

**COGNITIVE RADIO - DEPLOYMENT STRATEGY & APPLICATIONS
(ECEN 4245)**

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) What is the range of white space in TV Broadcasting Band?
(a) 84-850 MHz (b) 80-854 MHz
(c) 52-854 MHz (d) 54-852 MHz.
 - (ii) The basic premises of Artificial Intelligence in Cognitive Radio are
(a) Awareness, Reasoning, and Learning (b) Sensing and Applying
(c) Debugging and Reprogramming (d) Monitoring and Reorganizing.
 - (iii) Grey Space spectral occupancy signifies
(a) Partial interferes (b) Full interferes
(c) Small interferes (d) Negligible interferes.
 - (iv) An adaptive radio changes its intermediate frequency characteristics in accordance to which of the following?
(a) Encryption method (b) Enciphering method
(c) Network load (d) Channel characteristics.
 - (v) Hyken's proposed Cognitive Cycle completed in
(a) Three Steps (b) Four Steps
(c) Six Steps (d) Seven Steps.
 - (vi) Full duplex means which of the following?
(a) Only transmission
(b) Only reception
(c) Transmission and reception but not at the same time
(d) Transmission and reception.
 - (vii) IEEE 802.11 specifies operation of WRAN (Wireless Regional Area Network) in TV white space of?
(a) 54 MHz and 862 MHz (b) 2.4 GHz and 5.2 GHz
(c) 100 MHz to 240MHz (d) None of these.

- (viii) Which among the following is not an API of the software communication architecture put forth by the SDR forum?
(a) Physical (b) MAC (c) Security (d) Transport.
- (ix) GNU radio uses which of the following for baseband processing?
(a) DSP (b) GPP (c) FPGA (d) ASIC.
- (x) Which of the following conditions does not affect SNR?
(a) Small signals in an environment of strong interference
(b) Wide band channelized receiver
(c) High fidelity instrumentation
(d) High dynamic range.

Group - B

2. (a) What is Artificial Intelligence? Explain its features. How it is related with Cognitive Radio technology? [(CO2)(Remember/LOCQ)]
(b) Explain the salient specifications of IEEE 802.22 WRAN standard as applied to cognitive radios. [(CO1)(Understand/LOCQ)]
(c) Explain the features of Aware and Adaptive Radio. [(CO1,CO2)(Remember/LOCQ)]
(2 + 2 + 1) + 3 + 4 = 12
3. (a) With a neat diagram, explain cognitive radio operation as a continuous loop. [(CO2)(Remember/LOCQ)]
(b) Why underlay network implementation is more challenging than inter-wave network? Explain. [(CO3)(Analyse/IOCQ)]
(c) Explain the concept of Radio Flexibility and capability in Cognitive Radio. [(CO2)(Apply/IOCQ)]
5 + 4 + 3 = 12

Group - C

4. (a) What are the various computational processing resources in SDR? Explain in details? [(CO1,CO2)(Remember, Understand/LOCQ)]
(b) Illustrate in details about the function of a MODEM and tell how is it implemented? [(CO2)(Apply, Evaluate/IOCQ)]
(c) Write down the basic premises of software communication architecture? [(CO2)(Evaluate/HOCQ)]
3 + (3 + 2) + 4 = 12
5. (a) Discuss the essential features in the application of cognitive radio in the cellular mobile networks? [(CO2)(Understand/LOCQ)]
(b) Categorize the different types of cognitive radio? [(CO2)(Evaluate/HOCQ)]
(c) Illustrate in details about the five spectrum sharing steps in SDR? [(CO2,CO4)(Apply/IOCQ)]
4 + 3 + 5 = 12

Group - D

6. (a) What do you mean by localization in Cognitive Radio Network? Why location awareness is an essential feature in Cognitive Radio Network?
 [(CO5)(Apply/IOCQ)]
- (b) Explain Weighted Centroid Localization algorithm. How accuracy of WCL algorithm can be enhanced?
 [(CO5)(Analyse/IOCQ)]
(2 + 3) + (4 + 3) = 12
7. (a) What is the importance of dynamic spectrum sensing in cognitive radio network?
 [(CO3,C04)(Remember/LOCQ)]
- (b) Illustrate in details about the deployment procedure of the underlay cognitive radio network?
 [(CO3,C04)(Apply/IOCQ)]
- (c) What is the difference between spectrum mobility and spectrum handoff? Briefly explain the importance of spectrum mobility in cognitive radio network design?
 [(CO4)(Remember, Understand/LOCQ)]
3 + 3 + (3 + 3) = 12

Group - E

8. (a) Summarize the key applications of cognitive radio technology in communication system?
 [(CO6)(Evaluate/HOCQ)]
- (b) Illustrate in details about the application areas of matched filter detection?
 [(CO6)(Analyze/IOCQ)]
- (c) What do you mean by localization in cognitive radio network?
 [(CO5)(Remember/LOCQ)]
4 + 4 + 4 = 12
9. (a) Why cooperative spectrum sensing is superior to non-cooperative spectrum sensing? Justify.
 [(CO4)(Analyze/IOCQ)]
- (b) Why cyclostationary based spectrum detection is more reliable than energy detection based spectrum selection scheme?
 [(CO4)(Evaluate/HOCQ)]
- (c) Briefly explain spectral estimation methods.
 [(CO2,C04)(Remember/LOCQ)]
4 + 3 + 5 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	47.92	37.5	14.58

Course Outcome (CO):

After the completion of the course students will be able to

1. Apply knowledge of mathematics, science and engineering in the emerging areas of Wireless Communication System.
2. Understand the under lying technologies and features of cognitive radio network.

3. Analyse the various deployment issues and design challenges of cognitive radio network.
4. Learn different spectrum sensing and detection schemes of cognitive radio.
5. Learn correct technique in locating radios in the network.
6. Pursue research work.

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