

SOFTWARE DEFINED RADIO
(ECEN 4121)

Time Allotted : 3 hrs

Full Marks : 70

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

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

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**
- (i) SDR features can be changed by:
(a) changing hardware and software
(b) changing function specific software only
(c) changing the monitor program
(d) changing the controller.
- (ii) In software programmable radios, the parameters which can be controlled are
(a) volume (b) channel number
(c) modulation scheme (d) (a) and (b).
- (iii) The BER
(a) Is directly proportional to SNR (b) Inversely proportional to SNR
(c) Is not related to SNR (d) None of these.
- (iv) Source encoding:
(a) Adds redundancy at transmitter and removes it at receiver
(b) Adds redundancy at receiver and removes it at transmitter
(c) Adds redundancy at transmitter and removes at receiver
(d) Has nothing to do with redundancy.
- (v) SWaP stands for:
(a) Size, weight and power (b) Small, wide and power
(c) Size, weight and pull (d) None of these.
- (vi) Using multi carrier modulation:
(a) The fading can be controlled (b) Interference can be reduced
(c) Data speed can be increased (d) All three benefits are achieved.
- (vii) Cognitive radios can
(a) Sense free spectrum (b) Can locate transmit stations
(c) Can use AI (d) All are true.

- (viii) FPGA allows:
(a) Parallel addition (b) parallel multiplication
(c) both (a) and (b) (d) none of these.
- (ix) SDR in combination with cognitive radio will provide:
(a) Vehicular network (b) WLAN
(c) MAN (d) None of these.
- (x) In SDR, the computation technology is provided by:
(a) DSP (b) FPGA (c) GPU (d) any of these.

Group - B

2. (a) Draw the block diagram of a typical transmitter of a digital radio and label the different modules. [(CO1)(Remember/LOCQ)]
(b) Differentiate source encoder and channel encoder? Explain the importance of the channel encoding. [(CO1)(Apply/IOCQ)]
(c) Why is the DAC connected in the transmitter chain? Justify the importance of this conversion. [(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) Why is probability an important topic in digital communication? What is PMF? Point out the differences between uniform, Poisson and Bernoulli random variable functions. State their uses in communication systems. [(CO4)(Analyze/IOCQ)]
(b) Show how a transmitted symbol X is received as Y at the receiver in a binary channel. [(CO4)(Understand/LOCQ)]
- 8 + 4 = 12**
5. Define SNR and SINAD. Why are these two parameters used to measure receiver performance? Derive the SNR equation for a sine wave. Hence prove that SNR value increases with the bit rate of the converter. [(CO3)(Evaluate/HOCQ)]
- (2 + 2 + 6 + 2) = 12**

Group - D

6. Why is matched filter concept important for receiver? What is the goal of the well designed matched filter? Prove mathematically. [(CO5)(Evaluate/HOCQ)]
- (3 + 3 + 6) = 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 + 8 = 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)(Apply/IOCQ)]
- 4 + 8 = 12**
9. (a) What is Bumblebee behavioural model? Where and why is it used? [(CO6)(Remember/LOCQ)]
(b) Cognitive radios will increase radio spectrum efficiency. Explain. [(CO2)(Analyze/IOCQ)]
- 6 + 6 = 12**
-

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	31.2%	39.6 %	29.2 %

Course Outcomes (CO):

After completing the course the student will be able to:

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

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

Department & Section	Submission link:
CSE, ECE	https://classroom.google.com/w/MzKxODYyMjgxNzAx/tc/NDY0MDA5OTMzNTYz