NIRMA UNIVERSITY
SCHOOL OF TECHNOLOGY, INSTITUTE OF TECHNOLOGY
M.Tech. in Electronics and Communication Engineering (Embedded System)
M.Tech. Semester - II
Department Elective I

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Course Code	6EC266ME22
Course Title	Autonomous Navigation

Course Learning Outcomes (CLOs):

At the end of the course, students will be able to -

1. Compare and select the sensor technologies for autonomous navigation of robots and drones.
2. Plan the path of navigation using obstacle avoidance algorithms and exploration.
3. Apply tracking and motion estimation techniques for autonomous navigation.

Syllabus: **Teaching Hours:45**

UNIT I: Sensor Technology **08**

Sensor technologies for Autonomous Navigation: Gyro meter, Accelerometer, Radar, Sonar, LIDAR, Infrared, GPS, touch sensors, proximity sensors, sound sensors, vision sensors, Sensor Fusion

UNIT II: Modeling of Navigation **08**

Degree of autonomy, components of mobile robot, Behaviour modeling, trajectory prediction, localization and mapping methods, and path planning in the presence of obstacles, Feature based Simultaneous Localisation and Mapping (SLAM), Indoor Navigation

UNIT III: Geometry Estimation Methods **08**

Geometry, Visual SLAM Using 2D Visual Odometry, State estimation methods - Kalman filter, Extended Kalman filter, Bayesian Approach, Recursive Filtering and particle filtering

UNIT IV: Camera Modeling **06**

Camera mapping using SLAM, 3D calibration, Pixel based techniques for motion, structure from motion, Multi Camera modeling and Vision

UNIT V: Tracking and Estimation **05**

Object Tracking, Road following, edge extraction, passive depth estimation, visual motion estimation, passive stereo, feature tracking, robust estimation, motion planning

UNIT VI: Avoidance Algorithm **05**

Local Motion planning for indoor navigation, Collision detection and avoidance, Trajectory Design and Motion Control, Obstacle avoidance and exploration,

UNIT VII: Case Study **05**

Robots and Drones autonomous navigation, Cross country navigation

Self-Study:

The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

Suggested Readings:

1. Sebastian Thrun, Wolfram Burgard, and Dieter Fox, Probabilistic robotics, MIT Press,
2. Richard Hartley and Andrew Zisserman, Multiple view geometry, Cambridge University Press
3. Richard Szeliski, Computer vision: Algorithms and applications, Springer.