COGNITIVE RADIOS AND NETWORKS
(ECEN 5241)

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) IEEE 802.22 standard proposed by
(a) WTN (b) WRN (c) RAN (d) RLA.

(ii) Black Space spectral occupancy signifies
(a) Partial interferes (b) Full interferes
(c) Small interferes (d) Negligible interferes.

(iii) CDMA based cellular system is an example of
(a) Adaptive Radio (b) Software Enabled Radio
(c) Aware Radio (d) Both (b) & (c).

(iv) In ZIF, the IF value is
(a) Infinity (b) Zero (c) Variable (d) None of these.

(v) The increase in the bandwidth of the antenna causes the thermal noise power to
(a) decrease linearly (b) increase linearly
(c) increase exponentially (d) decrease exponentially.

(vi) For CR, the candidate processors are
(a) GPP (b) DSP (c) ARM (d) FPGA.

(vii) The European Telecommunication Standard Institute (ETSI) formed a regulatory group of
(a) RRS (b) WRN (c) WAN (d) RLA.

(viii) Agility is the capability of a CR to change
(a) the spectrum (b) the modulation scheme
(c) the transmit power level (d) none of these.

(ix) If the BW of the antenna is increased, the thermal noise power will
(a) decrease linearly (b) increase linearly
(c) increase exponentially (d) decrease exponentially.

(x) Drawbacks of SDR
(a) Difficulty in writing software for various applications
(b) Cant able to support different networks
(c) Does not provide benefits to the manufacturers
(d) Interfacing in easy.

Fill in the blanks with the correct word

(xi) Hyken's proposed Cognitive Cycle completed in _____ steps.

(xii) The range of white space in TV Broadcasting Band _____.

(xiii) GNU Radio operates with programming language known as _____.

(xiv) ARM is a _____ processor.

(xv) Anti-aliasing filters to suitably alter the ____ waveform.

Group - B

2. (a) What is Software-Defined Radio? Discuss the "Antenna Trade off" scheme. *[(CO2)(Analyze/IOCQ)]*

(b) Explain the architecture of SDR with neat diagram. *[(CO3)(Apply/IOCQ)]*

(2 + 4) + 6 = 12

3. (a) What is the meaning of the word "Cognitive" and what do you understand by the phrases "Cognitive Engine" and "Policy Engine"? Highlight the major advantages of a Software Defined Radio. *[(CO2)(Understand/LOCQ)]*

(b) What is an Adaptive Radio? Mention its features. *[[(CO2)(Remember/LOCQ)]*

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

Group - C

4. (a) What are the policy challenges for Cognitive Radios? *[(CO5)(Understand/IOCQ)]*

(b) What is dynamic spectrum access? What is 'Opportunistic Spectrum Access'- explain clearly. Why is it required in cognitive radios? *[(CO4)(Analyse/HOCQ)]*

4 + 8 = 12

5. (a) Draw the Centralised CR Network architecture diagram with labelling of each entity. *[(CO3)(Analyze/IOCQ)]*

(b) What are the 5 spectrum sharing steps in SDR? *[(CO3)(Analyze/IOCQ)]*

7 + 5 = 12

Group - D

6. (a) Cognitive Radio or SDR hardware design is based on multi-core systems and system-on-chip concept. The maximum clock speed of such systems is limited. Explain why. *[(CO4)(Analyse/IOCQ)]*

(b) Four basic design philosophies are used now for SDR software. Describe briefly the Linear programming and OOP approaches. *[(CO4)(Understand/IOCQ)]*

6 + 6 = 12

7. (a) What do you mean by localization in cognitive radio network? *[(CO5)(Understand/LOCQ)]*

(b) Why location awareness is an essential feature in cognitive radio network? *[(CO5)(Evaluate/HOCQ)]*

(c) What are the different classes of security aspect in the cognitive radio network? *[(CO4)(Analyze/IOCQ)]*

3 + 3 + 6 = 12

Group - E

8. (a) What are the differences between under-lay and over-lay types of networks in relation to cognitive radio networks? How can the location of a radio transmitter be identified using radio networks? How can it help to work in under-lay mode? *[(CO6)(Analyse/IOCQ)]*

(b) A cognitive radio network is using a pool of 3 channels. The default channel is 1and any radio can switch to other 2 channels using machine intelligence. Channel 1 detects strong interference on channel 1. How will you program the sets so that automatically, the best channel will be operating?
Work out flow-chart or algorithm to solve the problem. *[(CO6)(Design/HOCQ)]*

6 + 6 = 12

9. (a) What is the difference between spectrum mobility and spectrum handoff? Briefly explain the importance of spectrum mobility in cognitive radio network design. *[(CO4)(Apply/IOCQ)]*

(b) Differentiate centralized and distributed inter-network spectrum sharing. How does the mobility affects the localization process? *[(CO5)(Evaluate/HOCQ)]*

(2 + 4) + 6 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	15.63	60.42	23.96

Course Outcome (CO):

After the completion of the course students will be able to

1. An ability to apply knowledge of mathematics, science and engineering in the emerging areas of RF communication.
2. An ability to analyze a performance in a radio net.
3. An ability to learn and apply modular approach in design.
4. An ability to understand emerging research work in new areas of cognitive radios and spectrum holesensing.
5. Development of a passion to pursue next generation wireless communication.
6. An power of analysis to apply correct technique in locating radios in networks.

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