NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR

Even Semester End-term Examination, 2021-22

Course Code: ECE 610 Full Marks: 30

Course Name: Artificial Intelligence and Soft Computing Time: 90 Minutes

Question Paper No.: NITDGP/ECE610/1 Date of Exam: 21/04/2022

Instructions: Answer all the questions.

Materials to be supplied: Graph paper shall be supplied, if required.

Question No.	Body of the Question	Marks	Mapped CO
1	The following function is to be minimized using Flower Pollination Algorithm: $F= X_1^2 +X_2^2+X_3^2$ Initial random population is $\begin{bmatrix} -4.3 & -6.8 & 8.7 \\ 3.2 & -7.5 & 7.4 \\ -3.1 & 2.7 & -6.4 \end{bmatrix}$. Upper and lower bound of every variable is +10 and -10 respectively. Apply the usual equation in the global pollination only $x_i^{t+1} = x_i^t + L(best\_solution - x_i^t)$ and calculate new solution set at the end of first iteration after comparing it with the initial. Assume Levy flight(L)=0.02 . Calculate the best solution and its value at the end of first iteration in the global pollination only. Limit the variable value to the upper and lower bound if anyone is trying to cross in either direction	12	CO2
2	Explain the basic principles of Heuristic Cross over and non-uniform mutation in connection to Real coded GA.	08	CO1
3	The following data set is to be clustered into two groups (K=2) using K-means clustering. Generate the two groups and determine the center of each group: Assume [-3.6, -2.1], [2.4, -6.1] are the initial centers of two groups. Show all the steps	10	CO4

Individual	X_1	X_2
1	4.2	-2.8
2	-3.6	-2.1
3	2.3	4.6
4	-3.6	5.4
5	2.4	-6.1

Course Outcomes

CO1: Basics of optimization and soft computing algorithms

CO2: Learn different soft computing algorithms

CO4: Study of radial basis function neural and its training

2021 -2022

ECE 612
Advanced Digital Communications

Time: 1 hr. 30 mins. Full Marks: 30

All questions are compulsory

1. Answer the following questions
(a) Define pseudo noise sequence and chip.
(b) A DS-BPSK system uses a feedback shift register of length 19 for the generation of the PN sequence. Calculate the processing gain of the system.
(c) Explain why MFSK is used in FH-Spread Spectrum.

[1+2+2 = 5]

2. A slow FH-MFSK signal has the following parameters:

Number of bits per MFSK symbol,	$n = 2$
Number of MFSK tones,	$M = 2^n = 4$
Length of PN segment/subsequence per hop,	$k = 3$
Total number of frequency hops,	$2^k = 8$

In this system, each hop of carrier carries two symbols or four information bits. The period of the PN sequence is $2^4 - 1 = 15$.
In a schematic diagram, show the variation of frequency with time of this slow FH-MFSK signal for one period of PN sequence. Also show the variation of MFSK tones with time. Bits sequence and PN sequence are as follow
Information bit sequence : 0 1 0 1 1 1 1 0 0 1 0 0 0 1 1 1 1 1 1 0
PN sequence : 1 0 0 1 0 0 1 1 0 0 1 1 1 0 0

[5]

3. (a) A 1-watt information bearing signal of bandwidth 10 KHz is spread in a bandwidth of 100 MHz using a frequency-hopping technique that makes 10,000 hops per second.
Determine for what percentage of time the signal is present in a slice, and the average power density of the spread signal.
(b) Distinguish between direct-sequence and frequency-hop spectrum spreading techniques.

[2+3 = 5]

4. (a) In a CDMA system, how does an individual user's signal is recovered ?
(b) Show the generation of orthogonal PN sequences.

[2+3 =5]

5. In an M-ary transmission system, the channel characteristics is as that of AWGN channel. As per maximum likelihood detection criterion the following decision rule is used to decode each symbol

Set $\hat{m} = m_i$ if
$\Sigma_{j=1}^{n}(x_j - s_{kj})^2$ is minimum for $k = i$

Derive an equivalent decision rule from the above rule which is related to correlation of the received signal vector $\mathbf{X}$ and the signal vector $\mathbf{S}_k$. All the symbols have their usual meanings.

[5]

contd .....

6. (a) Briefly explain the reason of introducing OFDM?
(b) Mention the applications of OFDM.

[3+2 = 5]

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National Institute of Technology, Durgapur

Department of Electronics and Communication Engineering

Session-2021-2022, Even Semester, ECE621

Final examination

Full marks 30 **Time 90 min**

1. A strain gauge material has a Poisson's ratio ν, resistivity ρ, and longitudinal strain ε_L. Derive an expression for the gauge factor (G) of that strain gauge. Suppose the same strain gauge experiences a strain of 0.001. Calculate the change in resistance in ohm in that strain gauge if the gauge factor G $= -120$ and the initial resistance is 1 kΩ.. What does negative gauge factor indicate? [5]

2. Explain the effect of series mode noise through inductive coupling and the effect of parallel mode noise through capacitive coupling. [5]

3. How to define reliability of a system? Discuss the reliability of a system consisting of *n* number of blocks connected in series. [5]

4. Explain loading effect in a system with an example. Discus with an example that the loading effect can introduce nonlinearity. [5]

5. Short note: (a) Bandwidth (b) Wear and aging effect of a system (c) Two port network (d) Thermal noise (e) Power spectral density [5x2=10]