

National Exams May 2015

04-Geom-B2  
Satellite Navigation

**3 Hours duration**

**NOTES:**

1. If doubt exists as to the interpretation of any question, the candidate is urged to submit with the answer paper, a clear statement of any assumptions made.
2. This is a CLOSED BOOK EXAM.
3. Candidate may use one of the calculators, the Casio or Sharp non-programmable models.
4. Each question is specified for its maximum marks in bracket.
5. Clarity and organization of the answer are important

**15 Marks QUESTION ONE**

- 1). Name the fully operational GNSS systems and the other GNSS systems being developed worldwide (5 Marks).
- 2). What are the respective tasks of the three segments of the Global Positioning System? (10 Marks)

**10 Marks QUESTION TWO**

Analytically describe how the DOPs are calculated in single point positioning based on pseudorange measurements? (Include the measurement model, the clear definition of the individual DOPs, and an explanation of your notation in your answer).

**10 Marks QUESTION THREE**

Summarize the GPS Modernization project.

**15 Marks QUESTION FOUR**

Mathematically construct the double-differenced GPS measurements from the (L1 C/A-code) pseudoranges  $\rho_A^j(t), \rho_B^j(t), \rho_A^k(t), \rho_B^k(t)$  between stations  $A$  and  $B$ , and between satellites  $j$  and  $k$  at an instant  $t$ , and briefly discuss how the systematic and random errors on GPS measurements are reduced, cancelled or increased in the double-differencing process. (Include the measurement equations, error terms and an explanation of your notation in your answer).

**10 Marks QUESTION FIVE**

With the determination of a single baseline using the double-differenced phase measurements (L1 only), assume that one used two receivers to have collected 300 epochs of data from 7 satellites without signal interruption. Explain how many measurements and unknown parameters one has in static and kinematic positioning, respectively.

**10 Marks QUESTION SIX**

Describe the approach of relative static GPS positioning (also referred to as “Conventional Static Positioning”) in geodetic control surveying.

**10 Marks QUESTION SEVEN**

Explain the cycle slip phenomenon with GPS phase measurements and its consequence.

**CHOOSE EITHER QUESTION EIGHT OR NINE**

**20 Marks QUESTION EIGHT**

Conceptually describe the PPP technique and the Network RTK technique, respectively.

**20 Marks QUESTION NINE**

Describe three different integration strategies (loosely-coupled, tightly-coupled and deeply-coupled) that are used in GNSS-aided inertial integrated navigation in terms of the data processing. (Include the sensors used and the application areas in your answer.)

Question No	Marks	Comment
1	15	mandatory
2	10	mandatory
3	10	mandatory
4	15	mandatory
5	10	mandatory
6	10	mandatory
7	10	mandatory
8	20	Select one of 8 or 9
9	20	
Sum	100	