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JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -2 EXAMINATIONS- 2026

B.Tech-VI Semester (ECE)

COURSE CODE (CREDITS): 18B1WEC632 MAX MARKS: 25

COURSE NAME: INTELLIGENT CONTROL SYSTEMS

COURSE INSTRUCTOR: Dr Rajiv Kumar MAX. TIME: 1 Hour 30 Min

Note: *(a) All questions are compulsory.*
(b) The candidate is allowed to make Suitable numeric assumptions wherever required for solving problems
(c) Use of non-programmable calculator is allowed

Q.No	Question	CO	Marks
Q1	A) A temperature control system uses a sensor with sensitivity of 0.05 V/°C and an actuator that adjusts heating power at a rate of 10 W per volt input. If the desired temperature is 50°C and the current measured temperature is 40°C:Determine: i. Sensor output voltage. ii. Calculate the control signal required to eliminate the error (assume a proportional controller with gain Kp=2. B) Explain the concept of an intelligent control system. Also, highlight the need for intelligent systems in modern engineering applications. C) Explain the structure and working of an Artificial Neural Network (ANN). Compare a biological neuron with an artificial neuron and discuss different types of ANN architectures with suitable diagrams.	CO-2	2+2+2=6
Q2	A) Why is Fuzzy Logic considered suitable for intelligent control systems? Discuss its advantages. B) Define a fuzzy set and membership function. How does a membership function represent uncertainty in real-world systems? C) A fuzzy set A (Temperature) is defined over the range 0°C to 40°C with the membership function: $\mu_A(x) = \begin{cases} 0 & x \le 10 \\ \frac{x-10}{10} & 10 < x < 20 \\ 1 & x \ge 20 \end{cases}$ Find the membership values for: (i) x = 5°C (ii) x = 15°C (iii) x = 25°C	CO-2	2+2+2=6

Q3	A) Explain the concept of adaptive control. Differentiate between direct adaptive control and indirect adaptive control with suitable block diagrams and examples. B) A second-order system is described by: $$G(s) = \frac{1}{s^2 + 3s + 2}$$ Design a state feedback controller such that the closed-loop poles are placed at $-2 \pm j2$	CO-3	4
Q4	A) Explain the concept of parameter estimation in adaptive control systems. Discuss how parameter estimation is used in self-tuning regulators (STR) and its impact on system performance. B) Consider an under-actuated mechanical system with uncertain parameters. • Explain how adaptive control can be applied to stabilize the system. • Formulate the control law using a suitable adaptive technique. • Briefly discuss its application in flight control systems or robot manipulators.	CO-3	2.5+2.5 = 5
Q5	Carefully study the following statement and respond to the question that follows: *In contemporary control engineering, systems are required to maintain consistent and stable performance despite the presence of uncertainties, external disturbances, and nonlinear dynamics. To meet these demands, modern control approaches integrate intelligent algorithms with adaptive control techniques to enhance system robustness and adaptability. By combining sensors, actuators, and computational intelligence, such systems can continuously observe their behavior and automatically adjust control parameters in real time. Methods like self-tuning regulators and pole placement are widely employed to ensure that system performance remains within desired specifications. These advanced strategies find broad applications in areas such as industrial automation, robotics, and aerospace systems, often utilizing simulation tools like MATLAB for design and analysis.* **Question:** Analyze the role of adaptive control in real-world engineering systems. Compare various adaptive control methods and critically examine their effectiveness in applications such as industrial processes, robotic systems, and aerospace engineering.	CO-4	4