

**COGNITIVE RADIOS AND NETWORKS  
(ECEN 5241)**

**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) GNU Radio operates with programming language known as
    - (a) FORTRAN
    - (b) COBOT
    - (c) JAVA
    - (d) PYTHON.
  - (ii) IEEE 802.22 standard proposed by
    - (a) WTN
    - (b) WRN
    - (c) RAN
    - (d) RLA.
  - (iii) 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.
  - (iv) Black Space spectral occupancy signifies
    - (a) Partial interferes
    - (b) Full interferes
    - (c) Small interferes
    - (d) Negligible interferes.
  - (v) Matched filtering is basically
    - (a) Modulation Technique
    - (b) Multiplexing Technique
    - (c) Demodulation Technique
    - (d) De-multiplexing Technique.
  - (vi) Hyken's proposed Cognitive Cycle completed in
    - (a) Three Steps
    - (b) Four Steps
    - (c) Six Steps
    - (d) Seven Steps.
  - (vii) CDMA based cellular system is an example of
    - (a) Adaptive Radio
    - (b) Software Enabled Radio
    - (c) Aware Radio
    - (d) Both (b) & (c).

- (viii) The European Telecommunication Standard Institute (ETSI) formed a regulatory group of  
(a) RRS (b) WRN  
(c) WAN (d) RLA.
- (ix) What is the wireless communications technology used in retail operations to identify and secure merchandise?  
(a) ISM (b) RFID  
(c) UNII (d) Micro Sensors.
- (x) 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.

### Group - B

2. (a) What is the meaning of the word “Cognitive” and what do you understand by the phrases “ Cognitive Engine” and “Policy Engine”? *[[CO1, CO2](Understand/LOCQ)]*  
(b) What is an Adaptive Radio? Mention its features. *[[CO2](Remember/LOCQ)]*  
**5 + (3 + 4) = 12**
3. (a) What is the significance of software defined radio? Explain the essential features of SDR. *[[CO1, CO2](Remember/LOCQ)]*  
(b) Explain the architecture of SDR with neat diagram. *[[CO3](Apply/IOCQ)]*  
**5 + 7 = 12**

### Group - C

4. (a) Why should the cognitive radio resources be optimized? Explain. *[[CO2](Analyze/IOCQ)]*  
(b) Learning based radio works more efficiently compare to software controlled radio. Justify the statement. *[[CO1, CO5](Evaluate/HOCQ)]*  
**5 + 7 = 12**
5. (a) Write the key applications of cognitive radio technology in communication system. *[[CO2](Understand/LOCQ)]*  
(b) The deployment procedure of underlay cognitive radio network is more challenging than inter-wave network. Explain. *[[CO2](Evaluate/HOCQ)]*  
**5 + 7 = 12**

### Group - D

6. (a) What do you mean by Denial of Service and Primary User Emulation Attack? *[[CO2, CO6](Apply/IOCQ)]*  
(b) Classify Cognitive Radio Users based on spectrum occupancy and usage. *[[CO4](Understand/LOCQ)]*  
**6 + 6 = 12**

7. (a) What are the different class of security aspect in the cognitive radio network?  
[[CO4](Analyze/IOCQ)]
- (b) Underlay communication is more secure over the overlay communication. Justify this statement.  
[[CO3](Evaluate/HOCQ)]
- 7 + 5 = 12**

### Group - E

8. (a) What do you mean by spectrum sensing and detection? Derive test static of energy detector for analog signal. What are the critical factors while designing any energy detector and why?  
[[CO4](Remember/LOCQ)]
- (b) Differentiate between centralized and distributed inter-network spectrum sharing.  
[[CO4](Understand/LOCQ)]
- (2 + 4 + 3) + 3 = 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) How can the hidden and exposed terminal problem can be minimized in cognitive radio network?  
[[CO3](Analyze/IOCQ)]
- 5 + 7 = 12**

<i>Cognition Level</i>	<i>LOCQ</i>	<i>IOCQ</i>	<i>HOCQ</i>
<i>Percentage distribution</i>	41.67	38.55	19.78

#### 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 hole sensing.
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.*

