1. Subject code: **EP- 410** Course title: **Robotic Engineering**
2. Contact Hours: L:3 T:1 P:0
3. Examination Duration (Hrs): Theory: 3 Practical: 0
4. Relative Weight: CWS:25,PRS:--,MTE:25, ETE:50, PRE:--
5. Credits: 4
6. Semester: ODD
7. Subject area: DEC-7
8. Pre-requisite: Basic knowledge of Automation
9. Objective: The course provides basic understanding of the Automation and Robotics

10. Detail of Course:

S. No.	Contents	Contact Hours
1.	Robotic manipulation – Automation and Robots – Robot Classification – Applications – Robot Specifications – Notation. Direct Kinematics: The ARM Equation – Dot and Cross products – Coordinate frames – Rotations – Homogeneous coordinates – Link coordinates – The arm equation – A five-axis articulated robot (Rhino XR-3) – A four-axis SCARA Robot (Adept One) – A six-axis articulated Robot (Intelledex 660). Inverse Kinematics: Solving the arm equation – The inverse kinematics problem – General properties of solutions – Tool configuration – Inverse kinematics of a five-axis articulated robot (Rhino XR-3) – Inverse kinematics of a four-axis SCARA robot (Adept one) - Inverse kinematics of a six-axis articulated robot (Intelledex 660) - Inverse kinematics of a three-axis articulated robot – A robotic work cell.	**14**
2.	Workspace analysis and trajectory planning: Workspace analysis – Work envelop of a five-axis articulated robot – Work envelope of a four-axis SCARA robot – Workspace fixtures – The pick-and-place operation – Continuous-path motion – Interpolated motion – Straight-line motion. Differential motion and statics: The tool-configuration Jacobian matrix – Joint-space singularities – Generalized Inverses – Resolved-Motion rate control:n<=6 – Rate control of redundant robots:n>6 – rate control using {1}-inverses – The manipulator Jacobian – Induced joint torques and forces. Manipulator Dynamics: Lagrange's equation – Kinetic and Potential energy – Generalized force – Lagrange -Euler dynamic model – Dynamic model of a two-axis planar articulated robot - Dynamic model of a three-axis SCARA robot – Direct and Inverse dynamics – Recursive Newton-Euler formulation – Dyamic model of a one-axis robot.	**14**
3.	Robot control: The control problem – State equation – Constant solutions – Linear feedback systems - Single-axis PID control – PD-Gravity control – Computed-Torque control – Variable-Structure control – Impedance control, Robot vision – Image representation – Template matching – Polyhedral objects – Shape analysis – Segmentation – Iterative processing – Perspective Transformations – Structured illumination –Camera calibration. Task planning: Task-level programming – Uncertainty – Configuration space – Gross-Motion planning – Grasp planning – Fine-Motion planning – Simulation of planar motion – A task-planning problem	**14**
	Total	**42**

11.Suggested Books

S. No.	Name of Books/ Authors	Year of publicat