GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3171717
Semester – VII
Subject Name: ROBOTIC ENGINEERING

Type of course: Professional Elective Course

Prerequisite: Sensor/ Transducer, Fundamental of engineering mechanics, Control systems design

Rationale: In near future, robots will be used widely in the fields of manufacturing, medicine, search and rescue, service, and entertainment. So, it is very much important to teach robotics as the synergistic integration of mechanics, electronics, controls, and computer science. This subject is intended to make student aware with basics of robot sensors, controls and transformations along with essential kinematics and dynamics

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1.	**Basic Concepts** Definition and origin of robotics, different types of robotics, various generations of robots, degrees of freedom, Asimov‘s laws of robotics, dynamic stabilization of robots.	06
2	**Power Sources** Hydraulic, pneumatic and electric drives, determination of HP of motor and gearing ratio, variable speed arrangements, path determination, micro machines in robotics.	06
3	**Manipulators, Actuators and Grippers** Construction of manipulators – manipulator dynamics and force control, electronic and pneumatic manipulator control circuits, end effectors, various types of grippers – design considerations.	06
4	**Kinematics and Path Planning** Solution of inverse kinematics problem, multiple solution Jacobean work envelop, hill	06

	climbing techniques, introduction to robot programming languages.	
5	**Sensors and Intelligent Robots** Introduction to robotic sensors, vision systems, Range detectors, assembly aid devices, force and torque sensors, machine vision, ranging, laser, acoustic, magnetic, fiber optic and tactile sensors.	06
6	**Case Studies** Multiple robots, machine interface, robots in manufacturing and non-manufacturing applications, robot cell design, selection of robot.	06

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
7	**14**	**14**	**14**	**14**	**7**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Text Books:

1. Robot Modeling and Control *by* Spong, M.W., Hutchinson, H., &Vidyasagar, M., *John Wiley (Wiley India Ed.),* 2006, ISBN-13: 978-0471649908
2. Robotics Engineering – An integrated approach *by* Klafter R.D., Chimielewski T.A., Negin M., *Prentice Hall of India, 1994,* ISBN-13: 978-0134687520
3. Introduction to Robotics, by SAHA, *Tata McGraw-Hill Education, 2008,* ISBN 9781259083204
4. Fundamental of Robotics Analysis and control: by Robert J. Schilling, *Prentice Hall, 1996,* ISBN-13: 978-0133444339
5. Robotics Technology and Flexible Automation, by S. R. Deb, Sankha Deb, 2010 McGraw Hill, 2nd edition, 2010, ISBN: 9780070077911
6. Robotics and Image processing by P.A. Janakiraman, *Tata McGraw-Hill, 1995,* ISBN 9780074621677

7. Robotics and Control by R. K. Mittal, I. J. Nagrath, Tata-Mcgraw Hill, 2003

Reference Books:

1. Control in Robotics and Automation: Sensor Based Integration (Engineering) B. Ghosh, T. J. Tarn, Ning Xi, Academic Press, ISBN: 978-0122818455
2. Robots and manufacturing Automation by C Ray Asfahl, John Wiley, 1992, ISBN: 978-0-471-55391-5
3. Introduction to Robotics by McKerrowPhillip.John, Addison Wesley, Australia, 1991, ISBN 13: 9780201182408.
4. Principles of Robot Motion - Theory, Algorithms and Implementation (OIP) by Howie Choset, Kevin M Lynch , Seth Hutchinson , George Kantor, MIT Press, ISBN-13: 978-0262033275
5. Robotics, Vision and Control: Fundamental Algorithms in MATLAB by Peter Corke, Springer pub, 1st ed. 2011, ISBN-13: 978-3642201431

Course Outcome:

After learning the course the students should be able to:

After learning this course, the students should be able to:

CO 1	To understand the mathematics of rigid motions, rotations, translations, velocity kinematics related to robotic application
CO 2	To understand dynamics of robotic system and design multivariable controller accordingly
CO 3	evaluate the various parts of mechanical and electronic system of robots
CO 4	Apply knowledge of sensors to design intelligent robot for specific application
CO5	To be familiar with computer vision, visual servo control problems and industrial application

List of Experiments:

(Followingpracticals are recommended but they are not limited for modifications and or alterations by the faculty member/s teaching the particular subject.

1. Study different drivers for robotic arms.
2. To simulate simple robotic system using Matlab/ Msc Adam software
3. To study image processing system for robotics system
4. Matlab program for simple and inverse kinematics of simple robot configuration
5. To simulate joint torque control of manipulator
6. To model the robot dynamics using Euler-Langrangian method and to simulate the same.
7. To study feedback control of robot manipulator
8. To study adaptive control of robot manipulator
9. To study different methods of speed control of dc Motor.
10. To study speed control of stepper motor using microcontroller.
11. To study robotic programming language like AL and AML.

Design based Problems (DP)/Open Ended Problem:

Case study of one of the industrial robot or manufacturing robot

Major Equipment:

Robotic kits, Sensors, Computers, open source software, etc.

List of Open Source Software/learning website:

https://nptel.ac.in/courses/112/105/112105249/

https://nptel.ac.in/courses/107/106/107106090/

https://nptel.ac.in/courses/112/101/112101099/

http://nptel.ac.in/video.php