

**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) Which of the following is not an advanced requirement in terms of software defined radio?
 - (a) Adaptive diversity
 - (b) Multiband
 - (c) Innovation signalling
 - (d) Adaptive networks.
 - (ii) Which among the following caused the shift of complexity management from networks to cognitive radio?
 - (a) Introduction of multiple bands in radio
 - (b) Introduction of multiple modes in radio
 - (c) Introduction of multiple bands and multiple modes in radio
 - (d) Elimination of multiple bands in radio.
 - (iii) Which of the following connects sources that are physically remote from the radio node?
 - (a) INFOSEC
 - (b) RF/Channel access
 - (c) Network support
 - (d) Communication services.
 - (iv) In which of the following, radio access technologies use the same frequency band?
 - (a) Network centric approach
 - (b) Spectrum sharing
 - (c) Spectrum sensing
 - (d) RF band centric approach.
 - (v) 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.
 - (vi) Which of the following proposes the presence of secondary users for improved spectral efficiency?
 - (a) Cognitive radio
 - (b) Software defined radio
 - (c) Software capable radio
 - (d) Programmable digital radio.

- (vii) Which among the following is not a transmission detection technique?
(a) Matched filter detection (b) Energy detection
(c) Cyclostationary detection (d) Interference based detection.
- (viii) Localization of a primary user means
(a) Locate the exact coordinate (b) Locate the channel frequency
(c) Locate the interference level (d) None of these.
- (ix) Gray Space spectral occupancy signifies
(a) Partial interferes (b) Full interferes
(c) Small interferes (d) Negligible interferes.
- (x) Distributive Cognitive Radio network means
(a) Fusion centre based network (b) Infrastructure based network
(c) Local Sensing based network (d) Data network.

Group - B

2. (a) With the help of proper diagram, explain the cognitive cycle which was proposed by Mitola. [(CO1)(Understand/LOCQ)]
(b) Compare between underlay, overlay and interweave cognitive radio techniques. [(CO2)(Analyze/IOCQ)]
(c) Explain how artificial intelligence is related with cognitive radio technology. [(CO1,CO2)(Evaluate/HOCQ)]
5 + 4 + 3 = 12
3. (a) Explain the antenna trade off in cognitive radio. [(CO1,CO2)(Understand/LOCQ)]
(b) Differentiate the features of between software enable radio and software defined radio. [(CO1,CO2)(Remember/LOCQ)]
(c) Explain the significance of SDR in future wireless communication system. [(CO1,CO3)(Analyze/IOCQ)]
5 + 4 + 3 = 12

Group - C

4. (a) Categorize the different types of spectrum spaces in spectrum sensing. [(CO4)(Analyze/IOCQ)]
(b) Explain in details about the spectrum sensing with matched filter detection. [(CO4)(Evaluate/HOCQ)]
(c) Discuss the main advantages of cooperative spectrum sensing. [(CO4)(Understand /LOCQ)]
3 + 5 + 4 = 12
5. (a) Write in details about the cyclostationarity-based detection in spectrum sensing. [(CO4)(Evaluate/HOCQ)]
(b) Outline the security threats present in dynamic spectrum access environments. [(CO3,CO4)(Remember/LOCQ)]

- (c) Why underlay network implementation is more challenging than interwave network?
[[CO4](Apply/IOCQ)]

5 + 3 + 4 = 12

Group - D

6. (a) Centralized localization is more efficient than distributed localization. Justify the statement.
[[CO5](Analyze/IOCQ)]
(b) What are the different class of security aspect of the cognitive radio network?
[[CO3](Evaluate/HOCQ)]
5 + 7 = 12
7. (a) What do you mean by localization in Cognitive Radio Network? Why location awareness is an essential feature in Cognitive Radio Network?
[[CO5](Understand/LOCQ)]
(b) Explain Weighted Centroid Localization algorithm. How accuracy of WCL algorithm can be enhanced?
[[CO5](Apply/IOCQ)]
6 + 6 = 12

Group - E

8. (a) How cellular communication can be enhanced by cognitive radio technology?
[[CO1,CO6](Apply/IOCQ)]
(b) Explain the application of cognitive radio in the health care and E Medication.
[[CO6](Analyze/IOCQ)]
6 + 6 = 12
9. (a) What are significance of cognitive radio resources optimization? How resource optimization can enhance system performance in dense urban scenarios?
[[CO2,CO3](Evaluate/HOCQ)]
(b) Why cognitive application more economical than conventional radio applications? Explain.
[[CO6](Analyze/IOCQ)]
8 + 4 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	28.12	42.71	29.17

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. Analyze 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.