GUJARAT TECHNOLOGICAL UNIVERSITY

MECHANICAL (PRODUCTION ENGINEERING) (28)
ADVANCE ROBOTICS
SUBJECT CODE: 2742805
M.E. 4TH SEMESTER

Type of course: Major Elective - I

Prerequisite: NIL

Rationale: This course provides the knowledge of Machine Vision in manufacturing Industries. This course gives hands on practice regarding development of Older Manufacturing Unit renovating Intelligent Automation like Robot cutting, Robot Welding and Assembly line different Processes. This course gives knowledge about different major industrial application related to modernize Production.

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)		
						ESE	OEP	PA	RP	
3	2#	0	4	70	30	30	0	10	10	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	**INTRODUCTION:** Automation and Robotics, Robot anatomy, robot configuration, motions joint notation work volume, robot drive system, control system and dynamic performance, precision of movement.	**05**	15
2	**CONTROL SYSTEM AND COMPONENTS:** Basic concept and modals controllers control system analysis, robot activation and feedback components. Positions sensors, velocity sensors, actuators sensors, power transmission system	**05**	15
3	**MOTION ANALYSIS AND CONTROL:** Manipulator kinematics, position representation forward transformation, homogeneous transformation, manipulator path control, robot dynamics, configuration of robot controller.	**05**	15
4	**END EFFECTORS:** Grippers-types, operation, mechanism, force analysis, tools as end effectors consideration in gripper selection and design	**06**	17
5	**SENSORS:** Desirable features, tactile, proximity and range sensors, uses sensors in robotics	**05**	15
6	**MACHINE VISION:** Functions, Sensing and Digitizing-imaging, Devices, Lighting techniques, Analog to digital single conversion, Image storage, Image processing and Analysis-image data reduction, Segmentation feature extraction. Object	**08**	23

	recognition, training the vision system, Robotics application.		

Reference Books:

1. Introduction to Robotics Analysis, Systems, Applications by Saeed B Niku PHI.
2. A Robot Engg text book by Moshen Shahinpoor, Harper and Row Publishers,NY.
3. Fundamentals of Robotics – Analysis and Control, Robert J Schilling, PHI.
4. Robotic technology, Principles and practice – Werner G Holz book – Van Nostrand Reinhold Co NY.
5. Robotic Engineering – An Integrated Approach by Richard D Klaffer, Thomas A Chmielewski, Michael Negin – PHI.
6. Robot Dynamics and Control – Mark W Spong, M Vidyasagar – Wiley India.
7. Intro to Robotics, Mechanics and Control by John J Craig, Pearson Education.
8. Modelling and Control of Vehicular and robotic systems by Sisil Kumararawadu – Narosa publishing house.
9. Industrial Robots by Ganesh S Hegde – Laxmi Publications.

Course Outcome:

Student will became familiar with the latest production systems.

List of Experiments:

1. Introduction of Robot Anatomy and configuration
2. To study about direct kinematics of robot
3. To study of robot dynamics
4. To study of types of End effectors and Grippers
5. To study of Machine Vision System
6. To study of types of Robot controller
7. To study of Robotics Sensors
8. Study of Image processing of Machine Vision System

ASSIGNMENTS:

Assignment No:1

1. Which are the types of automation? How robotics is necessary in automation?

2. Define Robot. Which are the basic laws of robotics?

3. Which are the basic configurations of robots? Explain advantage and disadvantage of each with its work volume.

4. What is degree of freedom in robot? Explain degree of freedom associated with robot wrist.

5. Elaborate types of robot control. Explain merits and demerits of each.

6. Explain the term with context of robot

(i) Spatial resolution

(ii) Accuracy

(iii) Repeatability

(iv) Compliance

Assignment No 2

1. What is transfer function? How We can develop control system of robot?

2. What is the need of different types of controllers? Why derivative controller is not used alone?

3. How proportional controller works? Explain working of every proportional controller combinations.

4. Find the output voltage of a potentiometer with the following characteristics. Also determine the Kp. The excitation voltage = 12 V total wiper travel = 320°. Wiper position = 64°.

5. What is the resolution in degrees of an encoder with 10 tracks?

6. What is the velocity of the piston and the force generated by the piston if the fluid pressure is 1500 lb/in2. inside the cylinder, the piston is 2.0 in in diameter and the flow rate is 10 in3/min?

Assignment No 3

1. What is the use of scale factor in homogeneous transformation matrix? Explain denavit hertenberg notations in homogenous transformation matrix.

2. Which are static forces in robot? Explain static analysis for two degree of freedom robot.

3. What is use of gripper? How mechanical gripper work? Enlist and analyse gripper mechanism.

4. What is sensor? Which features are significant for the selection of sensor in robot?

5. Which are the basic sensors used in robot? Discuss merits & demerits of each sensor.

Assignment No 4

1. What is machine vision system? Why sensing and digitizing image data is necessary?

2. What is frame grabber? What is black and white camera? Explain working of it with neat sketch.

3. How Charge coupled device works explain with neat sketch? What are the advantage and disadvantage of it?

4. What is sampling and quantization? How it is useful in analogue to digital converter.

5. Explain the terms

(i) Image Date Reduction

(ii) Segmentation

(iii) Feature extraction

(iv) Object Recognition

Assignment No 5

1. Which are the methods of robot programming? Which method is most suitable? Explain merits & demerits in detail.

2. Elaborate Wait, Signal and Delay Command.

3. For an image digitized at 128 points per line and 128 lines, determine (a) the total number of bits to represent the gray level values required if an 8 bit A/D converter is used to indicate various shades of gray and (b) the reduction in data volume if only black and white values are digitized.

4. A continuous video voltage signal is to be converted into a discrete signal. The range of the signal after amplification is 0 to 5 V. The A/D/ converter has an 8-bit capacity. Determine the number of quantization levels, the quantization level spacing, the resolution, and the quantization error.

Major Equipments:

1. CMM
2. INDUSTRIAL ADVANCED ROBOTS

List of Open Source Software/learning website:

1. http://www.rethinkrobotics.com
2. www.vexrobotics.com

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.