

Register No.: ..... Name: .....

**SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)**

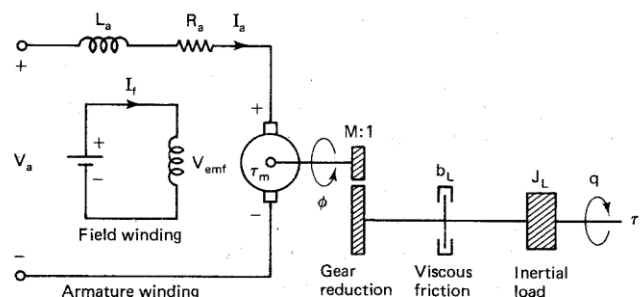
(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

**SIXTH SEMESTER B.TECH DEGREE EXAMINATION (R), MAY 2024****(2020 SCHEME)****Course Code : 20RBT392****Course Name: Advanced Control for Robotics****Max. Marks : 100****Duration: 3 Hours****PART A****(Answer all questions. Each question carries 3 marks)**

1. Examine the role of PID Controller in single-axis robot manipulators.
2. Differentiate between open loop control and closed loop control.
3. List the limitations of linear controllers in robotic systems.
4. Define the Lyapunov function and explain its role in analyzing stability.
5. List the industrial operations where the force control of robot manipulators is significant.
6. Differentiate between natural and artificial constraints in force control.
7. Illustrate the state space model of a skid-steer robot.
8. List the challenges of implementing computed torque control in mobile robots.
9. Classify the types of visual servoing mechanisms in robots.
10. How to develop a control mechanism for a robot manipulator using a vision system.

**PART B****(Answer one full question from each module, each question carries 14 marks)****MODULE I**

11. a) Illustrate the working of a single-axis PID controller with the help of a block diagram. (8)
- b) Examine the transfer function of an electric motor with load in robotic systems in reference to the following figure. (6)



OR

12. a) Differentiate between continuous and discrete time control frameworks. (8)  
 b) Examine how disturbance rejection is integrated into closed-loop control algorithms. (6)

**MODULE II**

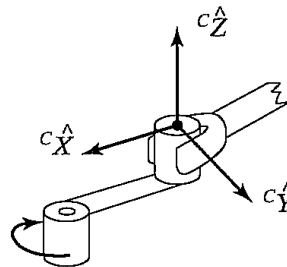
13. a) Illustrate the working of computed torque control with the help of a block diagram. (8)  
 b) Differentiate between computed torque control and PD gravity control. (6)

OR

14. a) Illustrate the resolved motion rate control of the 2R manipulator with the help of diagrams. (7)  
 b) Illustrate the working of the adaptive manipulator controller. (7)

**MODULE III**

15. a) Examine the artificial and natural constraints of the system shown below.

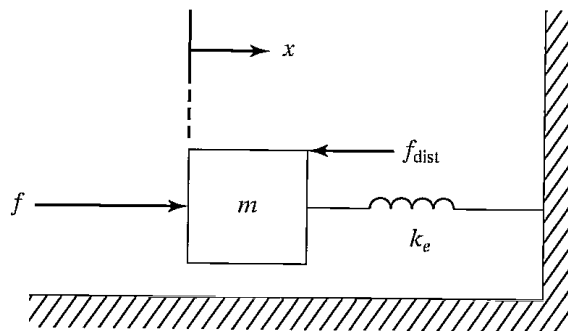


(9)

- b) List the objectives of the hybrid position and force control problems. (5)

OR

16. a) Examine the force control of mass-spring system shown below.



(7)

- b) Illustrate how a control algorithm can be implemented for a cartesian manipulator with three degrees of freedom. (7)

**MODULE IV**

17. a) Differentiate between resolved motion rate control and resolved motion acceleration control in mobile robot. (8)  
b) Describe the selection criteria of controllers for mobile robots. (6)

**OR**

18. a) Examine the constraints involved in the navigation of a wheeled mobile robot. (5)  
b) Illustrate the Lyapunov stability criteria in mobile robots. (9)

**MODULE V**

19. a) Demonstrate the techniques involved in image processing. (8)  
b) Examine how the pose of an object can be estimated using a position-based visual servoing process. (6)

**OR**

20. a) List the advantages and disadvantages of using vision systems for robot control. (8)  
b) Explain the role of camera calibration in image-based visual servoing. (6)

\*\*\*\*\*