17

B.Sc. in EEE, 6th Semester — February 23, 2023 **(Morning)**

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

Mid-Semester Examination
Course No.: EEE 4641
Course Title: Cellular Communication

Summer Semester, A. Y. 2021-2022
Time: 90 Minutes
Full Marks: 75

There are 3 **(three)** questions. Answer all 3 **(three)** 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.

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1. a) Compare the scrambling operation and the spreading with OVSF codes. Explain why they both are required in UMTS. **5 (CO1, PO1)**

   b) Determine the generation of OVSF codes with spreading factor 8. **8 (CO2, PO2)**

   c) Assume that there is no periodic TAU. When an initial attach or a TAU is triggered in a particular TA, a particular TAI list is sent according to Table 1. A UE first performs initial attach in TA1. Then the UE moves through the following TAs sequentially: **12 (CO2, PO2)**

   TA1 -> TA2 -> TA4 -> TA7 -> TA6 -> TA7 -> TA1 -> TA3 -> TA5

   Determine when (in which TAs) TAUs have occurred.

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

Table 1

2. a) State the advantage of correlation in frequency domain compared to correlation in time domain during downlink synchronization. State the location of Primary Synchronization Signal (PSS) and Secondary Synchronization Signal (SSS) in time and frequency. Describe how different types of information are determined using Primary Synchronization Signal (PSS) and using Secondary Synchronization Signal (SSS). **10 (CO1, PO1)**

   b) Explain which applications are suitable for semi-persistent scheduling and how the PDCCH instance indicates that semi-persistent scheduling has been used. **5 (CO1, PO1)**

   c) Assume that all symbols have an equal period in a slot with normal cyclic prefix. The control region is 3 symbols period in every subframe and a PDCCH instance takes both symbols of the control region. An uplink data packet is retransmitted 3 times. All original transmission and retransmissions use Resource Blocks on the second slot of the subframes. The propagation delay is 800 microseconds. **10 (CO2, PO2)**

Determine the time gap (experienced by the UE) between the resource allocation on PDCCH for original transmission and the 3rd retransmission (i.e. time from when the UE completes listening PDCCH allocation, up to when it begins the 3rd retransmission).

3. a) Explain the difference between the functions of Scheduling Request (SR) and Buffer Status Report (BSR). Explain how a good receiver of UE can send a higher Channel Quality Indicator (CQI) level. **7 (CO1, PO1)**

b) Explain the reasons for the variation of the radio channel quality within the operating frequency bandwidth for a particular user in the cell. **6 (CO1, PO1)**

c) As shown in Figure 1, for uplink data transfer, packet 1 is transmitted, then packet 2 is transmitted, and thereafter packet 1 is retransmitted. Packet 1 is transmitted with the following values of PDCCH (DCI Format 0). **12 (CO2, PO2)**

- Resource Block Assignment: X
- New Data Indicator (NDI): 1
- Modulation and Coding Scheme: 18

DCI Format 0 (PDCCH) is used when Packet 1 is retransmitted and it uses RV2 redundancy version.

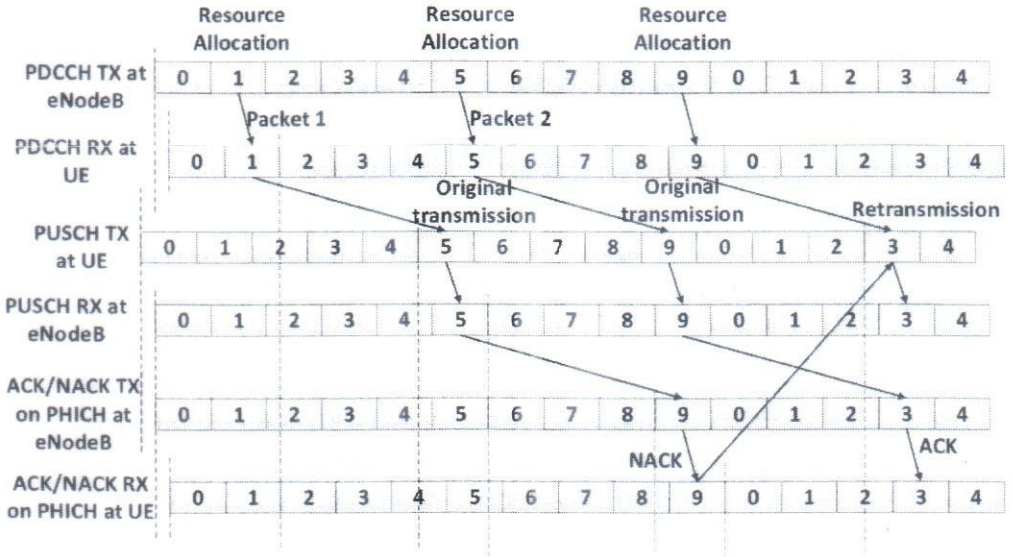

Figure 1

Determine the following for PDCCH (DCI Format 0) when packet 1 is retransmitted.

- Determine whether the value of Resource Block Assignment field has to be X or it can be different.
- Determine the value of New Data Indicator (NDI) field.
- Determine the value of Modulation and Coding Scheme field.
- Determine whether the field HARQ Process Identifier (HARQ ID) exists.
- Determine whether the field Redundancy Version (RV) exists. If it exists, then determine what it indicates.