M.Tech ECE Sem.-2

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M.Tech (ECE), Semester- 2rd

NEURAL NETWORKS

Subject Code: 25C1ECP-PE3-03

M. Code:

Date of Examination: 08-05-2026

Time: 3 Hrs. Max. Marks: 60

INSTRUCTIONS TO CANDIDATES:

1. Attempt any FIVE questions out of EIGHT questions.
2. Each question carries TWELVE marks.

Q. No.	Question	CO	BL
1.	Explain the concept of learning in Neural Networks. Describe the different types of learning with suitable examples. Also, outline the key characteristics and differences among these learning approaches.	CO1	L2
2.	Apply the concept of a Fuzzy Inference System (FIS) to determine the output for a given problem.. Consider a system with input variable 'Temperature' and output variable 'Fan Speed' with the following membership values: • Temperature (°C): Low = 0.2, Medium = 0.6, High = 0.8 • Rules: 1. IF Temperature is Low THEN Fan Speed is Slow. 2. IF Temperature is Medium THEN Fan Speed is Moderate. 3. IF Temperature is High THEN Fan Speed is Fast 4. Output membership (Fan Speed): Slow = 0.3, Moderate = 0.5, Fast = 0.9 a) Apply the fuzzy inference process to determine the aggregated output. b) Perform defuzzification using the centroid method to obtain the crisp output.	CO2	L3
3.	Analyze the architecture and working of a Hopfield Network . Construct a Hopfield Network to store the pattern (11011) using the Hebbian learning rule, compute the weight matrix to recall the stored pattern.	CO1	L4
4.	Apply the working principles of a Neuro-Fuzzy Hybrid System in solving a real-world problem. Construct a simple Neuro-Fuzzy model by defining input membership functions, fuzzy rules, and explain how learning is achieved using neural network techniques.	CO4	L3

5.a)	Given a fuzzy set G defined on universe $G = \{(x_1, 0.0), (x_2, 0.3), (x_3, 0.7), (x_4, 1.0), (x_5, 0.5)\}$ Determine Core, support and height of Fuzzy set G . Also find α-cut for α=0.5.	CO2	L5
b)	Given two fuzzy relations RRR and SSS defined on the sets X= { x1, x2} and Y={y1, y2, y3} $R = \begin{bmatrix} 0.2 & 0.7 & 0.5 \\ 0.6 & 0.3 & 0.8 \end{bmatrix}$, $S = \begin{bmatrix} 0.4 & 0.5 & 0.6 \\ 0.2 & 0.9 & 0.7 \end{bmatrix}$ Compute the union R∪S and intersection R∩S using standard fuzzy operations.		
5.	Evaluate the effectiveness of crossover and mutation operators in a Genetic Algorithm (GA) in terms of maintaining diversity and achieving convergence. Given the parent chromosomes (P1 = 110011) and (P2 = 101101):	CO4	L5
a)	Perform two-point crossover with cut points between positions 2–3 and 4–5 to generate offspring.		
b)	Apply bit-flip mutation at position 3 on one of the offspring.		
c)	Critically assess how the crossover and mutation operations have altered the genetic structure of the chromosomes. Justify whether the applied operations improve or degrade the search efficiency of the GA.		
7.a)	Analyze different selection strategies in Genetic Algorithms and compare roulette wheel selection and rank-based selection in terms of selection pressure and convergence behavior.	CO4	L4
b)	Given the population and fitness values: **Chromosome Fitness** 1110 7 1011 5 1001 4 0110 2 Perform roulette wheel selection to choose two parents. Calculate selection probabilities and analyze which chromosomes are more likely to be selected and why.		
8.	Critically evaluate the effect of linguistic hedges on fuzzy set representation. Consider the fuzzy statement 'Speed is fast' defined over the universe. (S = {20, 40, 60, 80, 100}) (in km/h) with the membership function: F = {(20, 0.1), (40, 0.4), (60, 0.7), (80, 0.9), (100, 1.0)}	CO3	L5
a)	Construct the modified fuzzy sets corresponding to the linguistic hedges 'slightly', 'very', and 'not fast'. Compute the new membership values for each hedge using appropriate operations.		
b)	Critically compare the effect of these hedges on the original fuzzy set in terms of expansion, concentration, and complement.		
c)	Evaluate which hedge is more appropriate for cautious decision-making and which supports broader interpretation, justifying your answer with reasoning.		

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M.Tech (ECE), Semester- 2nd

NANO ELECTRONICS

Subject Code: 25C1ECP-PE4-01

M.Code:

Date of Examination: 09-05-2026

Time: 3 Hrs.

Max. Marks: 60

INSTRUCTIONS TO CANDIDATES:

1. Attempt any FIVE questions out of EIGHT questions.
2. Each question carries TWELVE marks.

Q. No.	Question	CO	BL
1.	Interpret the working principle of Infrared (IR) spectroscopy in terms of its interaction with molecular vibrations and the role of functional groups in IR absorption.	CO3	L2
2. a.	Identify the distinguishing features of single-walled and multi-walled carbon nanotubes.	CO2	L3
b.	Make use of the vibrational properties of nanotubes to interpret Raman spectroscopy results.		
3.	Examine how dimensionality governs the behavior of nanostructures by comparing the structural, electronic, and physical properties of zero, one, and two dimensional systems with suitable examples.	CO1	L4
4.	Apply the principles of quantum interference to explain the switching behavior of a Quantum Interference Transistor, considering how constructive and destructive interference control electron transport and device operation.	CO4	L3
5. a.	Compare the CVD method with arc discharge and laser ablation techniques for nanotube synthesis.	CO2	L5
b.	Criticize the limitations of nanotube applications in real-world engineering systems.		
6.	Justify the preference for High Electron Mobility Transistors (HEMTs) in high-speed applications, with emphasis on their superior carrier transport mechanisms and material properties.	CO4	L5
7. a.	Differentiate the working mechanism of a Quantum Interference Transistor from a Single Electron Transistor (SET).	CO4	L4
b.	Distinguish the one-dimensional lattice structure of Carbon Nanotubes from the three-dimensional crystal structure of silicon-based transistors.		
8	Recommend suitable operating conditions for Atomic Force Microscopy (AFM) in nano-scale surface analysis, considering different modes of operation, sample characteristics, and instrumental limitations.	CO3	L5

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M.Tech (ECE), Semester- 2nd

Advanced Digital Signal Processing

Subject Code: 25C1ECP-202

M.Code:

Date of Examination: 07-05-2026

Time: 3 Hrs.

Max. Marks: 60

INSTRUCTIONS TO CANDIDATES:

1. Attempt any FIVE questions out of EIGHT questions.
2. Each question carries TWELVE marks.

Q. No.	Question	CO	BL
1.	Describe the principle of Wiener filtering for both signal filtering and prediction, and explain how it minimizes the mean square error in noisy environments.	CO3	L2
2 a.	Solve a decimation problem where an input signal sampled at 48 kHz is down sampled by a factor of 4. Determine the new sampling rate and design the required anti-aliasing filter specifications.	CO2	L3
b.	Compute the output sampling rate of a system where a signal sampled at 96 kHz is first decimated by 3 and then interpolated by 2.		
3.	Categorize digital filters into FIR and IIR types based on their stability, phase response, and computational complexity, and discuss the distinguishing characteristics of each category.	CO1	L4
4.	Compute the RLS gain vector for: Input $x(n) = [1 \quad 1]^T$, forgetting factor $\lambda = 0.9$, $P(n-1) = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$.	CO4	L3
5 a.	Compare different sampling rate conversion techniques in multirate DSP, focusing on their performance, efficiency, and practical limitations.	CO2	L5
b.	Defend the preference of polyphase filter implementation in sampling rate conversion systems based on computational savings and efficient realization.		
6.	Recommend an appropriate nonparametric spectral estimation technique for analyzing random signals, considering computational simplicity and accuracy.	CO4	L5
7 a.	Examine the minimum mean square error (MMSE) criterion and its significance in the design of optimum adaptive filters.	CO4	L4
b.	Distinguish between wavelet transform and Fourier transform in terms of time-frequency localization and applications.		
8	Justify the preference of lattice structures for AR and ARMA filters, considering their advantages in stability, modularity, and reduced sensitivity to coefficient variations.	CO3	L5

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M.Tech (ECE), Semester- 2nd

ANTENNA AND RADIATING SYSTEMS

Subject Code: 25C1ECP-201

M.Code:

Date of Examination: 06-05-2026

Time: 3 Hrs.

Max. Marks: 60

INSTRUCTIONS TO CANDIDATES:

1. Attempt any FIVE questions out of EIGHT questions.
2. Each question carries TWELVE marks.

Q. No.	Question	CO	BL
1.	Describe radiation mechanism of single wire, two wire and dipole of an antenna.	CO1	L2
2. a)	Solve expression for field for antenna array of two isotropic point sources of equal amplitude & same phase.	CO2	L3
b)	Identify the ground effects in linear wire antennas.		
3.	Analyse the significance of the Friis transmission equation in determining the received power in a communication link.	CO1	L4
4.	Examine the construction & working of Microstrip patch antenna with applications.	CO4	L4
5. a)	Explain the mechanism of circular loop with non-uniform current distribution.	CO2	L5
b)	Interpret the physical significance of reactive near-field, radiating near-field, and far-field regions in a dipole antenna.		
6.	Compare between contacting and non-contacting feed mechanisms in micro strip patch antenna.	CO4	L5
7. a)	Write the fundamental principle of MIMO systems with respect to antenna configuration and operation.	CO4	L3
b)	Construct cassgrain reflector on the basis of working principle, design equations and applications.		
8	Evaluate the expression of array factor of uniform array of n isotropic point sources having equal amplitude and spacing.	CO3	L5

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