BMS College of Engineering, Bangalore-560019

Subject	ROBOTICS	Sub. Code	IT6GERBS
Credit	4	L-T-P	4-0-0

UNIT 1: INTRODUCTION ***7 Hrs***

Objectives, Classification of robots, Major components of robot, definitions: Kinematics, Controls, and actuators. Robot history, types and applications current and future with examples. Fixed and flexible automation.

UNIT 2: ROBOT ARM KINEMATICS ***10 Hrs***

Introduction, The direct kinematics problem, Rotation Matrices, Composite rotation Matrix, Rotation matrix about arbitrary axis, Rotation matrix with Euler angle representation, Geometric interpretation of rotation matrix, Homogenous coordinates and transformation matrix, Geometric interpretation of Homogenous transformation matrices, Composite homogenous transformation matrices, Links, Joints, and their parameters, The Denavit - Hartenberg representation, Kinematic equation for manipulator, Other specifications of the locations of the end effectors, Inverse kinematics problem. ***[Reference: Text 1]***

UNIT 3: CONTROL OF ACTUATORS ***8 Hrs***

Objective, Motivation, Closed loop control in position servo, Effect of friction and gravity, Adaptive control, Optimal control, Computed torque technique, Transfer function of single joint, Position control for single joint, Brief discussion on performance and stability criteria. ***[Reference: TEXT 2]***

UNIT 4: SENSORS ***10 Hrs***

Sensor characteristics, Position sensors- potentiometers, Encoders, LVDT, Resolvers, Displacement sensor, Velocity sensor- encoders, tachometers, Acceleration sensors, Force and Pressure sensors – piezoelectric, force sensing resistor, Torque sensors, Touch and tactile sensor, Proximity sensors-magnetic, optical, ultrasonic, inductive, capacitive, eddy-current proximity sensors.

Hall Effect sensors, Binary sensors, Analog sensors, Force and Torque sensing, Elements of a Wrist sensor. ***[Reference: Text 1, Reference book 2]***

UNIT 5: VISION AND PROCESSING ***10 Hrs***

Image acquisition, illumination Techniques, imaging geometry, some basic transformations, perspective transformations. ***[Reference: Text 1]***

Camera model, camera calibration, stereo imaging, Higher-Level Vision: Segmentation, Edge Linking and Boundary detection, Thresholding. Region-oriented segmentation, Use of motion, Description, Boundary descriptors, Regional descriptors. ***[Reference: Text 1]***

PRACTICE SESSION ***7 Hrs***

Discussion on DC motors with gears, Stepper motor, Servo motor

Mini-project:

Mini projects using Basic sensors, 555 timers, Motors (DC motors with gears, Stepper motor, Servo motor)

A batch of TWO students is required to undertake a mini project to showcase the knowledge acquired during the course of this study.

Example topics:

1. Line follower robot
2. Obstacle avoiding robot
3. Face reorganization algorithm
4. MATLAB simulation or Use of robo sim
5. PCB design (Using PCB design software)

Note: small models / prototypes of projects undertaken are preferred

Project report has to be submitted with following chapters

1. Abstract
2. Introduction
3. Block diagram
4. Materials used with detailed specification
5. Design and Design issues in detail
6. Model testing

With presentation

TEXT BOOKS:

1. **"Robotics – control, sensing, Vision and Intelligence",** K.S.Fu, R.C.Gonzalez, C.S.G. Lee, McGraw Hill, 1987.
2. **"Robotic Engineering" -** Richard D Klafter, PHI

REFERENCE BOOKS*:*

1. **"Introduction to Robotics Mechanics and control",** John J. Craig, 2nd Edition, Pearson education, 2003.
2. **"Introduction to Robotics" –** Saeed B. Niku, PHI

Valuation (CIE and SEE) pattern:

CIE:

PART - 1

1. 1 test – 20 Marks
2. Quiz 1 – 05 Marks
3. Quiz 2 – 05 Marks

Eligibility Criteria

Total = 30 Marks, Minimum marks for eligibility = 15

PART - 2

1. Mini project – 20 Marks ------- Total = 20 Marks, Minimum marks for eligibility = 10

Total = 50 Marks, Minimum marks for eligibility = 25

SEE:

1. Final Paper – 100 Marks (Questions covering 5 units)

Note:

1. Mini project does not carry any marks in SEE.
2. 20 Marks from each units