Only the faculty's own calculators are allowed in the exam.

Answer **only five (5)** questions out of the following six questions. (The grade of this exam is based on the five answers that yield the lowest number of points).

1. a)   Which functions of a GNSS receiver are performed by the following blocks?   (2p)

    (1) Radio Front End

    (2) Baseband

    b)   How does a GPS receiver identify the transmitting satellites?   (1p)

    c)   What means Differential GPS? (DGPS)   (1p)

    d)   What is the difference between ephemeris and almanac data in GPS?   (1p)

    e)   What is Spoofing?   (1p)

2. a)   GPS signals can be presented as: (3p)

$$I_{1_k} = \frac{A}{\sqrt{2}} C_k D_k \cos(\phi_k - \phi_{ref_k})$$

$$Q_{1_k} = \frac{A}{\sqrt{2}} C_k D_k \sin(\phi_k - \phi_{ref_k})$$

    Give short explanations of the following signal components:

    $I_{1_k}, Q_{1_k}, A, C_k, D_k, \phi_k$ and ϕ_{ref_k}

    b)   Explain briefly the concepts of bit synchronization and frame synchronization.   (3p)
         Why are they needed in a GNSS receiver?

3. a)   What is carrier aiding of code loop? Why do we give carrier aiding to code   (2p)
         loop and not the other way around?

    b)   If you had to design a GNSS receiver for a Formula 1 race-car that has huge   (2p)
         acceleration but no jerk, what is the minimum order of tracking loops that you
         should choose? Why?

    c)   Antenna polarization. What polarization antenna would you use for best   (2p)
         reception of GNSS signals? Why?

4. a)   Essay: Acquisition, Brute force and FFT. (Draw block diagram of FFT based   (6p)
         acquisition). What are the unknown parameters that acquisition process needs
         to find and what are their typical search bin sizes?

5.   Essay: Draw a block diagram describing a typical GPS receiver tracking   (6p)
channel (including both carrier and code tracking loops) and write a short
explanation/functionality of each block.

Hint: Think what you implemented in the Simulink exercises.

6.   Essay: Multipath. Explain in detail using text and figures how multipath   (6p)
affects GNSS accuracy. Also explain multipath mitigation techniques.