

Branch Name:	Mechanical Engineering
Program Code:	ET402
Course Title:	Advance Manufacturing Systems
Course Code:	2ET4020603
Pre-requisite Course:	-

Course Objectives:

1. The course content should be taught and implemented with the aim to develop different types of skills
2. Identify and select manufacturing systems to produce products at internationally competitive price with innovation and better quality.
3. Appreciate the need to integrate advance manufacturing systems.
4. Acquire adequate knowledge to use the proper system and approach regarding the manufacturing system.

TEACHING AND EVALUATION SCHEME:

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)			
Lecture	Tutorial	Practical	Credit	Theory		Practical	
				University Assessment	Continuous Assessment	University Assessment	Continuous assessment
3	-	2	4	60	40	20	30

COURSE DETAILS.

Unit	Topics and Sub-topics
Unit – I Introduction	1.1 Evolution of transformation & manufacturing systems. 1.2 Need of attitude, knowledge & skill required for application of manufacturing systems. 1.3 Need for system approach. 1.4 Role of computers and information technology in manufacturing and manufacturing systems. 1.5 Product life cycle & its importance. 1.6 Technology life cycle. 1.7 Scope, importance and challenges in Indian context to manufacture products at international competitive price with better quality& innovation.
Unit – II Group Technology (GT) & cellular layout.	2.1 GT - concept, definition, need, scope, & benefits. 2.2 Production layout-types, features and applications. 2.3 GT Layout -concept, need, benefits, comparison with conventional layout with examples. 2.4 GT- codification systems- types, method of coding and examples. 2.5 Part features- concept, types and examples. 2.6 Part family- concept, method to form and approach to form cell using part families. 2.7 Types and comparison of cell: manual and automatic cell, assembly cell. 2.8 Steps of cell design and cell layout.

Unit – III Flexible Manufacturing System (FMS).	3.1 Flexible Manufacturing System (FMS) –concept, definition and comparison with other manufacturing systems. 3.2 Major elements of FMS and their functioning: i. Tool handling system. ii. Material handling system. iii. Automated guided vehicles (AGV). iv. Automated storage and retrieval system (AS/RS). v. Main frame computer. 3.3 FMS layout - concept, types and applications. 3.4 Data required developing an FMS layout. 3.5 Signal flow diagram and line balancing in FMS. 3.6 FMS layout illustrations (Minimum two).
Unit – IV Robotics.	4.1 Robots-concept, definition, benefits and various areas of application in manufacturing systems. 4.2 Terminology used in robotics. 4.3 Robots-types, physical configuration, classification and selection criterion. 4.4 Axes nomenclature. 4.5 Types and uses of Manipulators & Grippers. 4.6 Sensors- types, classifications, working principle and applications of position, force & torque, proximity, vision, velocity & acceleration sensors. 4.7 Overview of robot programming methods & languages.
Unit – V Programmable Logic Controller (PLC) & Micro Controllers (MC).	5.1 Role of control system in instrumentation 5.2 Open and close loop control system, types and block diagram. 5.3 Servomechanism and regulators with suitable examples. 5.4 Basic control actions - on-off, proportional, derivative, integral control, proportional derivative (PD), proportional integral (PI), p proportional integral and derivative (PID) control. 5.5 Basic digital logic gates: symbol, operation, truth-table and examples of AND, OR, NOT, NAND, NOR, EX-OR, EX-NOR gates. 5.6 PLC: Concept, general constructional features, types of diagrams, working and major applications in manufacturing systems. 5.7 Use of SCADA (Supervisory Control And Data Acquisition) in PLC design. 5.8 Microcontrollers: introduction, hardware components, i/o pins, ports; selection of micro controllers & embedded controllers, applications.
Unit – VI Recent trend	6.1 Computer Aided Process Planning (CAPP) - concept, types, features, methods and importance. 6.2 Computer Integrated Manufacturing (CIM): need, block diagram, functional areas covered and their importance. 6.3 Protocols in CIM- their features, functions and applications. 6.4 Computer Aided Inspection (CAI) - concept, benefit, types, working and examples. Coordinate Measuring Machine (CMM) - its working and applications. 6.5 Rapid Prototyping (RP): working principles, methods, applications and limitations, rapid tooling, techniques for rapid prototyping. 6.6 Artificial neural network: working principles, applications and limitations. 6.7 Lean manufacturing - concept, benefits and applications. 6.8 Factory of future (FOF).

SUGGESTED SPECIFICATION TABLE WITH HOURS AND MARKS (THEORY)

Unit	Unit Title	Teaching	Distribution of Theory Marks
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No.		Hours	R Level	U Level	A Level	Total Marks
I	Introduction.	04	02	04	00	06
II	Group Technology (GT) & cellular layout.	06	04	04	04	12
III	Flexible Manufacturing system (FMS).	06	04	04	04	12
IV	Robotics.	10	07	04	04	15
V	Programmable Logic Controller (PLC) & Microcontrollers.	10	07	04	04	15
VI	Recent trends.	06	06	04	00	10
	Total	42	30	24	16	70

Legends: R = Remember U= Understand; A= Apply and above levels

SUGGESTED LIST OF EXERCISES/PRACTICALS

The practical/exercises should be properly designed and implemented with an attempt to develop different types of skills (outcomes in psychomotor and affective domain) so that students are able to acquire the competencies/programme outcomes. Following is the list of practical exercises for guidance.

Sr. No.	Unit No.	Practical Exercises (outcomes in Psychomotor Domain)	Approx Hours. required
1	--	Presentation on “How it’s made”: Teacher will assign any one part from Annexure-I. (Each student will have different part in a batch). Student will download movies and will present with the concept “How it’s made”. Note: Each student will make his/her folder having the name as <batch number_Enrollment number> and will save his/her downloaded content. A DVD is to be made which will contain folders of all students. Same DVD is to be submitted.	04
2	II	GT codes: Teacher will ask each student to bring at least one component having mechanical features and having more than 5-6 machining operations. Each student will also prepare the drawing and process plan (As per attached Annexure-II). Then the data will be interchanged by batch students. Collection of parts and making drawing and process plans will be as home assignment. Teacher will assign this task in very first period of practice. a. Prepare drawing of part brought by student. b. Prepare process plan as per Annexure-II for the part brought by student. c. Interchange part drawings and process plans. (No photo copies are allowed. Each student in a batch will have total drawings and process plans equal to number of students in a batch who have brought parts.).	04

		d. Prepare feature matrix. e. Select GT coding system and assign GT code to each part.	
3	III	FMS layout: a. Develop part family (May be 3-6 parts) from all parts.(Taken in Ex. No. 2 above.) This is to be carried out logically from feature matrix. b. Assume quantities of each part of part family developed in a. above. c. Assume additional data for following: i. Number of shifts and working hours in each shift. ii. Average number of working days in a month. iii. Utilization factor of FMS unit. d. Prepare process time matrix. (Suggested format is attached as per Annexure-III). e. Determine type and number of work stations. f. Perform necessary calculations and prepare conceptual FMS layout.	06
4	IV	Demonstration: a. Demonstrate working of following: i. Robot-anyone. ii. Sensors-each one from force & torque type, velocity and acceleration type, proximity type, position type and vision type. iii. PLC-anyone. iv. MC-anyone. v. Control system-anyone. b. Sketch following. i. Configuration sketch of robot demonstrated. ii. Working sketch of sensors demonstrated. iii. Block diagrams of PLC and MC demonstrated. iv. Circuit diagram of control system demonstrate	06
5	All	Mini project (In the group of 4-6 students): a. Prepare at least one from the following (as approved by the faculty): i. Prepare simple circuit using application of sensor. ii. Prepare simple robot using available kit. iii. Prepare ladder diagram for any one real life PLC application. iv. Build and operate the functionality of basic or advance logic gates. b. Prepare report which includes sketches, specifications, observation tables, parameters, truth tables, applications, etc. (as applicable). c. Present the project.	04
	All	Industrial visit and report :	04

6	Visit any one advanced manufacturing system /CAD-CAM based industry/centre of excellence/exhibition and prepare brief report on it.	
Total Hours		28

SUGGESTED LEARNING RESOURCES

A. List of Books:

S. No.	Title of Book	Author	Publication
1.	CAD/CAM/CIM.	P. Radhakrishnan & S. Subranarayan.	New Age Intentional
2.	Computer Integrated Design & Manufacturing.	Bedworth, Wolfe and Anderson	McGraw Hill International Publication.
3.	Mechatronics.	-	HMT
4.	Introduction to Robotics.	Arthur J. Critchlow	McMillan publication
5.	Robotics for engineers.	Yorom Koran	McGraw Hill
6.	Computer aided manufacturing.	Rao, Tiwari & Kundra.	Tata McGraw Hill Publication
7.	Computer Aided Design & Manufacturing.	Dr Sadhu Singh.	KP
8.	Computer Integrated Manufacturing.	S.K.Vajpayee.	PHI
9.	Automation, Production and Computer integrated Manufacturing.	Mikell P. Groover.	PHI
10.	Mechatronics.	Bradleg and Offers.	Chapman and Hall
11.	Practical Robotics.	William C. Burns Jr. & Janet Evans Worthington	PHI
12.	Basic electronics.	Mehta ,V.K.	S.Chand Publication,

B) List of Major Equipment/ Instrument with Broad Specifications:

Sr. No.	Resource with brief specification.
1	Kits on robotics.
2	Set of sensor / transducer demonstration and operation trainer kit. (This should include sensors/transducers as per syllabus.)
3	Analog to digital and digital to analog trainer modules.
4	Digital logic trainer board.
5	PLC trainer.
6	Microcontroller trainer.

C. List of Software/Learning Websites.

- i. <http://www.vlab.com>
- ii. <http://www.mtabindia.com>
- iii. <http://www.nptel.ac.in>

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Identify role of computers and information technology in manufacturing systems.	1 Remembering, 2 Understand,
CLO2	Use group technology concepts to develop GT cell and GT layout for given simple part family and make proper grouping as per their attributes	1 Remembering, 2 Understand, 3 Applying
CLO3	Develop skill about FMS (Flexible Manufacturing System) in the context of Manufacturing system.	1 Remembering 2 Understanding 3 Applying
CLO4	Develop familiarity with robotics,	1 Remembering, 2 Understand,
CLO5	Develop familiarity with programmable logic controllers, microcontrollers and recent advances in the field of manufacturing.	1 Remembering, 2 Understand,
CLO6	Understand the Recent trends in Manufacturing system.	1 Remembering, 2 Understand,

Course Learning Outcomes	Program Outcomes(Pos)												Program Specific Outcomes(PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO1	L												L		L
CLO2	L	M	M	M	M		L						M	L	M
CLO3	L	M	M	M									M	L	M
CLO4	L												M	L	M
CLO5	L					L							L		M
CLO6	L												M	L	M

H: High, M: Medium, L: Low