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) SDR enables the following:
(a) Change of modulation scheme (b) Change of transmit power level
(c) Change of internal clock frequency (d) None of these

(ii) In an analog radio receiver, the following is true:
(a) LO I is variable (b) LO II is fixed
(c) LO II is equal to 10.245 MHz (d) All three are true

(iii) The device which is most suited for SDR is:
(a) DSP (b) GPP
(c) FPGA (d) Any one

(iv) Gibbs Phenomenon shows the:
(a) Time signals (b) Frequency Signals
(c) Only harmonics (d) (a) and (b)

(v) Phase detection is preferred in PLL as:
(a) Really, the phase locking is necessary
(b) The frequency detection is a slower process
(c) Frequency is derived from phase
(d) Both (c) and (d) are true

(vi) If the Eye-diagram clearance is wider, it indicates that:
(a) Interference is strong (b) Interference is weak
(c) There is no interference (d) All are false

(vii) In the term MCM, the first M stands for:
(a) Mode (b) Multiplex
(c) Multi (d) More

(viii) In OFDM, the angle between the sine and cosine signals is:
(a) 360 degrees (b) 90 degrees
(c) 180 degrees (d) 0 degrees

(ix) The antenna for cognitive radios must have MI as:
(a) The frequency band may change (b) The transmit power level may change
(c) Both (a) and (b) are true (d) All are false

(x) In VANET, the maximum challenge is coming because of:
(a) Response time (b) Use of improper frequency
(c) Interference between different bands (d) Some unknown reason

Fill in the blanks with the correct word

(xi) The SDR software can be _____ by _____ simulator.

(xii) Quantization error happens because the exact value is hardly ever an integral _____ of the _____ .

(xiii) AWGN type noise stands for Additive _____ _____ noise.

(xiv) In the PLL, the _____ is used to lock the _____ .

(xv) In OFDM, _____sub-carriers are used and the transmit power level is kept _____ .

Group - B

2. (a) Explain the significance of RF front-end architecture in SDR and how it influences the overall system performance. What is the ZIF concept? Explain with a block diagram the ZIF architecture. *[(CO1)(Analyse/IOCQ)]*
(b) Explain the significance of GNU radio in SDR system. *[(CO1)(Understand/LOCQ)]*
(4 + 4) + 4 = 12

3. (a) Draw the block diagram of a typical digital radio receiver. Describe the name of each block. *[(CO2)(Understand/LOCQ)]*
(b) Why is source coding and channel coding required? *[(CO2)(Understand/IOCQ)]*
(c) An information packet consists of 4 symbols. The probability associated with the four symbols are as – (i) s1, 0.2; (ii) s2, 0.4; (iii) s3, 0.1 and (iv) s4,0.3. Shannon–Fano coding is applied.
Will the lengths of the encoded bits be same or will be different? Which symbol will require the maximum number of bits and which symbol will require the least number of bits? Explain the reason. *[(CO2)(Apply/HOCQ)]*
5 + 3 + 4 = 12

Group - C

4. (a) What is "Eye-diagram" in digital communication? It is a very important tool to detect ISI – inter symbol interference- explain how it helps to detect ISI.
[(CO3)(Analyse/HOCQ)]

(b) Draw (not–to-scale), Eye diagrams to show (i) rectangular frequency response pulse filtering and (ii) triangular frequency pulse filtering. Is there any difference between the two? Explain. *[(CO3)(Understand/IOCQ)]*

6 + 6 = 12

5. (a) Explain the concept of matched filter in a digital radio receiver circuit. Why is it critical for reliable operation? Draw the schematic diagram of a matched filter at receiver. Show the time-domain input and output signal waveforms for the matched filter. *[(CO5)(Analyse/IOCQ)]*

(b) Given a BER range of 10^(-2) to 10^(-5). The SNR range is from 5 dB to 20 dB. Plot BER vs SNR in a graph (not to scale). *[(CO5)(Analyse/HOCQ)]*

(3 + 3 + 3) + 3 = 12

Group - D

6. (a) Draw the block diagram of typical OFDM system and label the different blocks. What are the functions of the DFT and the IDFT blocks? *[(CO6)(Understand/LOCQ)]*

(b) Show the frequency response of OFDM subcarriers in an OFDM system with a diagram. *[(CO6)(Understand/IOCQ)]*

(6 + 2) + 4 = 12

7. (a) Explain with block diagram the function of the DFE using adaptive FIR equalization. Why is it called equalizer with decision feedback? *[(CO6)(Analyse/IOCQ)]*

(b) Channel equalizers play a vital role in the success of multi carrier OFDM systems-explain. *[(CO6)(Analyse/LOCQ)]*

(6 + 2) + 4 = 12

Group - E

8. (a) Define a cognitive radio. Explain briefly why the CR can be considered an application example of SDR. CR differs from normal radio as it can sense, it can learn and it can adapt- explain the functions. *[(CO6)(Understand/LOCQ)]*

(b) The CR needs some special processors for its architecture. Name some of them. Why is FPGA preferred even though it is not easy to reprogram. *[(CO6)(Remember/LOCQ)]*

(3 + 5) + 4 = 12

9. (a) Where do we see the combination of SDR and CR? In vehicular networking, what are V2V and V2I communications? What are DSRC and WAVE standards? Expand the two. What does MANET stand for? *[(CO6)(Remember/LOCQ)]*

(b) There are three types of VANET applications. Describe those. What are the differences between BSS and IBSS? It is wasteful to form a service set (SS) before any communication starts in VANET. How was it solved by IEEE 802.11p standard? *[(CO6)(Understand/IOCQ)]*

4 + 8 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	38.5	47.9	13.5