

National Exams May 2016

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 GNSSs and also the other GNSSs being developed worldwide (5 Marks).
- 2). What are the respective tasks of the three segments of the Global Positioning System? (10 Marks)

**15 Marks QUESTION TWO**

Analytically describe how to calculate the DOPs in single point positioning based on L1 C/A 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**

Conceptually summarize the different GPS positioning modes inclusive of static, kinematic, single point and relative positioning methods. (Use diagrams, figures, etc. where helpful.)

**15 Marks QUESTION FOUR**

Describe how to establish a control network for an engineering project through static GNSS baseline observations in terms of network design, baseline observations, baseline processing, and baseline network adjustment.

**10 Marks QUESTION FIVE**

Describe the cycle slip phenomenon with GPS carrier phase measurements and its consequence in GPS data processing.

**15 Marks QUESTION SIX**

Mathematically construct the double-differenced GPS measurements from (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 in GPS measurements are reduced, cancelled or increased in the double-differencing process. (Include the measurement equations, the error terms and the explanation of your notation in your answer).

**CHOOSE ONE OUT OF QUESTIONS SEVEN AND EIGHT**

**20 Marks QUESTION SEVEN**

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

**20 Marks QUESTION EIGHT**

Describe three different integration architectures (loosely-coupled, tightly-coupled and deeply-coupled) that are used in the GNSS-aided inertial integrated navigation in term of the data processing. Include the sensors used and their characteristics for each integration architecture in your answer.

Question No	Marks	Comment
1	15	mandatory
2	15	mandatory
3	10	mandatory
4	15	mandatory
5	10	mandatory
6	15	mandatory
7	20	Select one out of 7 & 8
8	20	
sum	100	