

ECE246:SENSORS FOR ROBOTICS

L:3 T:0 P:0 Credits:3

Course Outcomes: Through this course students should be able to

- CO1 :: Identify the principles and characteristics of robotic sensors.
- CO2 :: Distinguish different position, motion, force, and environmental sensors.
- CO3 :: Examine the performance of sensors interfacing with microcontrollers
- CO4 :: Analyze vision and proximity sensing techniques for navigation
- CO5 :: Apply sensor fusion methods in autonomous robotic applications.
- CO6 :: Design sensor-based robotic solutions for real time applications.

Unit I

Measurements in Robotics : Definitions of sensors and transducers, Errors & Classification, other Generalities, Definition and architecture of smart sensors, Calibration techniques, Sensor characteristics, Signal conditioning basics, Noise and filtering

Unit II

Force & Velocity Transducers : Force measurement generalities, strain gauges, non-resistive transducers, Load cells, interfacing of force transducers, Velocity measurements, Tacho-generator, Optical incremental encoder systems, interfacing of velocity transducers, Kalman filter

Unit III

Position & Light Transducers : Position transducers, Potentiometers, Optical encoders, interfacing of position transducers, Light transducers, photo resistors, Photo diodes & Photocells, photomultipliers, optical array transducers, Thermal and photon detectors, Interferometers, Gyroscopes, Inertial Measurement Unit (IMU), Wheel odometry, Accelerometers, Limit switches, Infrared sensors, Ultrasonic sensors

Unit IV

Robot Vision Sensors : Vision sensor generalities, 2D/3D sensors, interfacing of vision sensors, SLAM Navigation, Sensor fusion technique, LiDAR, Image acquisition fundamentals, ADC and DAC, I2C, SPI and UART communication, ROS-based sensor communication

Unit V

Robot Tactile Sensors : Touch sensors, tactile sensors, interfacing of tactile sensors, Tactile array sensors, Dynamic tactile sensor

Unit VI

Robotic Sensor Applications and Use cases from Industry : use cases in tactile sensing, soft robotics, robotic arc welding sensors, use cases of sensor in robot navigation, chemical sensing, use cases in wearables, use cases of sensors in agriculture, use cases in military, use cases in healthcare

Text Books:

1. SENSORS AND TRANSDUCERS by PATRANABIS D, PHI Learning Pvt Ltd

References:

1. SENSOR TECHNOLOGY HANDBOOK by JON WILSON,, ELSEVIER
2. TACTILE SENSING—FROM HUMANS TO HUMANOIDS by RAVINDER S. DAHIYA, IEEE

