GUJARAT TECHNOLOGICAL UNIVERSITY

INSTRUMENTATION & CONTROL ENGINEERING (17)
ROBOTIC ENGINEERING – Department Elective-III
SUBJECT CODE: 2181706
B.E. 8th SEMESTER

Type of course: Core Engineering

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:

TeachingScheme			Credits	Examination Marks						Total Marks
L	T	P	C	TheoryMarks			PracticalMarks			
				ESE (E)	PA(M)		ESE (V)		PA (I)	
					PA	ALA	ESE	OEP		
4	0	2	6	70	20	10	20	10	20	150

Content:

S. N.	Content	Total Hrs	% Weightage
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.	08	16
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.	08	16
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.	08	16
4	**Kinematics and Path Planning** Solution of inverse kinematics problem, multiple solution Jacobean work envelop, hill climbing techniques, introduction to robot programming languages.	08	16
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.	08	16

6	**Case Studies** Multiple robots, machine interface, robots in manufacturing and non- manufacturing applications, robot cell design, selection of robot.	10	20

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 McKerrow Phillip.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 this course, the students should be able to :

CO1. learn the mathematics of rigid motions, rotations, translations, velocity kinematics

CO2. evaluate the various parts of mechanical and electronic system of robots.
CO3. evaluate robot dynamics and multivariable control
CO4. familiar with computer vision, visual servo control problems and applications in the industry.

List of Experiments:

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

Major Equipment: Robotic kits, computers, open source software, etc.

List of Open Source Software/learning website:

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

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.