

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)  
ORGANISATION OF ISLAMIC COOPERATION (OIC)  
DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination  
Course No.: EEE 4641  
Course Title: Cellular Communication

Summer Semester, A. Y. 2021-2022  
Time: 3 Hours  
Full Marks: 150

There are 6 (six) questions. Answer all 6 (six) questions. The symbols have their usual meanings. Programmable calculators are not allowed. Marks of each question and corresponding COs and POs are written in the brackets.

1. a) Sketch the control plane protocol stack between the UE and the eNodeB. 5  
(CO1, PO1)
- b) State the cases when a non-contention based random access procedure is usually used. Describe briefly the first two steps of the contention based random access procedure. 8  
(CO1, PO1)
- c) Assume that there is no periodic TAU. When an initial attach or a TAU is triggered in a particular TA, a TAI list is sent according to Table 1. A UE first performed an initial attach in TA1. Then the UE moved through the following TAs sequentially. Three Paging messages were transmitted while the UE was staying in TA3, TA7, and TA4 as shown below. 12  
(CO2, PO2)

TA1 → TA3 (Paging message 1) → TA6 → TA4 → TA7 (Paging message 2) → TA2 → TA1 → TA4 (Paging message 3).

For each of the 3 Paging messages (Paging messages 1, 2, and 3), determine the TAs, which the Paging messages were transmitted in.

Place for triggering Initial Attach or Tracking Area Update (TAU)	Tracking Area Identity (TAI) list sent
TA1	TA1, TA2, TA4
TA2	TA1, TA2, TA3
TA3	TA3, TA6
TA4	TA4, TA7
TA5	TA4, TA5, TA6
TA6	TA4, TA6
TA7	TA2, TA7

Table 1

2. a) Discuss which parameters are scaled for speedy users in cell reselection and the reasons for this scaling. 8  
(CO1, PO1)
- b) State how different EPS bearers are used in VoLTE calls. State when the service request procedure is used. 7  
(CO1, PO1)
- c) For paging in a cell, the DefaultPagingCycle is 128 and NB is 2. Determine the subframe positions that can be used by the eNodeB for transmissions of paging messages. 10  
(CO2, PO2)

3. a) Distinguish between ciphering and integrity protection. Identify the messages or data for which ciphering and integrity protection are applied. 7  
(CO1, PO1)
- b) Explain the use of distributed antenna system (DAS). State the advantage of avoiding transmission of neighbor cell list (NCL) for the measurements of neighboring LTE cells in 4G. 8  
(CO1, PO1)
- c) The Periodic Tracking Area Update Timer value is 54 minutes. The Mobile Reachable Timer value is 58 minutes. The Implicit Detach Timer value is 12 minutes. If a UE moves out of coverage immediately after a Periodic Tracking Area Update (TAU), determine the time difference between this TAU and when the network detaches the UE. 10  
(CO2, PO2)
4. a) State three significant things that are set up during the initial attach procedure. Explain why and how a cell may be biased in the selection for camping. 8  
(CO1, PO1)
- b) Discuss how uplink interference can be mitigated by sharing information among neighboring eNodeBs. 7  
(CO1, PO1)
- c) The DRX configuration is as follows. 10  
(CO2, PO2)
- Number of short DRX cycles before long DRX cycles begin = 10  
Length of short DRX cycles = 20 subframes  
Length of long DRX cycles = 512 subframes  
Length of DRX-Inactivity Timer = 300 subframes
- The data transfer pauses at 10:30:20.340 am (10 hours 30 minutes 20 seconds 340 milliseconds position). The data transfer resumes after the completion of 3 long DRX cycles. Determine the time when the data transfer resumes.
5. a) Discuss the difference in HARQ techniques between 4G and 5G and compare their advantages and disadvantages. 7  
(CO1, PO1)
- b) State the number of PCIs possible in 5G and justify the use of an increased number. State the advantages of low earth orbit (LEO) satellites for 5G non-terrestrial networks (NTN). 8  
(CO1, PO1)
- c) In 5G, the data rate for a UE is found 20 Mbps with a subcarrier spacing 15 kHz. The subcarrier spacing is increased to 60 kHz with no other changes. Determine the new data rate. 10  
(CO2, PO2)
6. a) Name the messages which indicate the location of CORESET. Name the messages that must be read by the UE before camping on a cell in 4G and 5G. 6  
(CO1, PO1)
- b) State the benefits of the reduction of always-on signals. Explain how 5G can work without the always-on cell-specific reference signal (CRS) and PCFICH. 9  
(CO1, PO1)
- c) Explain how new subcarrier spacing options can help improve latency in 5G. State the number of symbols in a radio frame for 120 kHz subcarrier spacing. Compare the possible number of symbols in a resource block between 4G and 5G. 10  
(CO1, PO1)