GUJARAT TECHNOLOGICAL UNIVERSITY

PACKAGING TECHNOLOGY (58)
ROBOTICS AND AUTOMATED PACKAGING
SUBJECT CODE: 715806
SEMESTER: I

Type of Course: Major Elective 1

Prerequisite: Nil

Rationale:
This course will introduce the basic principles of robotics and its applications in packaging. Topics will include fundamentals of robotics, kinematics and dynamics of robot, trajectory planning of robots, sensors and end effectors used for packaging.

Teaching Scheme			Credits	Examination Marks						Total Marks
L	Tutorial /Presentation	P	C	Theory Marks		Practical Marks				
				ESE(E)	PA(M)	PA(V)		PA(I)		
						ESE	OEP	PA	RP	
3	2	2	5	70	30	20	10	10	10	150

Sr. No.	Contents	Total Hours	% Weightage
1	Fundamentals of Robotics: Automation and robotics, definitions of robotics, application of robot, laws of robotics, common configuration of robot, robot workspace, robot drive system, control system Forward and inverse kinematics, homogeneous transformation, DH parameter	14	30%
2	Dynamic Modelling of Robot: Introduction of Newton Euler approach & Lagrange Euler approach. Dynamic model of one link arm by Newton Euler approach & Lagrange Euler approach. Trajectory Generation: Joint space scheme through cubic polynomial and Introduction to cartesian space scheme.	8	20%
3	Gripper Technologies for Food Industry Robots: Gripper challenges in food process automation, Gripping physics, Pinching and enclosing grippers, Penetrating (needle) grippers, Suction grippers, Surface effect (freeze) grippers, Selection of the appropriate gripping technology.	4	10%
4	Sensors in Robotics and automation: Transducers and sensors, sensors in robotics, tactile sensors, proximity and range sensors, miscellaneous sensors and sensor based system	4	10%
5	Application of Automation and Robotics in Packaging: Sorting, processing industry like fresh food product, poultry and meat, sea food, confectionery, thermal processing, low temperature and chilling application.	8	20%
6	Complex Carton Packaging with Dexterous Robot Hands: Design Requirements and Principles, Conceptual design and simulation of packaging process, Packing machine	4	10%

Reference Books:

1) Robotics and Automation in the Food Industry: Current and Future Technology Edited by Darwin Caldwell, Wood head Publisher
2) Robotics in Meat, Fish and Poultry Processing Edited by K. Khodabandehloo, SPRINGER-SCIENCE Publisher
3) Integration of Robotics and Automation for Packaging Industries, by Hassan Elahi, LAP LAMBERT Academic Publishing
4) Industrial Robotics: Technology, Programming and Application, by M. P. Grover, Tata McGraw-Hill
5) Industrial Robotics: Programming, Simulation and Applications edited by Low Kin Huat Publisher, Literature Verlag
6) Introduction to Robotics: Analysis, Control, Applications by Saeed B Niku, Wiley India Pvt. Ltd.
7) Introduction to Robotics by S K Saha, Tata McGraw-Hill
8) Introduction to Robotics by J J Craig, Pearson Education

Course Outcome:

After learning this course the student must demonstrate the knowledge and ability to:

1. To solve forward and inverse kinematics problem of a robot
2. To understand dynamic analysis of robot
3. To perform trajectory planning of a robot
4. To decide the required sensors and end effectors for packaging
5. To appreciate role of robotics in various packaging application

List of Experiments:

1. Experiments based on robot kit to make different kind of configuration
2. Use of robot simulation software to perform variety of task
3. Experiments on determination of D-H parameters of serial manipulator
4. Experiments on forward kinematic of a robot
5. Experiments on inverse kinematic of a robot
6. Experiments on forward dynamics of a robot using software
7. Experiments on path and trajectory generation using software

List of Open Source Software/Learning Website:

1. RoboAnalyzer
2. NPTEL web source

Major Equipment:

Robot/Simulation software/Virtual reality software or any other robotic kit, C programming or MATLAB may be used for performance of experiments

Open Ended Problem (OEP):

Students are expected to solve some research problem related to kinematics, dynamics and trajectory planning of robot by developing own program in Matlab or using any other tool.

Review Presentation (RP):

The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester. The same list will be uploaded on GTU website during the first two weeks of the start of the semester. Every student or a group of students shall critically study 2 papers, integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website.