates of previous epoch using transition matrix?

a. State observe b. State prediction c. State Update d. State Conclude

19. The full form of the GNSS observation file format RINEX is

a. Receiver Integrated Exchange b. Receiver Independent Extended
c. Receptor Independent Exchange d. Receiver Independent Exchange

20. The relative weight given to the measurement and current state estimate and can be tunes to achieve particular performance

a. Kalman variable b. Kalman Gain
c. Kalman matrix d. Kalman Update

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SECTION "B"
[6 Q × 4 = 16 marks]

Attempt *ANY SIX* questions.

1. Describe briefly the working architecture of PPP using appropriate diagram.

2. If i and j are the receiver and k and l are the satellite in following equation of GNSS observables then answer the following
$L_{ij}^{kl} = |x^k - x_i| - |x^k - x_j| - |x^l - x_i| + |x^l - x_j| + T_{ij}^{kl} + \lambda N_{ij}^{kl}$,
   a. What type of differencing equation is this? [1]
   b. What are the applications of such differencing? [1]
   c. What are x^k and x_i? [1]
   d. What are the term N_{ij}^{kl}, T_{ij}^{kl}, λ ? [1]

3. Explain the components of total carrier phase observables with appropriate diagram.

4. Explain how troposphere and ionosphere causes error in GNSS observation. [2+2]

5. Define GNSS error budget. Describe briefly the antenna dependent delays of GNSS observation. [1+3]

6. What are the differences between linear combination of GNSS observation and Differencing of GNSS observation? [4]

7. Compute Ionosphere-free linear combination for pseudorange observations on two frequencies f1 and f2. [4]

8. Write short notes on [2×2=4]
   a. Integer ambiguity resolution
   b. Kalman Gain

SECTION "C"
[2Q × 8 = 16 marks]

Attempt *ALL* questions.

9. Explain briefly the components of GNSS signal. Write down the observation equation of pseudorange and Carrier phase measurements of a GNSS receiver on a single frequency of satellite (sat) at receiver (rec) at time t. (Define every observable of the equations) [3+2+3]

10. Differentiate between State-space model and measurement model. How does a Kalman filter works? Describe with appropriate diagram (workflow). [3+5]