

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST-3 EXAMINATION – 2026

B.Tech–VIII Semester (CSE)

COURSE CODE (CREDITS): 25B1WEC832 (2)

MAX. MARKS: 35

COURSE NAME: Intelligent Robotics and Autonomous Systems

COURSE INSTRUCTORS: Dr. Vikas Baghel

MAX. TIME: 2 Hours

Note: (a) All questions are compulsory.

(b) The candidate is allowed to make suitable numeric assumptions wherever required for solving problems.

(c) Use of calculators is allowed.

| Q.No | Question                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | CO  | Marks          |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|----------------|
| Q1   | <p>(a) What are lifecycle nodes in ROS 2? Name the major lifecycle states of a managed node and write one advantage of lifecycle management in robot bringup.</p> <p>(b) In Nav2, how is a NavigateToPose request handled? Briefly explain the roles of BT Navigator, Planner Server, Controller Server, and Behavior Server, and state why both global and local costmaps are needed.</p>                                                                                                                                                                                    | CO1 | [2]<br><br>[3] |
| Q2   | <p>(a) What are forward kinematics and inverse kinematics for a wheeled robot? For the unicycle model</p> $\dot{x} = v \cos \psi, \quad \dot{y} = v \sin \psi, \quad \dot{\psi} = \omega,$ <p>identify the state variables and control inputs. What type of motion is obtained when <math>\omega = 0</math>?</p> <p>(b) For a differential-drive robot, describe what happens in the following cases: (i) <math>v_r = v_l</math>, (ii) <math>v_r &gt; v_l</math>, and (iii) <math>v_r = -v_l</math>. Also explain the meaning of ICC (Instantaneous Center of Curvature).</p> | CO2 | [3]<br><br>[4] |
| Q3   | <p>(a) Differentiate localization and mapping. List any three sensors used in mobile robots for localization or mapping, and write one use of each sensor.</p>                                                                                                                                                                                                                                                                                                                                                                                                                | CO3 | [3]            |

| Q.No | Question                                                                                                                                                                                                                                                                                                                                                                                        | CO  | Marks                 |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----------------------|
|      | (b) What is sensor fusion? Why is uncertainty important in localization and mapping? Write any two outputs of a robot-vision system and mention one metric used to evaluate robot vision.                                                                                                                                                                                                       |     | [4]                   |
| Q4   | <p>(a) What is path planning in robotics? Explain the meanings of <math>g(n)</math>, <math>h(n)</math>, and <math>f(n) = g(n) + h(n)</math> in A* search.</p> <p>(b) Write the basic steps of the RRT algorithm. Briefly explain the roles of Pure Pursuit, PID control, and MPC in robot navigation or control.</p>                                                                            | CO4 | <p>[3]</p> <p>[5]</p> |
| Q5   | <p>(a) What is AI-based perception in robotics? Write any three kinds of information that a deep-learning vision system can provide to a robot.</p> <p>(b) Explain how AI helps in autonomous decision-making. Why should robot decisions consider uncertainty? Give one example where perception output affects navigation action, and mention one evaluation criterion for AI perception.</p> | CO5 | <p>[3]</p> <p>[5]</p> |