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 a software controlled radio, the following parameters can be changed
(a) the channel frequency (b) the volume level
(c) enabling the Bluetooth (d) all of these three.

(ii) Source coding generates number of bits, which
(a) increases with decreasing probability
(b) increases with increasing probability
(c) has no relation to probability
(d) none of these.

(iii) MATLAB can be used to simulate
(a) the modulation scheme switching
(b) the demodulation scheme selection
(c) both (a) and (b)
(d) none is true.

(iv) In a double-sided spectrum, the negative frequency indicates
(a) imaginary frequency
(b) it is higher than the median frequency
(c) it is lower than the median frequency
(d) it is equal to the median frequency.

(v) The best parameter to check receiver performance is
(a) SINAD (b) SNR (c) SIND (d) none of these.

(vi) Channel coding is necessary as it helps to
(a) detect errors (b) correct the errors
(c) both (a) and (b) are true (d) none is true.

(vii) In OFDM, DFT is applied to
(a) Demodulate (b) Multiplex (c) Modulate (d) Multiply.

(viii) DFE stands for
(a) Decision Forward Equalizer (b) Detection Feedback Equalizers
(c) Decision Feedback Equalizers (d) None of these.

(ix) Cognitive radios have the following features
(a) Learn, Adapt and apply (b) Sense, Learn and Adapt
(c) Sense and Learn (d) Learn and Apply.

(x) If the number of nodes in a wireless network is low,
(a) Pro-active routing is good (b) Reactive routing is better
(c) Any one will work (d) Both are not usable.

Fill in the blanks with the correct word

(xi) In a Cognitive radio, the three cycles of operation are sense, _____ and _____.

(xii) The receiver section of a radio requires a _____ to _____ converter before the audio amplifier.

(xiii) In equalizers, the error is reduced by trial and error with a high number of _____ till the error signal is _____ zero.

(xiv) DSDV is a _____ routing _____.

(xv) VANET requires dedicated _____ band so that the response is _____.

Group - B

2. (a) Draw the block diagram of a typical digital radio transmitter. Describe the name of each block. What is the function of the symbol modulator? *[(CO2)(Understand/IOCQ)]*

(b) Which type of modulation should be applied when the SNR value is poor for the link- QAM-4 or QAM-8? Explain your choice of the modulation order. *[(CO3)(Analyse/HOCQ)]*

8 + 4 = 12

3. (a) Why is ADC so important while designing a digital radio? What are the steps in an ADC? What is quantization error and how can it be reduced? What is the function of the sample-and-hold circuit? *[(CO1)(Analyse/IOCQ)]*

(b) A sine signal has a peak-to-peak swing of 10 volts. This signal is being converted to digital form using a 10-bit converter. At an instance T1, the voltage reading is 1.5 volts and at T2, the voltage is 1.7 volts. Encode both the voltages to digital form- both binary and Hex forms. *[(CO1)(Analyse/HOCQ)]*

6 + 6 = 12

Group - C

4. (a) Define and compare the given abbreviations with respect to wireless communication: (i) SNR and SINAD; (ii) THD and (THD+N). *[(CO3)(Understand/IOCQ)]*

(b) An analog signal needs to be sampled before ADC. (i) If the signal contains frequencies- 1 KHz, 2 KHz and 3.5 KHz, what should be the minimum Nyquist rate for sampling? (ii) If 2 KHz signal is replaced by 2.8 KHz signal, what should be the system sampling rate? Justify. *[(CO3)(Analyse/HOCQ)]*

(4 + 4) + 4 = 12

5. (a) Why is probability a very important concept in digital communication? Write the equation to express the probability of a random event in a communication system. Expand the concept to cover a range of sampled values within a range- a to b- and write down the equation for PDF. *[(CO4)(Understand/LOCQ)]*

(b) Write the equations and draw the distribution for the PDFs- (i) Uniform; and (ii) Gaussian function. When do we apply noise of Gaussian type during simulation? *[(CO4)(Analyse/HOCQ)]*

(2 + 2 + 2) + 6 = 12

Group - D

6. (a) What is multi-path signalling? Define the delay spread of a receiver. Show with a diagram the phenomenon of multi-path transmission. Write the equation for multipath signal r(t), explaining the terms. *[(CO6)(Analyse/HOCQ)]*

(b) Draw the receiver block diagram for an OFDM radio with consideration for equalization. Define equalization. *[(CO5)(Understand/IOCQ)]*

(2 + 4 + 2) + (3 + 1) = 12

7. (a) Why is channel equalization very important for radios? The channel response is modulated by training data, derived from the transmitter. Why is this AI approach useful? *[(CO6)(Analyse/IOCQ)]*

(b) Draw the block diagram for an adaptive FIR equalization of a FIR channel using training data. Explain the function of the filter block. *[(CO6)(Understand/IOCQ)]*

(2 + 4) + (4 + 2) = 12

Group - E

8. (a) In a cognitive radio, machine intelligence (MI) is applied extensively. Explain a few modules where the MI plays important role. Who had coined the word Cognitive Radio first? *[(CO6)(Remember/LOCQ)]*

(b) Decisions are made in a CR following two methods. One is Bumblebee behavioural model. How does it differ from those of honeybees? Why is this behaviour more suited for cognitive radios? *[(CO6)(Analyse/HOCQ)]*

6 + 6 = 12

9. (a) In a wireless network, the selection of the correct routing protocol is very critical. What are the important differences between reactive and pro-active protocols? Give at least four differences. *[(CO5)(Remember/LOCQ)]*

(b) What is the full form of DSDV protocol? What type is it? With the help of a network of 8 nodes, develop the route generation table. *[(CO5)(Analyse/HOCQ)]*

4 + 8 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	16.66	39.58	43.76