

**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) 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.
- (iii) A carrier frequency of 800 MHz is modulated by a 1 kHz signal. SDR requires Nyquist sampling rate of
(a) 2×800.001 MHz (b) 2×1 kHz
(c) 2×800 MHz (d) 2×800 kHz.
- (iv) In ADC, the correct sequence is
(a) sampler, quantizer, encoder (b) quantizer, sampler, encoder
(c) encoder, quantizer, sampler (d) the order is variable.
- (v) Bernoulli random variables are used to generate
(a) random outputs in binary process (b) regular outputs
(c) to model the delays (d) both (a) and (b).
- (vi) VCO stands for
(a) variable control oscillator (b) voltage controlled oscillator
(c) variable control (d) very critical oscillation.
- (vii) 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.
- (viii) FPGA allows
(a) parallel addition (b) parallel multiplication
(c) both (a) and (b) (d) none of these.

- (ix) Cognitive radios can
(a) sense free spectrum (b) can locate transmit stations
(c) can use AI (d) all are true.
- (x) SDR in combination with cognitive radio will provide
(a) vehicular network (b) WLAN
(c) MAN (d) none 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) What are the functions of the source encoder and the channel encoder? Explain the importance of the channel encoding. [(CO1)(Understand/IOCQ)]
(c) Why is the DAC connected in the transmitter chain? Justify the importance of this conversion. [(CO1)(Understand/IOCQ)]
4 + 4 + 4 = 12
3. (a) SDRs require the combination of efficient processors and software. What are the types of Processors/Controllers generally considered for SDR? Explain the functions of FPGA and ARM processors. [(CO2)(Remember/LOCQ)]
(b) What is GNU? Why is it popular for development of SDRs? [(CO2)(Understand/IOCQ)]
8 + 4 = 12

Group - C

4. (a) What is Eye Diagram? How does it indicate the BER? Explain. [(CO3)(Understand/LOCQ)]
(b) The present work in SDR relates to development of modulation and demodulation techniques using suitable reconfigurable hardware and a two-step process. Briefly describe those. How does MATLAB help to develop the modules in an SDR? [(CO3)(Analyze/HOCQ)]
5 + 7 = 12
5. (a) How is an analog signal converted to a digital signal? Explain the steps with the help of a block diagram. Define quantization error. [(CO3)(Understand/LOCQ)]
(b) Show with a suitable diagram how a quantized signal is produced, considering a uniform sampling process. [(CO3)(Analyze/IOCQ)]
6 + 6 = 12

Group - D

6. (a) How is time synchronization maintained between the transmitter and the receiver? Show how the PLL helps to lock the frequency. [(CO5)(Analyze/IOCQ)]
(b) What is the difference between matching and correlation? How is correlation achieved in receiver? [(CO5)(Understand/IOCQ)]
6 + 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) Define a cognitive radio. How is it different from other radios? Explain the cycle of logical operations in a cognitive radio. [[CO6](Compare/IOCQ)]
(b) Draw the block diagram of a cognitive radio engine and explain the operation of the software defined radio platform. [[CO6](Understand/LOCQ)]
6 + 6 = 12
9. (a) What is BSM group of messages for electric vehicles? What are the services provided by BSM? [[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	48.96	43.75	7.29

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

