Course Title: **COMPUTER INTEGRATED MANUFACTURING**		
Scheme (L:T:P) : **4:0:0**	Total Contact Hours: **52**	Course Code: **15ME62T**
Type of Course: **Lectures, Self Study & Quiz**	Credit :**04**	Core/ Elective: **Core**

Prerequisites: Knowledge of basic mathematics and Applied Science, Engineering Graphics

Course Objectives:

The use of conventional machines is decreasing day by day. Evolution of information Technology, variety of manufacturing concepts with zero lead time demand and quality consciousness has supported fast adaption of Computer Aided Manufacturing.

Course Outcomes:

On successful completion of the course, the students will be able to attain CO:

	Course Outcome	**CL**	**Linked PO**	**Teaching Hrs**
CO1	Understand the principle of automation	*R/U/A*	2	09
CO2	Compare NC and CNC machines	*R/U/A*	2	08
CO3	Know the constructional features of CNC machines.	*R/U/A*	2	10
CO4	Construct part programmes using ISO format for given simple components	*R/U/A/An*	2	12
CO5	Develop an FMS (Flexible Manufacturing System) layout for given simple part family, using group technology concepts and familiarize with computer aided process planning	*R/U/A*	2	07
CO6	Recognize use of robotics, in the field of manufacturing.	*R/U/A*	2	06
		Total sessions		52

Legend: R: Remember U: Understand A: Application An: Analysis

COURSE-PO ATTAINMENT MATRIX

Course	Programme Outcomes									
	1	2	3	4	5	6	7	8	9	10
CIM	0	3	0	0	0	0	0	0	0	0

Level 3- Highly Addressed, Level 2-Moderately Addressed, Level 1-Low Addressed.
Method is to relate the level of PO with the number of hours devoted to the COs which address the given PO.
If ≥40% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 3
If 25 to 40% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 2
If 5 to 25% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 1
If < 5% of classroom sessions addressing a particular PO, it is considered that PO is considered not-addressed

COURSE CONTENT AND BLUE PRINT OF MARKS FOR SEE/

Unit No	Unit Name	Hour	Questions to be set for SEE/Marks			Marks weightage	weightage (%)
			R	U	A/An		
1	**Introduction to CIM& Automation**	09	5	10	5	20	13.79
2	**NC &CNC machines.**	08	5	5	5	15	10.34
3	**Constructional features of CNC machines.**	10	10	15	10	35	24.13
4	**CNC Part programming**	12	5	15	20	40	27.58
5	**Computer aided manufacturing**	07	5	5	10	20	13.79
6	Robotics	06	5	5	5	15	10.34
	Total	52	35	55	55	145	100

Legend: R; Remember, U: Understand A: Application An: Analysis

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UNIT I: INTRODUCTION TO CIM & AUTOMATION   09 Hrs

CIM – definition, scope and elements of CIM system-benefits, Production system facilities – low-medium-high-Manufacturing support systems-Automation in production systems-Automated manufacturing systems-Computerized Manufacturing Support Systems-Reasons for Automating, Automation principles and strategies-USA Principle-Ten Strategies for Automation and Production Systems, Automation –definition- Basic elements of an automated system - Levels of automation

UNIT II: NC AND CNC MACHINES   08 Hrs

Fundamentals of NC Technology- Basic Components of an NC System- NC Coordinate Systems- Motion Control Systems, Applications of NC- Machine Tool Applications- Other NC Applications- Advantages and Disadvantages of NC, Computer Numerical Control-Features of CNC- The Machine Control Unit for CNC- CNC Software, CNC Applications-Advantages and Disadvantages of CNC, DNC- Direct Numerical Control- Distributed Numerical Control

UNTIII: CONSTRUCTION OF CNC MACHINES   10Hrs

Construction of CNC machines-Machine structure- Static load-Dynamic load-Thermal load, Guide ways-Friction guide ways-V guide ways-Flat &dovetail guide ways-Cylindrical guide ways-Anti frictional linear motion guide ways, Feed drives-Servomotors-Mechanical transmission system, Spindle and spindle bearings-Hydrodynamic bearings-Hydrostatic bearings-Antifriction bearings, Measuring systems- direct & indirect measuring systems, Gauging, Tool monitoring-direct & Indirect monitoring, Automatic tool changer (ATC)-Automatic pallet changer (APC)

UNITIV: CNC PART PROGRAMMING   12 Hrs

Introduction to Part Programming-Coordinate system-Dimensioning-Axes & motion nomenclature Definition and importance of various positions like machine zero, home position, and work piece zero, CNC part programming- Structure of part programme-Word addressed format-Preparatory function(G)-Miscellaneous function(M)- Tool compensation-Subroutines (Macros)(L)-Canned cycles-Mirror image, Simple programme on Milling and Turning operations

UNIT V: GROUP TECHNOLOGY AND CAPP   07 Hrs

Group technology-Definition-Advantages and limitations of GT-Part family formation-Classification and coding-Opitz coding system, Applications & benefits of GT, Cellular manufacturing-Machining cell designs-Machining cell planning, Computer aided process planning-Approaches to CAPP-Implementation techniques-Essential elements in a retrieval type CAPP system-Essential elements in a generative CAPP system, Flexible manufacturing system-Scope of FMS-FMS compared to other types of manufacturing approaches-Types of FMS-Benefits of FMS-Major elements of FMS

UNIT VI: ROBOTICS   06Hrs

Introduction-definition of robot-Elements of a robotic system-Need for using robots-Types of robots-Classification of robots based on mechanical configuration-Gantry robot-SCARA robot-Freedom of motion, End effectors-grippers & tools, Drive systems, Control systems,

Performance capabilities-specifications-key feature, Programming robots-Programming methods, Applications of industrial robot.

TEXT BOOKS AND REFERENCE

S. No.	Title of Book	Author	Publication	Reference unit
1	Automation, Production Systems, and Computer-Aided Manufacturing	by Mikell P. Groover	Prentice-Hall International publication	**Introduction to CIM & Automation**
				NC and CNC machines
2	Mechatronics	HMT limited	McGraw Hill Education	**Construction of CNC machines And**
3	CAD/CAM Principles and Applications	P N Rao	McGraw Hill Education	**CNC part programming. Group technology and CAPP**
5	CAD/CAM/CIM	P. Radhakrishnan, S. Subramanyan, V. Raju	New Age International Publishers	**Group technology and CAPP**
6	CNC Machines.	Pabla B.S., Adithan M.	New Age International, New Delhi,2014(reprint)	**Construction of CNC machines**
7	Computer Numerical Control-Turning and Machining centers.	Quesada Robert	Prentice Hall 2014	**CNC part programming**
8	CAD/CAM.	Sareen Kuldeep	S.Chand 2012.	**Group technology**
9	INDUSTRIAL ROBOTICS	Groover	McGraw Hill Education	**Robotics**

LIST OF SOFTWARES/ LEARNING WEBSITES:

i. http://www.nptel.ac.in

ii. http://www.youtube.com/watch?v=M3eX2PKM1RI

iii. http://www.youtube.com/watch?v=EHQ4QIDqENI&list=PLBkqkLQO2nAt5MNLo

iv. http://www.youtube.com/watch?v=hJFLcvtiNQ I

v. http://www.youtube.com/watch?v=BIM1AyxfYkw .

vi. http://www.mtabindia.com

vii. http://www.swansoftcncsimulator.com

SPECIAL INSTRUCTIONAL STRATEGIES

UNIT NO	UNIT NAME	STARATEGIES
1	**Introduction to CIM& Automation**	Videos, Presentations, Demonstration
2	**CNC machines.**	Videos, Presentations, Industrial Visits, Demonstration,
3	**Constructional features of CNC machines.**	Videos, Presentations, Industrial Visits, Demonstration,
4	**CNC Part programming**	Simulation software's, actual practice on

		CNC machines, Demonstration,
5	**Computer aided manufacturing**	Videos, Presentations, Industrial Visits, Demonstration,
6	**Robotics**	Videos, Presentations, Industrial Visits, Demonstration,

SUGGESTED LIST OF STUDENT ACTIVITYS

Note: the following activities or similar activities for assessing CIE (IA) for 5 marks (Any one)

- Each student should do any one of the following type activity or similar activity related to the course and before take up, get it approved from concerned Teacher and HOD.
- Each student should conduct different activity and no repeating should occur

1	Visit nearby industry having CNC machines. List and Recall important features of them. submit handwritten report of 500 words
2	Construct specifications of various types of CNC machines with images and names of manufacturers.
3	Download images and videos of CNC machines and its parts. Construct one VCD/DVD in a batch and submit them
4	Download free simulation software's available on website and practice for part programming.

Course Assessment and Evaluation Scheme:

	What		To whom	When/Where (Frequency in the course)	Max Marks	Evidence collected	Course outcomes
Direct Assessment	CIE	IA	Students	Three IA tests(Average of three tests will be computed)	20	Blue books	1,2,3,4,5,6
				Student activities	05	Activity sheets	1,2,3,4,5,6
	SEE	End Exam		End of the course	100	Answer scripts at BTE	1,2,3,4,5,6
Indirect Assessment	Student Feedback on course		Students	Middle of the course		Feedback forms	1,2,3 Delivery of course
	End of Course Survey			End of the course		Questionnaires	1,2,3,4,5,6 Effectiveness of Delivery of instructions & Assessment Methods

CIE- Continuous Internal Evaluation   SEE- Semester End Examination

Note: I.A. test shall be conducted for 20 marks. Average marks of three tests shall be rounded off to the next higher digit.

Note to IA verifier: *The following documents to be verified by CIE verifier at the end of semester*

1. Blue books (20 marks)
2. Student suggested activities report for 5 marks evaluated through appropriate rubrics.
3. Student feedback on course regarding Effectiveness of Delivery of instructions & Assessment Methods

- **MODEL OF RUBRICS /CRITERIA FOR ASSESSING STUDENT ACTIVITY**

RUBRICS MODEL

	RUBRICS FOR ACTIVITY(5 Marks)					
Dimension	**Unsatisfactory**	**Developing**	**Satisfactory**	**Good**	**Exemplary**	**Student Score**
	1	**2**	**3**	**4**	**5**	
Collection of data	Does not collect any information relating to the topic	Collects very limited information; some relate to the topic	Collect much information; but very limited relate to the topic	Collects some basic information; most refer to the topic	Collects a great deal of information; all refer to the topic	Ex: 4
Fulfill team's roles & duties	Does not perform any duties assigned to the team role	Performs very little duties but unreliable.	Performs very little duties	Performs nearly all duties	Performs all duties of assigned team roles	5
Shares work equally	Always relies on others to do the work	Rarely does the assigned work; often needs reminding	Usually does the assigned work; rarely needs reminding	Normally does the assigned work	Always does the assigned work without having to be reminded.	3
Listen to other Team mates	Is always talking; never allows anyone else to speak	Usually does most of the talking; rarely allows others to speak	Talks good; but never show interest in listening others	Listens, but sometimes talk too much	Listens and speaks a fair amount	2
Average / Total marks=(4+5+3+2)/4=14/4=3.5=4						

Note: This is only an example. Appropriate rubrics/criteria may be devised by the concerned faculty (Course Coordinator) for assessing the given activity.

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MODEL QUESTION PAPER (CIE)

Test/Date and Time	Semester/year	Course/Course Code	Max Marks
Ex: I test/6 th week of VI sem 10-11 Am	VISEM	**COMPUTER INTEGRATED MANUFACTURING** **15ME62T**	20
	Year: 2016-17	Course code:15ME62T	

Name of Course coordinator :   Units:1,2 CO: 1,2

Note: Answer all questions

Question no	Question	MARKS	CL	CO	PO
1	Compare between fixed, programmable and flexible automation system OR Explain the general configuration of Distributed Numerical Control system	05	A	1	2
2	List Ten Strategies for Automation and Production Systems	05	R	1	2
3	Compare between Point-to-Point Versus Continuous Path Control system OR Compare between Absolute Versus Incremental Positioning	05	A	2	2
4	Explain about Interpolation Methods	05	U	2	2

MODEL QUESTION PAPER

VI- Semester Diploma Examination
Course Title: **COMPUTER INTEGRATED MANUFACTURING**

Time: **3 Hours**] [Max Marks**: 100**

Note: Answer any **SIX** from Part A and any **SEVEN** from Part B

PART-A 6x5=30 marks

1. Indentify the benefits of CIM
2. Explain flat and dovetail guide ways
3. Compare between direct and indirect measuring system
4. Compare between fixed, programmable and flexible automation system
5. Compare between Point-to-Point Versus Continuous Path Control system
6. Define cellular manufacturing and Explain its relevance in modern manufacturing
7. List out the key features and specifications required for improving the performance capability of a robot
8. Compare between tool length compensation and tool radius compensation
9. Identify the applications of group technology

PART-B 7x10=70 marks

10. List the advantages and dis-advantages of CNC machines
11. Make use of sketch explain the working of Antifriction bearings
12. Explain the basic design factors involved in the design of a machine structure
13. Construct a part programme for the following component using sub routine shown in figure
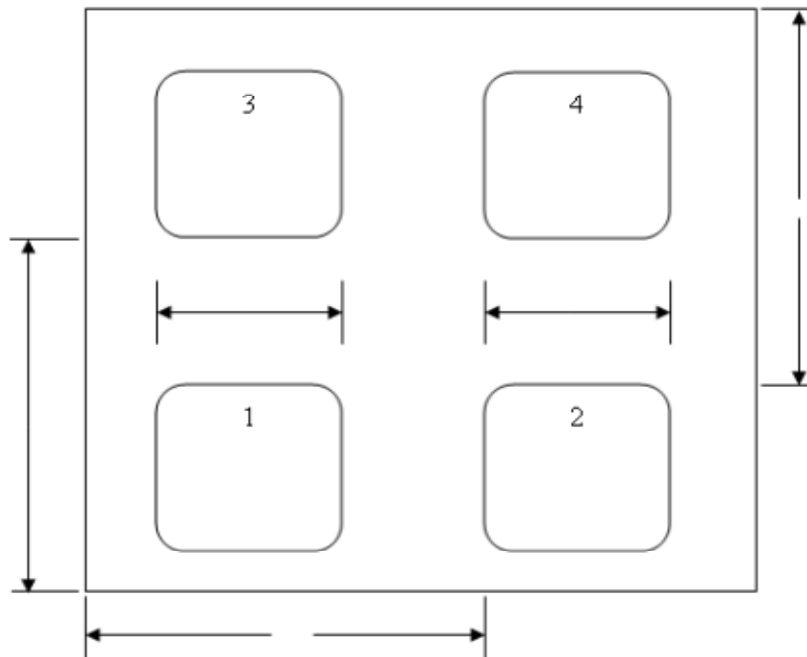
14. Construct a part programme for the following component using sub routine shown in figure
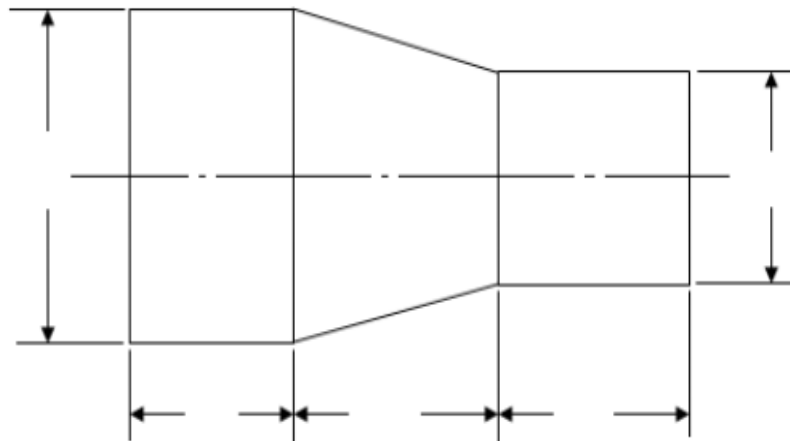
15. Explain about the Opitz coding system generally used in group technology
16. Explain the methodology to be followed for developing a generative type of computer aided process planning system
17. Explain with sketch the SCARA robot
18. Explain with sketch a typical machine tool with an automatic pallet changer (APC)
19. Explain tool monitoring and tool gauging system
20. Explain programming of robots

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MODEL QUESTION BANK

Diploma in Mechanical Engineering
VI Semester
Course title: COMPUTER INTEGRATED MANUFACTURING

Note: *The paper setter is of liberty to set the questions on his/her desecration based on cognitive levels notified for that unit. They have to follow only blue print of SEE question paper format. The model question bank is only for reference to students/course coordinator to initiate the process of teaching-learning only.*

CO1: Understand the principle of automation

REMEMBERING

1. Define CIM and mention its needs.
2. Recall the reasons for automation

3. Define automation and mention its needs
4. List Ten Strategies for Automation and Production Systems

UNDERSTANDING

5. Explain Production system facilities
6. Explain low quantity production
7. Explain medium quantity production
8. Explain high quantity production
9. Explain automation in production systems
10. Explain Automated manufacturing systems
11. Explain manufacturing support systems
12. Explain computerized manufacturing support systems
13. Explain USA principle
14. Explain control system
15. Explain programme of instructions
16. Explain about the main elements of CIM system
17. Explain the information-processing cycle in a typical manufacturing firm.
18. Compare between fixed, programmable and flexible automation system
19. Explain about basic elements of an automated system
20. Explain about the five levels of automation

APPLICATION

21. Indentify the benefits of CIM
22. Identify the scope of CIM

CO2: Compare NC and CNC machines

REMEMBERING

1. Recall the NC Interpolation Methods for Continuous Path Control
2. List Machine Tool Applications of NC system
3. List the advantages and disadvantages of NC system
4. Define Computer Numerical Control system and Recall its needs in manufacturing
5. List the Features of CNC
6. List the three types of CNC Software
7. List the advantages and disadvantages of CNC system

UNDERSTANDING

8. Explain three basic components of an NC System
9. Explain NC Coordinate Systems
10. Explain about Interpolation Methods
11. Explain Direct Numerical Control system
12. Explain Distributed Numerical Control system
13. Illustrate the general configuration of Direct Numerical Control system
14. Illustrate the general configuration of Distributed Numerical Control system
15. Compare between Point-to-Point Versus Continuous Path Control system

16. Compare between Absolute Versus Incremental Positioning.
17. Compare between linear and circular interpolation methods
18. Explain the configuration of CNC machine control unit.

APPLICATION

1. Choose the Applications of CNC system
2. Choose the Applications of NC system

CO3: Know the constructional features of CNC machines

REMEMBERING

1. List the important parts and aspects of CNC machines to be considered in their designing.
2. List the important factors to be considered while designing guide ways
3. Recall the necessity of antifriction linear motion guide ways used in CNC machine tools
4. List commonly used feed drive motors for CNC machines and Explain direct current servo motors
5. List two types of mechanical transmission system and Recall the main criterion to be considered in the design of a mechanical transmission system
6. List the various types of spindle bearings used in the design of a spindle for machine tools.
7. List the methods of measuring system
8. List the requirements for tool changing activity
9. List the requirements to operate the automatic tool changer

UNDERSTANDING

10. Explain static load, dynamic load and thermal load in machine structure
11. Explain frictional guide ways
12. Explain Vee guide ways
13. Explain flat and dovetail guide ways
14. Explain cylindrical guide ways
15. Explain the principle of hydrodynamic bearings
16. Explain the principle of hydrostatic bearings
17. Explain the principle of Antifriction bearings
18. Explain gauging in CNC machines
19. Explain tool monitoring system
20. Explain tool magazines
21. Explain the basic design factors involved in the design of a machine structure
22. Explain about elements used to convert the rotary motion to a linear motion
23. Explain about torque transmission elements

24. Compare between direct and indirect measuring system
25. Compare between direct and indirect monitoring system
26. Explain about tool changing

APPLICATION
27. Make use of sketch explain a typical machine tool with an automatic pallet changer (APC)
28. Identify the function of measuring systems which are used in CNC machines
29. Choose the functions of guide ways

CO4: Construct part programmes using ISO format for given simple components

REMEMBERING

1. Define CNC part programming
2. Choose the function of automatic tool changers in CNC machine tools

UNDERSTANDING

3. Explain the factors to be considered while writing the CNC part program.
4. Explain the co-ordinate system and methods of dimensioning.
5. Explain the various positions like machine zero, home position, and work piece zero.
6. Explain word addressed format.
7. Explain commonly used preparatory and miscellaneous functions for turning.
8. Explain commonly used preparatory and miscellaneous functions for milling
9. Illustrate the circular interpolation using interpolation parameters
10. Illustrate the circular interpolation by specifying the radius
11. Compare between tool length compensation and tool radius compensation
12. Illustrate subroutines (macros) (L)
13. Illustrate canned cycles using any one code from (G81-G89)
14. Illustrate mirror image
15. Explain axes and motion nomenclature.

APPLICATION/ANALYSIS
16. Make use of block diagram write the structure of part program.
17. Construct Simple programme on Milling and Turning operations
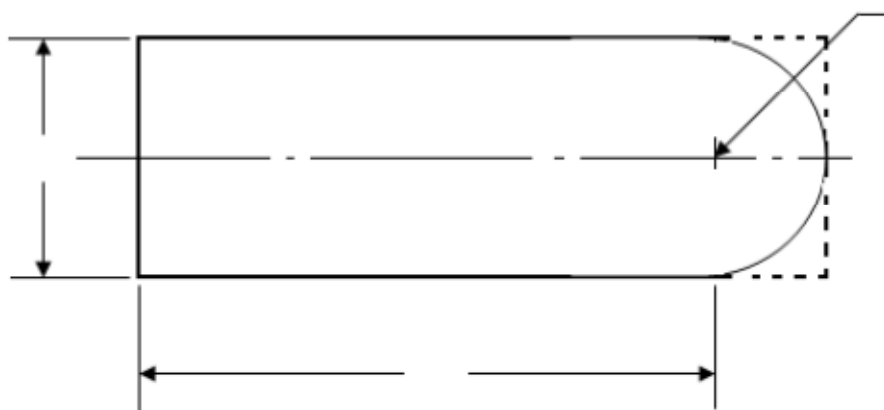18. Construct a part programme for the following component shown in figure
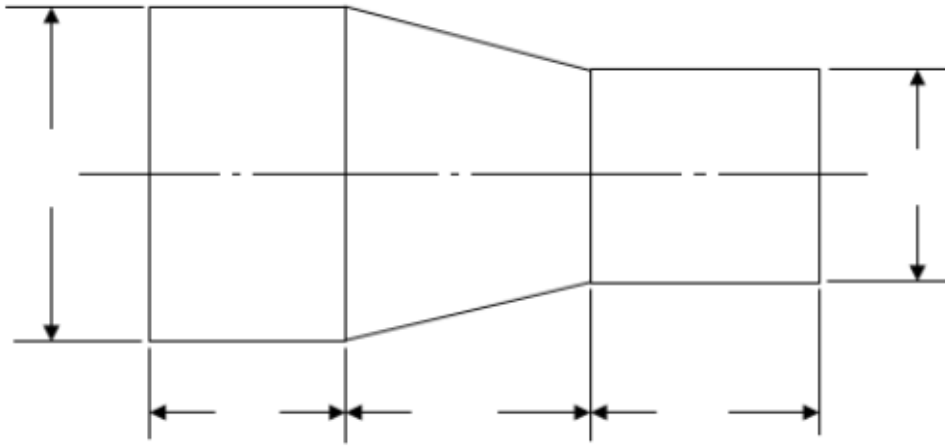
18. Construct a part programme for the following component shown in figure
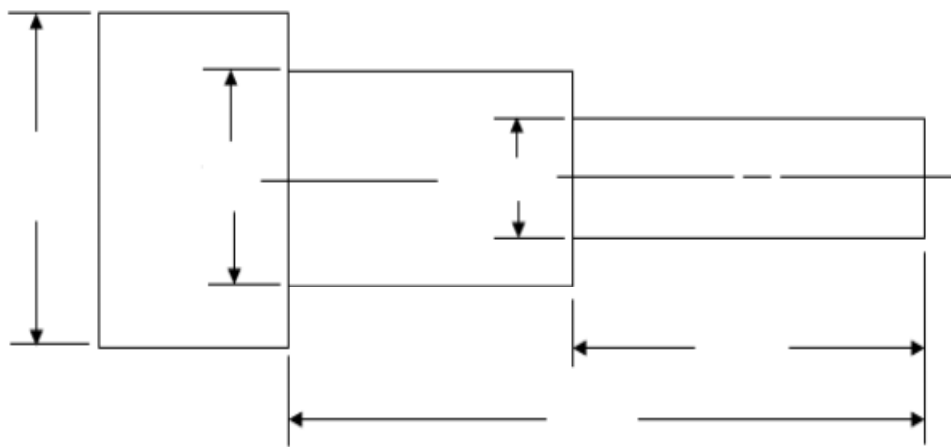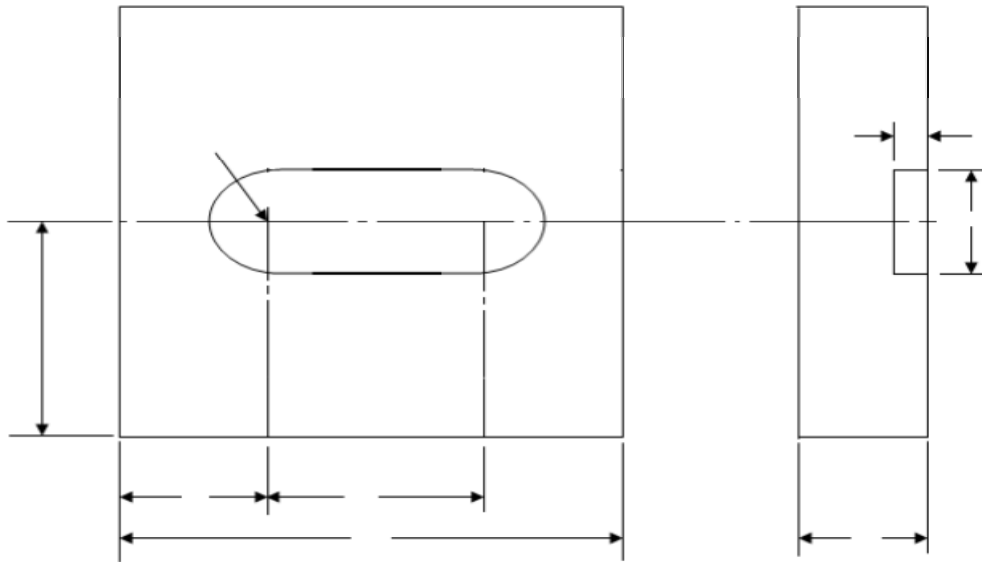

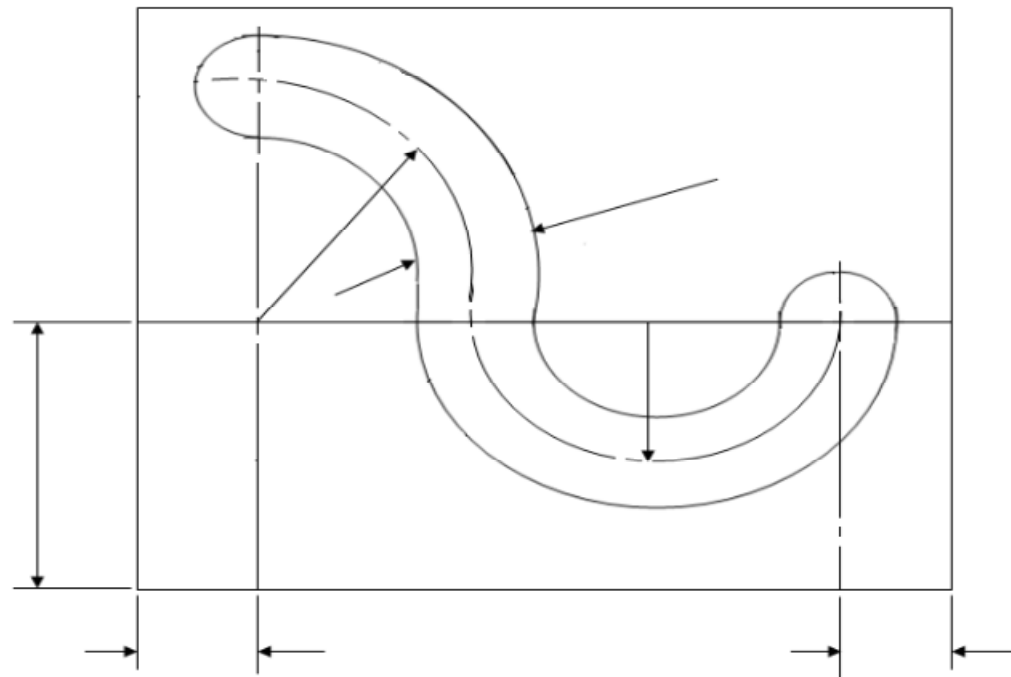19. Construct a part programme for the following component shown in figure

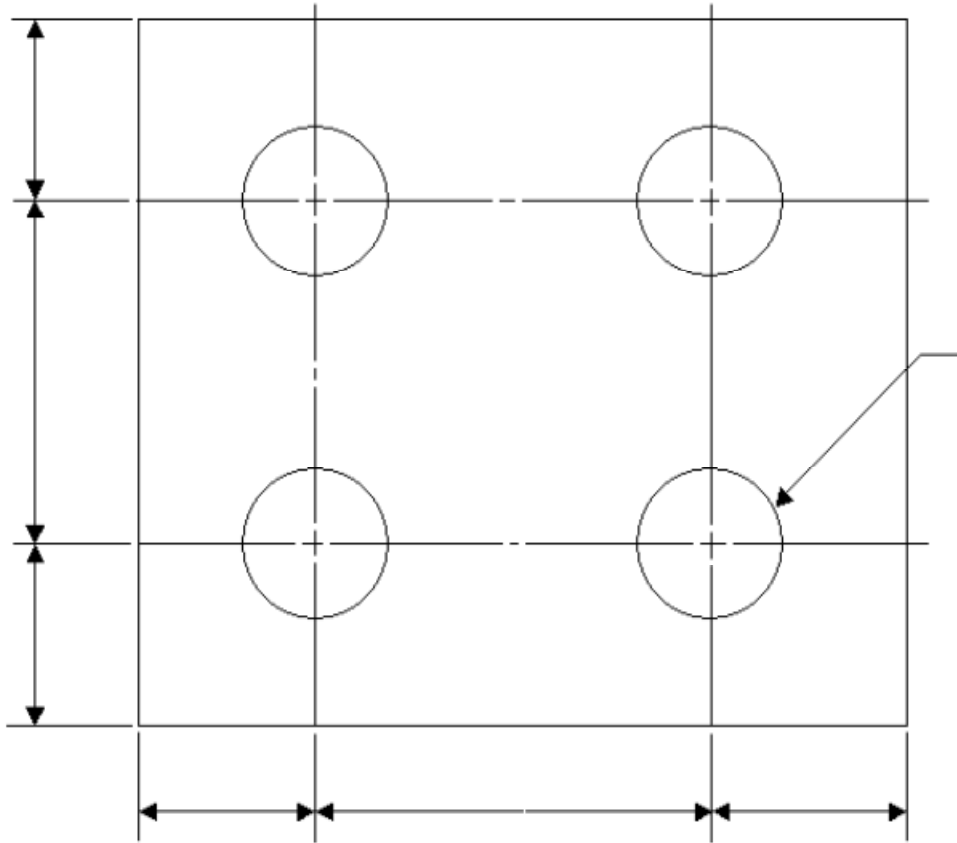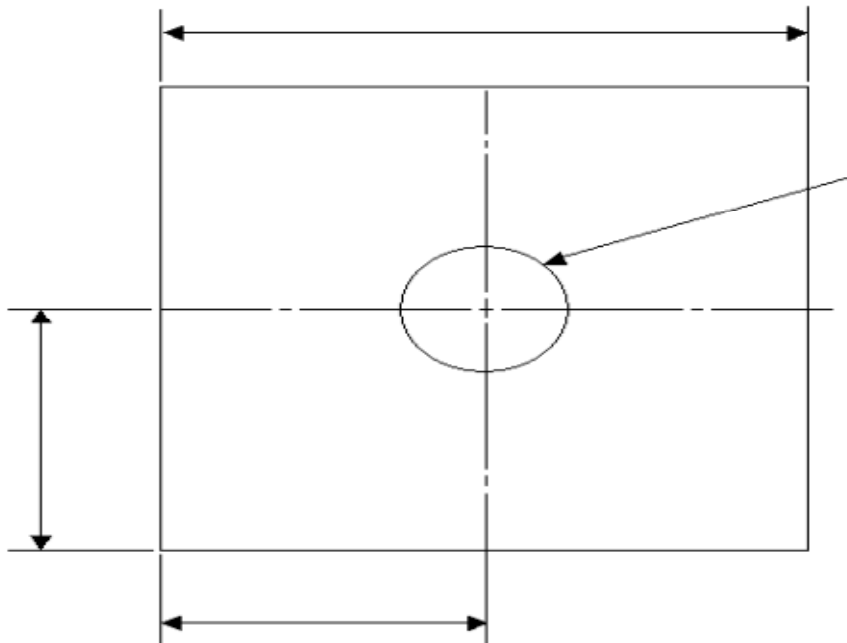20. Construct a part programme for the following component shown in figure

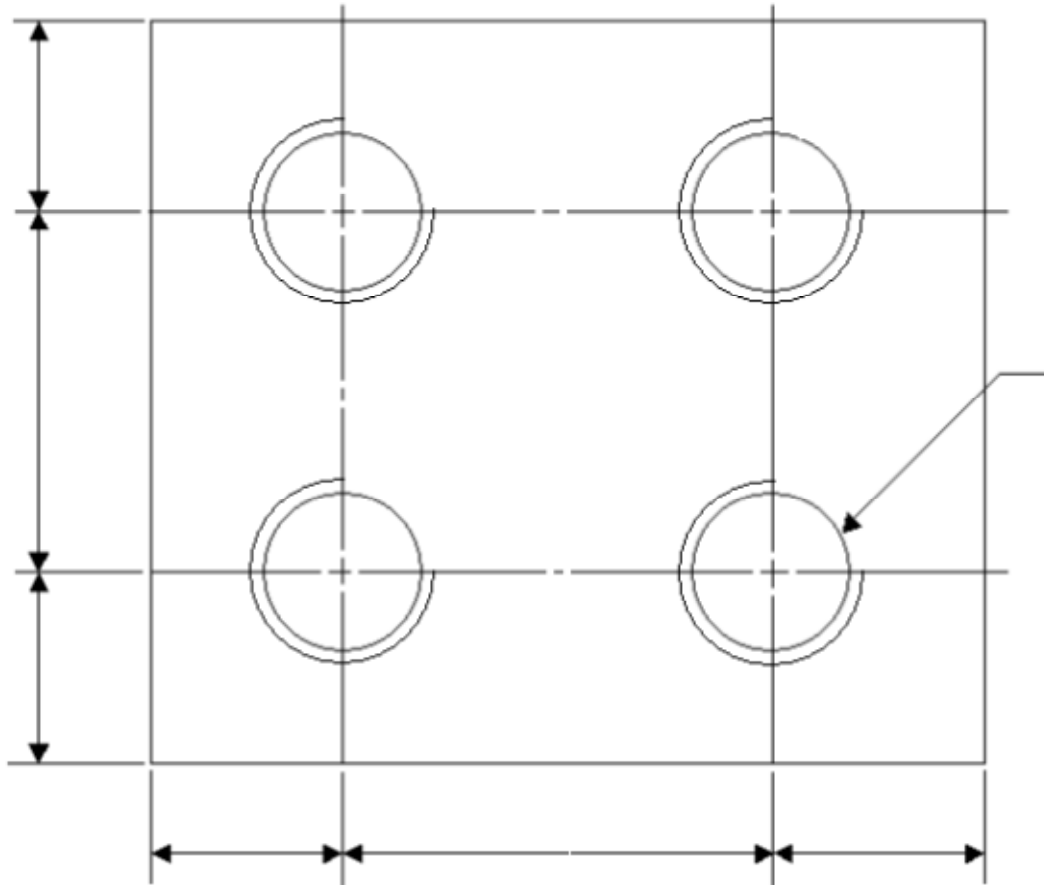21. Construct a part programme for the following component shown in figure

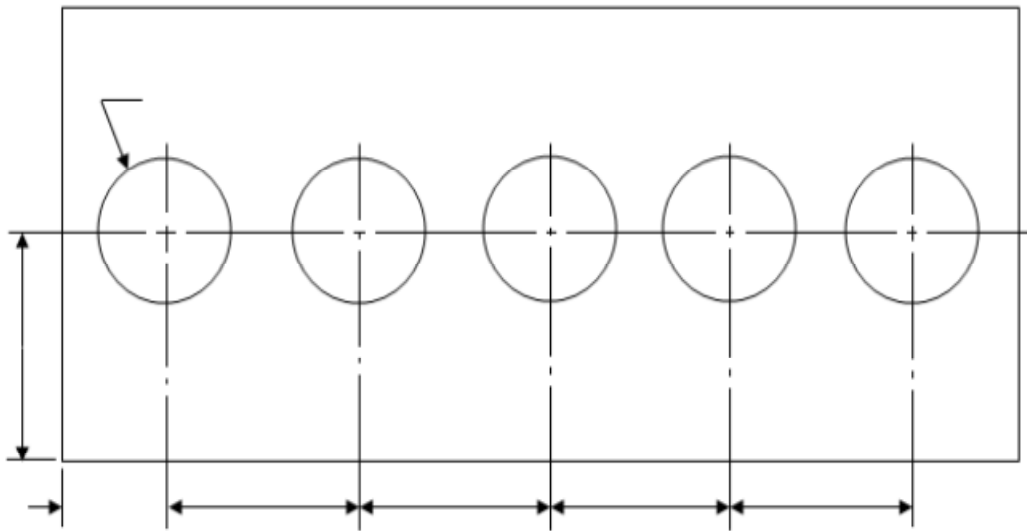22. Construct a part programme for the following component shown in figure

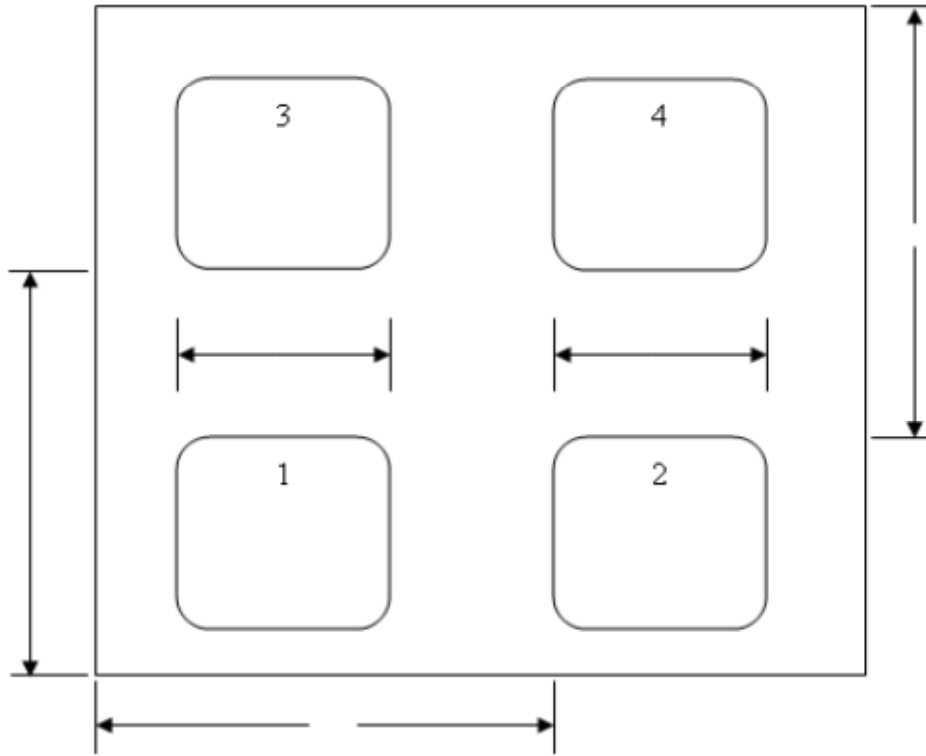23. Construct a part programme for the following component shown in figure

24. Construct a part programme for the following component shown in figure

25. Construct a part programme for the following component using do-loops shown in figure

26. Construct a part programme for the following component using sub routine shown in figure

REMEMBERING

1. List and explain the different methods available for forming groups in group technology
2. List the functions of classification and coding system
3. List the types of coding systems
4. List the applications of group technology
5. Define cellular manufacturing and Explain its relevance in modern manufacturing
6. List and explain the machining cell designs

UNDERSTANDING

7. Explain the importance of group technology in present manufacturing scenario
8. Explain group technology
9. Explain about the Opitz coding system generally used in group technology
10. Explain the needs for computer aided process planning
11. Explain the retrieval type of computer aided process planning method
12. Explain the generative type of computer aided process planning method
13. Explain the methodology to be followed for developing a retrieval type of computer aided process planning system
14. Explain the methodology to be followed for developing a generative type of computer aided process planning system
15. Explain the need for FMS
16. Explain the importance of material handling system in FMS

17. Explain the types of materials handling devices used in a FMS
18. Compare between retrieval type and generative type of computer aided process planning
19. Compare FMS to other types of manufacturing approaches

APPLICATION

20. Identify the benefits of group technology
21. Choose the major elements of FMS
22. Identify the benefits of FMS
23. Identify the advantages and limitations of group technology

CO6: Recognize use of robotics, in the field of manufacturing.

REMEMBERING

1. Define robot and explain its needs in computer integrated manufacturing
2. List the significant advantages of using a robot in a computer integrated manufacturing
3. List the different types of robots
4. Recall the different types of drive systems used in robots.
5. Recall   the different types of end effectors
6. Recall and explain the different types of control systems used in robots
7. List out the key features and specifications required for improving the performance capability of a robot

UNDERSTANDING

8. Explain the functions of mechanical components in robotic system
9. Explain rectangular co-ordinate robots
10. Explain cylindrical co-ordinate robots
11. Explain spherical co-ordinate robots
12. Explain revolute co-ordinate robots
13. Explain types of grippers used in industrial robot
14. Explain tools used in industrial robots as a end effectors
15. Explain programming of robots
16. Explain the methods used for program the robots
17. Explain the classifications of robots based on mechanical configuration
18. Compare between a SCARA and a gantry robot
19. Explain about six degrees of freedom in order to get the motions in robots.
20. Explain about the major functions of a control system used in robots
21. Explain about applications of industrial robot

APPLICATION

1. Make use of sketch explain the Gantry robot

2. Make use of sketch explain the SCARA robot
3. Choose the elements of a robotic system
4. Identify the important benefits of robots in CIM
5. Choose the functions of robot in computer integrated manufacturing