

Name:

Enrolment No:



UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, July 2020

Course: Wireless Communications

Program: B Tech Electronics Engineering

Course Code: ELEG422

Semester: VIII

Time 03 hrs.

Max. Marks: 100

Instructions:

- Attempt all questions as per the instruction.
- Assume any data if required and indicate the same clearly.
- Unless otherwise indicated symbols and notations have their usual meanings.
- If any complex formulae is required, just do calculation and write the answer without that formulae.

SECTION – A (30 Marks)

Each question carries 2 Mark and

1. A typical mobile switching center (MSC) can handle
 - (a) 1,00,000 cellular subscribers
 - (b) 5,000 simultaneous conversations at a time
 - (c) Both (a) and (b)
 - (d) None of these
2. Which of the following is/are the sources of interference in cellular system
 - (1) A call in progress in a neighboring cell
 - (2) Other base station operating in the same frequency
 - (3) A call in progress near to you in the same cell
 - (4) Any non-cellular system which leaks the energy into the cellular frequency band
 - (a) Both (1) and (2)
 - (b) Both (2) and (4)
 - (c) (1), (2) and (4)
 - (d) (2), (3) and (4)
3. The total available channels if a total of 30 MHz of bandwidth is allocated to a cellular system which uses two 25 kHz simplex channels to provide full duplex voice and control channels is _____
 - (a) 600 channels
 - (b) 630 channels
 - (c) 660 channels
 - (d) 690 channels
4. The far field distance for an antenna with diameter $D = 1$ m and operating frequency is of 900 MHz is _____.
 - (a) 6 m
 - (b) 6 cm
 - (c) 60 m
 - (d) 600 m
5. A mobile subscriber travels at a uniform speed of 60 km/hr. The time between fades if the mobile uses a cellphone operating at 3 GHz is approximately _____.
 - (a) 3 ms
 - (b) 3 μ s

(c) 6 ms (d) 6 μ s

6. In space diversity technique, at mobile the signal are independent if the separation between the antennas is _____ (given that the operating frequency is 2 GHz)
(a) 1.5 cm (b) 15 cm
(c) 7.5 cm (d) 7.5 mm
7. Consider an FDMA system for multimedia data users. The modulation format requires 10 MHz of spectrum for each user, and guard bands of 1 MHz are required on each side of the allocated spectrum in order to minimize out-of-band interference. What total bandwidth is required to support 100 simultaneous users in this system?
(a) 1.2 GHz (b) 1 GHz (c) 100 MHz (d) 120 MHz
8. The best channel utilization with the slotted ALOHA protocol is
(a) 18.4 % (b) 36.8 %
(c) 73.6 % (d) none of these
9. What is the time duration of a bit if data is transmitted at 270.833 kbps in the channel?
(a) 270.833 s (b) 3 μ s
(c) 3.692 μ s (d) 3.692 s
10. In US AMPS, 416 channels are allocated to various operators with 10 kHz guard band and channel between them is 30 kHz. What is the spectrum allocation given to each operator?
(a) 12.5 kHz (b) 30 kHz (c) 12.5 MHz (d) 30 MHz
11. How does HSCSD differs from the GSM to obtain higher speed data rate?
(a) By allowing single user to use one specific time slot
(b) By allowing single user to use consecutive user time slots
(c) By using 8-PSK modulation technique
(d) By allowing multiple users to use individual time slot
12. What is the term used by ITU for a set of global standards of 3G systems?
(a) IMT 2000 (b) GSM
(c) CDMA (d) EDGE
13. IMEI stand for
(a) International Mobile Equipment Identity
(b) Information Mobile Entity Identification
(c) Internal Mobile Equipment Identity
(d) None of these
14. A DSSS system has a 1.2288 Mcps code clock rate and a 9.6 kbps information rate. The processing gain is _____
(a) 128 (b) 512
(c) 64 (d) 1024
15. Which of the following standard committee specifies Bluetooth and other Personal Area Networks (PAN)?
(a) IEEE 802.11b
(b) IEEE 802.15
(c) IEEE 802.11g
(d) IEEE 802.16

SECTION – B (50 Marks)

16. In order increase the cellular systems capacity, the cellular systems have migrated to smaller cells. Discuss at least three design issues that are complicated by this trend. [6M]
17. What is the purpose of handoff? Describe the handoff criteria to make a handoff decision. [6M]
18. Explain the basic concept of equalization and diversity techniques. Also mention at least three classical equalizer algorithms and space diversity methods. [10M]
19. Explain the following multiple access techniques: Code division multiple access (CDMA) and OFDMA. [10M]
20. Write a short notes on GSM frame structure, Features of WCDMA, 4G-LTE [10M]
21. Consider a cellular system with hexagonal cells of radius $R = 1\text{km}$. Suppose, the minimum distance between cell centers using the same frequency must be $D = 6\text{ km}$ to maintain the required SIR. Find the required reuse factor N and the number of cells per cluster. If the total number of channels for the system is 1200, find the number of channels that can be assigned to each cell. [8M]

SECTION – C (20 Marks)

22. The main idea behind a cellular concept is the capacity increase associated with a decrease in cell size. Consider Dehradun is a square city of 300 km^2 . Suppose you design a cellular system for this city with square cells, where every cell has 500 channels and so can support 500 active users.
 - (a) What is the total number of active users that your system can support for a cell size of 1 km^2 ?
 - (b) What cell size would you use if your system had to support 2, 50,000 active users?
 - (c) If the base stations radiate 15 W in case (a), find the power that the base stations in the case (b) must transmit to maintain the signal-to-noise ratio at the cell boundaries. The path-loss exponent is $n = 4$. [(2+3+5) M]
23. Assuming the speed of a vehicle to be equal to 15 m/s , carrier frequency, $f_c = 1800\text{ MHz}$, and RMS delay spread $\sigma_\tau = 10\text{ }\mu\text{s}$, calculate coherence time and coherence bandwidth. At a symbol rate of 1.92 Mbps what kind of symbol distortion will be experienced? What type of fading will be experienced by the channel? [5M]
24. You work for a company that wants to design a next-generation cellular system for voice plus high-speed data. The FCC has decided to allocate 100 MHz of spectrum for this system based on whatever standard is agreed to by the various industry players. You have been charged with designing the system and pushing your design through the standards body. Describe your design in as much detail as possible, paying particular attention to how it will combat the impact of fading and ISI and to its capacity for accommodating both voice and data. Also develop arguments explaining why your design is better than competing strategies. [5M]