

SOFTWARE DEFINED RADIO
(ECEN 4121)

Time Allotted : 2½ hrs

Full Marks : 60

Figures out of the right margin indicate full marks.

*Candidates are required to answer Group A and
any 4 (four) from Group B to E, taking one from each group.*

Candidates are required to give answer in their own words as far as practicable.

Group – A

1. Answer any twelve:

12 × 1 = 12

Choose the correct alternative for the following

- (i) In SDR, the ZIF stands for
(a) zero insertion force (b) zero intermediate frequency
(c) zero insertion frequency (d) none of (a), (b) & (c).
- (ii) The fidelity of the reconstructed signal is better if
(a) the resolution is of 8-bits (b) the resolution is of 10-bits
(c) the resolution is of 6-bits (d) all of (a), (b) & (c) are same.
- (iii) BER is
(a) directly proportional to SNR (b) not related to SNR
(c) inversely proportional to SNR (d) none of (a), (b) & (c).
- (iv) In the DAC process, the low pass filter is necessary to
(a) smooth the steps (b) to reduce noise due to impulses
(c) to take care of both (a) and (b) (d) none of (a), (b) & (c).
- (v) All naturally produced signals are
(a) digital (b) analog (c) hybrid (d) none of (a), (b) & (c).
- (vi) In channel encoding, the target is to
(a) prevent pollution of data (b) to avoid repeat transmission of files
(c) achieve both (a) and (b) (d) none of these.
- (vii) For SDR, the FPGAs are suitable because of
(a) flexibility (b) speed
(c) high computation power (d) all of (a), (b) & (c) are true.
- (viii) The notch filters are normally used to
(a) accept a narrow band of frequency (b) reject a narrow band of frequency
(c) reject a wide band of frequency (d) none of (a), (b) & (c).

- (ix) In digital communication, the probability theory is important as
 (a) A 1 may be received as a 1 (b) A 1 may be received as a 0
 (c) A 0 may be received as a 1 (d) All of (a), (b) & (c).
- (x) In source encoding, the target is to:
 (a) Produce length in relation to probability
 (b) Make the lengths of all messages same
 (c) Lengths independent of probability
 (d) None of the above.

Fill in the blanks with the correct word

- (xi) FPGA stands for _____.
- (xii) In VANETs, the combination of _____ and _____ is necessary.
- (xiii) A digital signal can become exactly equal to the original analog signal, if the sampling rate is _____.
- (xiv) In PLL, the P stands for _____.
- (xv) A carrier frequency of 950 MHz is modulated by a 1 kHz signal. SDR requires Nyquist sampling rate of _____.

Group - B

2. (a) Draw the block diagram of a typical digital radio and label the different modules. *[[CO1](Remember/LOCQ)]*
- (b) What are the functions of source encoder? Explain the importance of the source encoding to make transmission efficient. *[[CO1](Understand/LOCQ)]*
- (c) Why is the DAC connected in the final stage of the transmitter chain? Explain. *[[CO1](Analyze/IOCQ)]*
4 + 4 + 4 = 12
3. (a) Mention and explain 3 important considerations to be applied during the design of SDR. *[[CO2](Remember/LOCQ)]*
- (b) Explain the ZIF concept. Explain with a schematic diagram the ZIF architecture. Why is ZIF difficult to implement even now? Give a few reasons. *[[CO2] Apply/IOCQ]*
4 + (6 + 2) = 12

Group - C

4. (a) What is Eye Diagram in digital communication? Why is it important to analyse the reliability of a digital communication system? *[[CO3](Understand/IOCQ)]*
- (b) What is Gibbs' Phenomenon? How does it help us to resolve a complex signal into its frequency components? Write down the equation and explain. Define even and odd functions for different types of signals. Prove the definitions with suitable waveforms. *[[CO3](Analyze/IOCQ)]*
(2 + 2) + (2 + 2 + 2 + 2) = 12

5. (a) Why is probability an important topic in digital communication? Explain with diagram the importance of the probability theory. [[CO4](Analyze/IOCQ)]
- (b) What are the steps required to obtain the encoded output from an analog signal? What is quantization error? Explain briefly. [[CO3](Apply/HOCQ)]
- (c) A 8 Volts (peak-to-peak) AC signal is to be converted to digital format using a 8-bit ADC. At a certain time, the AC amplitude is 1.2 volts. What is the encoded output in binary and Hex formats? [[CO3](Apply/HOCQ)]
- 4 + 4 + 4 = 12**

Group - D

6. (a) How is time synchronization maintained between the transmitter and the receiver? Explain how the PLL helps to lock the frequency. [[CO5](Analyze/IOCQ)]
- (b) What is the function of an equalizer? Describe the operation of a linear equalizer with a block diagram. [[CO5](Understand/IOCQ)]
- 4 + (3 + 5) = 12**
7. (a) What are the advantages of an OFDM system? Explain them. [[CO5](Remember/LOCQ)]
- (b) Draw the block diagram of a typical OFDM system and explain the operations of the DFT and the IDFT blocks. [[CO6](Understand/LOCQ)]
- 4 + (4 + 4) = 12**

Group - E

8. (a) Cognitive radios are radios with AI — Explain. [[CO6](Evaluate/HOCQ)]
- (b) What is reinforcement learning? Explain with a block diagram the application of reinforcement learning for communication systems. [[CO6](Understand/LOCQ)]
- 4 + (2 + 6) = 12**
9. (a) What is Bumblebee behavioural model? Where and why is it used? [[CO1](Understand/IOCQ)]
- (b) Draw the protocol stack for a vehicular communication system. Explain the operations of the MAC sublayer and the LLC sublayer. [[CO2](Understand/LOCQ)]
- 4 + (4 + 4) = 12**

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	41.66	45.84	12.5

Course Outcomes (CO):

After completing the course the student will be able to:

- ECEN4121.1. Understand the technological differences between families of radios.
- ECEN4121.2. Explain the function of reconfigurable hardware.
- ECEN4121.3. Analyze the processing techniques required for software defined radio.
- ECEN4121.4. Evaluate the effects of probability in communication reliability.
- ECEN4121.5. Analyze the synchronization requirements in SDR and SDR based networks.
- ECEN4121.6. Analyze functioning of different families of radios.

*LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question.

