M.TECH/ECE/2ND SEM/ECEN 5241/2022

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)   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.

    (ii)   To avoid aliasing, the wideband ADC is ___ by anti-aliasing filters to suitably
           alter the ____ waveform.
           (a) succeeded, digital   (b) preceded, digital
           (c) succeeded, analog   (d) preceded, analog

    (iii) Matched filtering is basically
           (a) modulation technique   (b) multiplexing technique
           (c) demodulation technique   (d) demultiplexing technique.

    (iv)   A radio that supports ___ channel bandwidths is ___
           (a) joint, adaptive   (b) joint, not adaptive
           (c) multiple, not adaptive   (d) multiple, adaptive

    (v)   Mitola's proposed Cognitive Cycle completed in
           (a) three steps   (b) four steps
           (c) six steps   (d) seven steps.

    (vi)   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.

    (vii) "Plug and play" in SDR signifies
           (a) industry wide component reuse (b) CORBA applications
           (c) predictability   (d) both (a) & (c).

(viii) Primary emulation attack affects
     (a) Cognitive Users   (b) Primary Users
     (c) Fusion Centres   (d) Cellular Networks.

(ix) Which of the following is used in base station applications?
     (a) Super heterodyne receiver   (b) Direct conversion receiver
     (c) Digital-RF receiver   (d) Homodyne receiver.

(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) What is Software-Defined Radio? Discuss the "Antenna Trade off" scheme.
                                        [(CO2)(Analyze/IOCQ)]
    (b) 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)]
                                        (2 + 4) + (4 + 2) = 12

3. (a) Define software flexibility and affordability. What are functional components in SDR.   [(CO2)(Remember/LOCQ)]
    (b) Explain the various interface topologies available for SDR.
                                       [(CO3)(Analyze/IOCQ)]
                                        (3 + 3) + 6 = 12

Group - C

4. (a) Define dynamic spectrum access. What is spectrum pooling and bandwidth exchange?   [(CO3)(Understand/LOCQ)]
    (b) Explain Security issues of overlay cognitive users? Explain one technique to minimize hidden terminal problem in cognitive radio network?
                                       [(CO3)(Analyze/IOCQ)]
                                          6 + 6 = 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) What do you mean by denial of service and primary user emulation attack?
                                       [(CO3)(Understand/LOCQ)]

    (b)   Briefly explain the deployment procedure of underlay cognitive radio network. Why underlay network implementation is more challenging than inter-wave network?   [(CO3)(Evaluate/HOCQ)]

                                                                     4 + 8 =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)   Describe the design rules in detail for cognitive radio.   [(CO3)(Understand/LOCQ)]

                                                                     3 + 3 + 6 = 12

Group – E

8.   (a)   Define spectrum efficiency under cognitive radio. How is spectrum efficiency dependent on the various aspects of CR?   [(CO4)(Apply/IOCQ)]

    (b)   Why threshold optimization is important in energy based sensing method?   [(CO4)(Evaluate/HOCQ)]

                                                                      6 + 6 = 12

9.   (a)   What are the upper layer issues in cognitive radio networks? What are the cross layer challenges in upper layers?   [(CO5)(Analyze/IOCQ)]

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

                                                                       6 + 6 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	32.29	43.75	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 RFcommunication.
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