Subject Code: 01ME0841

Subject Name: Robotics & FMS

B.Tech. IV Year – (Sem-8) Mechanical Engineering

Type of course: Programme Core

Prerequisite: N.A.

Rationale: This subject is useful to understand concepts and techniques in robot manipulator Kinematics, enough to evaluate, chose, and incorporate robots in engineering systems. Familiarize with applications of Group Technology, Flexible manufacturing techniques, Materials Requirement Planning and Manufacturing Resource planning to solve manufacturing and other industry related problems.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks		Practical Marks				
				ESE (E)	PA (M)	PA (V)		PA (I)		
						ESE	OEP	PA	RP	
4	2	0	5	70	30	30	0	20	0	150

Content:

Sr. No.	Content	Total Hrs.	% Weightage
1.	**FUNDAMENTALS OF ROBOTICS:** Introduction, Fundamentals of robot technology - anatomy, work volume, drives system, types of end effectors, robot sensor. Robot and its peripherals; Basic control systems, Controllers & sensors.	8	20
2.	**KINEMATICS OF ROBOTIC MANUPULATORS:** Introduction to manipulator kinematics, homogeneous transformations and robot kinematics, Matrix Representation point, vector, frame and rigid body, Representation of Transformations of pure translation, rotation and combined, Denavit-Hartenberg (D-H) representation, concept of forward and inverse kinematics. Robot programming & languages, Trajectory planning of robot motion.	12	26
3.	**APPLICATION ENGINEERING FOR MANUFACTURING:** Robot cell design, Robot cell layout, multiple robots & machine interference, work cell control, robot cycle time analysis; Material transfer, Machine loading / unloading; Process applications, Robot implementation & integration into manufacturing.	6	10
4.	**ROBOT VISION SYSTEM:** Vision sensors and their operation, image acquisition and processing, object recognition and interpretation.	4	10
5.	**COMPUTER INTEGRATED MANUFACTURING AND AUTOMATION:** Elements of CIM, Different modules and information flow, Design aspects of CIM, CIM planning & implementation process, requirements of CIM, Computerized production activities, Computerized integrated quality	6	10

	concept, Inventory management, shop floor control, Production costing. Computerized maintenance management, MRP-I & II, Information system		
6.	**FLEXIBILITY IN MANUFACTURING:** Definition & concept, flexible automation & productivity, components of FMS, Different types of FMS, Design problem of FMS, Technology required for FMS system. Robots - their function & programming in FMS. Bottleneck Model and related formula	6	12
7.	**GROUP TECHNOLOGY:** Part family, Part classification and coding, production flow analysis – OPITZ classification system, cellular manufacturing, quantitative analysis in cellular manufacturing. Rank Order Clustering Technique (ROC), Holier Method –I,II, Single Linkage Cluster Analysis Technique(SLCA).	6	12

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
Remembran	Understanding	Application	Analyze	Evaluate	
20	**20**	**10**	**10**	**10**	

Reference Book:

1. "Industrial Robotics: Technology Programming & Applications" Mitchell Weiss, Roger N. Nogel, McGraw Hill International
2. "Automation, Production Systems and Computer Integrated Manufacturing" M. P. Groover Prentice Hall of India
3. "A Robot Engineering Textbook" Mohsen Shahinpoo Harper & Row Publishers
4. "Introduction to Robotics: Analysis, Systems, Applications" Niku PHI publishers
5. "Robotics Technology & Flexible Automation" S. R. Deb Tata McGraw Hill
6. " Robotics and Control" R.K. Mittal, Tata McGraw-Hill
7. "Robot Technology" James G Keramas, DelMar Publisher

Course Outcome:

1. Introduce the state-of-art technology and products Automation and Robotics to enable the students them to take up challenging assignment in future and spread the learning to the peers and creating professional environment.
2. To familiarize the students with the concepts and techniques in robot manipulator Kinematics, enough to evaluate, chose, and incorporate robots in engineering systems.
3. Acquaint him / her with applications of Group Technology and Flexible manufacturing techniques to solve manufacturing and other industry related problems.

4. Expose him / her to the significance of various scientific tools and models including Materials Requirement Planning and Manufacturing Resource planning that are available in the subject to take decisions in a complex environment.

List of Experiments:

1. Experiments based on robot kit to make different kind of configuration.
2. Using robot simulation software to perform variety of task.
3. Experiments based on robot manipulator to perform variety of task for example loading and unloading, stacking, decision making, using sensor to test input and output function.
4. Experiments based on programing using C-language and MAT-lab tool.

Design based Problems (DP)/Open Ended Problem:

Student may be given a task to write program for robot.

Major Equipment:

Robot Manipulator, simulation software and virtual reality software or any other robotics kit may be used for the performance of experiments.

List of Open Source Software/learning website:

The website of NPTL may be utilized for additional learning.

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work. The faculty will assign chapters/ parts of chapters to students so that the entire syllabus to be covered. The power-point slides should be put up on the e resources in library, along with the names of the students of the group.