Ref No:

Sri Krishna Institute of Technology, Bangalore

COURSE PLAN

Academic Year 2019-20

Program:	B E – MECHANICAL
Semester :	VI
Course Code:	17ME62
Course Title:	COMPUTER INTEGRATED MANUFACTURING
Credit / L-T-P:	4 / 3-2-0
Total Contact Hours:	50
Course Plan Author:	PRAMOD S N

Academic Evaluation and Monitoring Cell

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Table of Contents

Note : Remove “Table of Content” before including in CP Book
Each Course Plan shall be printed and made into a book with cover page
Blooms Level in all sections match with A.2, only if you plan to teach / learn at higher levels

A. COURSE INFORMATION

1. Course Overview

Degree:	BE	Program:	ME
Year / Semester :	3/VI	Academic Year:	2019-2020
Course Title:	COMPUTER INTEGRATED MANUFACTURING	Course Code:	17ME62
Credit / L-T-P:	4/3-2-0	SEE Duration:	180 Minutes
Total Contact Hours:	50	SEE Marks:	60Marks
CIA Marks:	40	Assignment	1 / Module
Course Plan Author:	PRAMOD SN	Sign	Dt:
Checked By:	SHANKARE GOWDA K C	Sign	Dt:
CO Targets	CIA Target : ……. %	SEE Target:	……. %

Note: Define CIA and SEE % targets based on previous performance.

2. Course Content

Module	Module Content	Teaching Hours	Module Concepts	Blooms Level
1	**Introduction to CIM and Automation:**Automation in Production Systems, automated manufacturing systems- types of automation, reasons for automating, Computer Integrated Manufacturing,computerized elements of a CIM system, CAD/CAM and CIM. Mathematical models and matrices: production rate, production capacity, utilization and availability, manufacturing lead time, work-in- process, numerical problems. **Automated Production Lines and Assembly Systems:** Fundamentals, system configurations, applications, automated flow lines, buffer storage, control of production line, analysis of transfer lines, analysis of flow lines without storage, partial automation, analysis of automated flow lines with storage buffer, fundamentals of automated assembly systems, numerical problems.	10	CIM and Automation	L1,L2, L3
2	**CAD and Computer Graphics Software:** The design process, applications of computers in design, software configuration, functions of graphics package, constructing the geometry. Transformations: 2D transformations, translation, rotation and scaling, homogeneous transformation matrix, concatenation, numerical problems on transformations. **Computerized Manufacture Planning and Control System:** Computer Aided Process Planning, Retrieval and Generative Systems, benefits of CAPP, Production Planning and Control	10	CAD and Process Planning	L1,L2, L3

	Systems, typical activities of PPC System, computer integrated production management system, Material Requirement Planning, inputs to MRP system, working of MRP, outputs and benefits, Capacity Planning, Computer Aided Quality Control, Shop floor control.			
3	**Flexible Manufacturing Systems:** Fundamentals of Group Technology and Flexible Manufacturing Systems, types of FMS, FMS components, Material handling and storage system, applications, benefits, computer control systems, FMS planning and design issues, Automated Storage and Retrieval Systems, AS/RS and Automatic parts identification systems and data capture. **Line Balancing:** Line balancing algorithms, methods of line balancing, numerical problems on largest candidate rule, Kilbridge and Wester method, and Ranked Positional Weights method, Mixed Model line balancing, computerized line balancing methods.	10	FMS	L1,L2, L3
4	**Computer Numerical Control:** Introduction, components of CNC, CNC programming, manual part programming, G Codes, M Codes, programming of simple components in turning, drilling and milling systems, programming with canned cycles. Cutter radius compensations. **Robot Technology:** Robot anatomy, joints and links, common robot configurations, robot control systems, accuracy and repeatability, end effectors, sensors in robotics. Robot programming methods: on-line and off-line methods. Robot industrial applications: material handling, processing and assembly and inspection.	10	CNC and Robot	L1,L2, L3
5	**Additive Manufacturing Systems:** Basic principles of additive manufacturing, slicing CAD models for AM, advantages and limitations of AM technologies, Additive manufacturing processes: Photo polymerization, material jetting, binder jetting, material extrusion, Powder bed sintering techniques, sheet lamination, direct energy deposition techniques, applications of AM. Recent trends in manufacturing, Hybrid manufacturing. **Future of Automated Factory:** Industry 4.0, functions, applications and benefits. Components of Industry 4.0, Internet of Things (IOT), IOT applications in manufacturing, Big-Data and Cloud Computing for IOT, IOT for smart manufacturing, influence of IOT on predictive maintenance, industrial automation, supply chain optimization, supply-chain & logistics, cyber-physical manufacturing systems.	10	Additive Manufacturing and Hybrid communication	L1,L2

3. Course Material

Books & other material as recommended by university (A, B) and additional resources used by course teacher (C).

1. Understanding: Concept simulation / video ; one per concept ; to understand the concepts ; 15 – 30 minutes

2. Design: Simulation and design tools used – software tools used ; Free / open source

3. Research: Recent developments on the concepts – publications in journals; conferences etc.

Modules	Details	Chapters in book	Availability
A	**Text books (Title, Authors, Edition, Publisher, Year.)**		**-**
1,2	Dr.P Radhakrishnan		
1-5	Bharath Vinjamuri	1-8	In Lib/ In dept
1-5	Kestoor praveen	1-8	In Lib / In Dept
B	**Reference books (Title, Authors, Edition, Publisher, Year.)**		**-**
1-5	Mikell P Groover		In Lib
C	**Concept Videos or Simulation for Understanding**		**-**
C1			
C2			
D	**Software Tools for Design**	**-**	**-**
E	**Recent Developments for Research**	**-**	**-**
F	**Others (Web, Video, Simulation, Notes etc.)**	**-**	**-**
1	https://www.youtube.com/watch?v=Fd7wjZDoh7g		
2	https://www.youtube.com/watch?v=4FdEz5aqwII		
3	https://www.youtube.com/channel/UCpGClw1P0tC6LH4iLK9XOFA		
4	https://www.youtube.com/watch?v=TXlD6w2UV6s		

4. Course Prerequisites

Refer to GL01. If prerequisites are not taught earlier, GAP in curriculum needs to be addressed. Include in Remarks and implement in B.5.

Students must have learnt the following Courses / Topics with described Content . . .

Modules	Course Code	Course Name	Topic / Description	Sem	Remarks	Blooms Level
1	17ME14	EME	Module 3	1/2		L2

5. Content for Placement, Profession, HE and GATE

The content is not included in this course, but required to meet industry & profession requirements and help students for Placement, GATE, Higher Education, Entrepreneurship, etc. Identifying Area / Content requires experts consultation in the area.

Topics included are like, a. Advanced Topics, b. Recent Developments, c. Certificate Courses, d. Course Projects, e. New Software Tools, f. GATE Topics, g. NPTEL Videos, h. Swayam videos etc.

Modules	Topic / Description	Area	Remarks	Blooms Level

B. OBE PARAMETERS

1. Course Outcomes

Expected learning outcomes of the course, which will be mapped to POs. Identify a max of 2 Concepts per Module. Write 1 CO per Concept.

Modules	Course Code.#	Course Outcome **At the end of the course, student should be able to . . .**	Teach. Hours	Concept	Instr Method	Assessment Method	Blooms' Level
1	15ME62.1	Understand the knowledge of CIM and Automation	10	CIM and Automation	Chalk and board	Assignment ,Unit test and CIA	L1,L2.
2	15ME62.2	Understand the CAD and design applications by computer graphics and different process planning	10	CAD	Chalk and board	Assignment ,Unit test and CIA	L1,L2.
3	15ME62.3	Understand the fundamentals of FMS, line balancing and assembly lines	10	FMS	Chalk and board	Assignment ,Unit test and CIA	L1,L2
4	15ME62.4	Understand the CNC programming and robot configuration	10	CNC programming	Chalk and board	Assignment ,Unit test and CIA	L1,L2
5	15ME62.5	Understand the additive manufacturing techniques and hybrid communication	10	Additive manufacturing	Chalk and board	Assignment ,Unit test and CIA	L1,L2
-	-	**Total**	**50**	-	-	-	**L1-L2**

2. Course Applications

Write 1 or 2 applications per CO.

Students should be able to employ / apply the course learnings to . . .

Modules	Application Area Compiled from Module Applications.	CO	Level
1	Manufacturing and production	CO1	L2
2	Software and Planning department	CO2	L2
3	FMS and Shop Floor	CO3	L2
4	CNC Tooling and Automtion	CO4	L2
5	Special Purpose Machine and communication	CO5	L2

3. Mapping And Justification

CO – PO Mapping with mapping Level along with justification for each CO-PO pair.

To attain competency required (as defined in POs) in a specified area and the knowledge & ability required to accomplish it.

Modules	Mapping		Mapping Level	Justification for each CO-PO pair	Level
-	**CO**	**PO**	-	**'Area': 'Competency' and 'Knowledge' for specified 'Accomplishment'**	-
	CO1	PO1	L2	Understand the concepts of CIM	L2
	CO1	PO2	L2	Analyze bottle-neck in production	L2
	CO2	PO1	L2	Understand the concepts of automation	L2
	CO2	PO3	L3	To analyze the manufacturing problems	L2
	CO3	PO1	L3	Understand the concepts of automation	L2
	CO4	PO1	L2	To Learn a developing of new product	L2

	CO4	PO5	L2	To use modern tool usage	
	CO5	PO1	L2	Understand Structural data of new product development	L2
	CO5	PO2	L2	Analysis modern building technology	L2

4. Articulation Matrix

CO – PO Mapping with mapping level for each CO-PO pair, with course average attainment.

-	-	Course Outcomes	Program Outcomes														-
Modules	CO.#	**At the end of the course student should be able to . . .**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	Level
1	15ME62.1	Understand the knowledge of CIM ,flow lines and Automation	√	√	-	-	-	-	-	-	-	-	-	-	-	-	-	L2
2	15ME62.3	Understand the CAD and design applications by computer graphics, planning and control by computerized system	√	-	√	-	-	-	-	-	-	-	-	-	-	-	-	L2
3	15ME62.5	Understand the fundamentals of FMS, line balancing and assembly lines	√	-	-	-	-	-	-	-	-	-	-	-	-	-	-	L2
4	15ME62.7	Understand the CNC programming, robot configurations	√	-	-	-	√	-	-	-	-	-	-	-	-	-	-	L2
5	15ME62.9	Understand the additive manufacturing techniques and hybrid communication.	√	-	√	-	-	-	-	-	-	-	-	-	-	-	-	L2
-	**CS501PC**	**Average attainment (1, 2, or 3)**	√	√	-	-	-	-	-	-	-	-	-	-	-	**-**	**-**	L3
-	*PO, PSO*	*1.Engineering Knowledge; 2.Problem Analysis; 3.Design / Development of Solutions; 4.Conduct Investigations of Complex Problems; 5.Modern Tool Usage; 6.The Engineer and Society; 7.Environment and Sustainability; 8.Ethics; 9.Individual and Teamwork; 10.Communication; 11.Project Management and Finance; 12.Life-long Learning; S1.Software Engineering; S2.Data Base Management; S3.Web Design*																

5. Curricular Gap and Content

Topics & contents not covered (from A.4), but essential for the course to address POs and PSOs.

Modules	Gap Topic	Actions Planned	Schedule Planned	Resources Person	PO Mapping
1					
2					
3					

6. Content Beyond Syllabus

Topics & contents required (from A.5) not addressed, but help students for Placement, GATE, Higher Education, Entrepreneurship, etc.

Modules	Gap Topic	Area	Actions Planned	Schedule Planned	Resources Person	PO Mapping
1						
1						
2						

C. COURSE ASSESSMENT

1. Course Coverage

Assessment of learning outcomes for Internal and end semester evaluation. Distinct assignment for each student. 1 Assignment per chapter per student. 1 seminar per test per student.

Modules	Title	Teach. Hours	No. of question in Exam						CO	Levels
			CIA-1	CIA-2	CIA-3	Asg	Extra Asg	SEE		
1	Introduction to CIM and Automation, Automated Production Lines and Assembly Systems	10	2	-	-	1	1	2	CO1	L2
2	CAD and Computer Graphics Software Computerized, manufacturing Planning and Control System	10	2	-	-	1	1	2	CO2	L2
3	Flexible Manufacturing Systems, Line Balancing	10	-	2	-	1	1	2	CO3	L2
4	Computer Numerical, Control Robot Technology	10	-	2	-	1	1	2	C04	L2
5	Additive Manufacturing Systems, Future of Automated Factory	10	-	-	4	1	1	2	CO5	L2
-	**Total**	**50**	**4**	**4**	**4**	**5**	**5**	**10**	-	-

2. Continuous Internal Assessment (CIA)

Assessment of learning outcomes for Internal exams. Blooms Level in last column shall match with A.2.

Modules	Evaluation	Weightage in Marks	CO	Levels
1, 2	CIA Exam – 1	40	CO1, CO2	L2
3, 4	CIA Exam – 2	40	CO3, CO4	L2
5	CIA Exam – 3	40	CO5, CO6	L2
1, 2	Assignment - 1	–	–	–
3, 4	Assignment - 2	–	–	–
5	Assignment - 3	–	–	–
1, 2	Seminar - 1	–	–	–
3, 4	Seminar - 2	–	–	–
5	Seminar - 3	–	–	–
1, 2	Other Activities			
3, 4	CIA Exam – 1			
5	CIA Exam – 2			
	CIA Exam – 3			
1 - 5				
	Final CIA Marks	**40**	-	-

D1. TEACHING PLAN - 1

Module - 1

Title:	Introduction to CIM and Automation: Automated Production Lines and Assembly Systems:	Appr Time:	10 Hrs
a	***Course Outcomes***	-	**Blooms**
-		-	**Level**
1	Understand the knowledge of CIM,Automation and manufacturing flow lines	CO1	L2
b	***Course Schedule***	-	-
Class No	**Module Content Covered**	**CO**	**Level**
1	Automation in Production Systems, automated manufacturing systems-types of automation	C01	L2
2	Computer Integrated Manufacturing reasons for automating computerized elements of a CIM system	C01	L2
3	CAD/CAM and CIM. Mathematical models and matrices	C01	L2
4	production rate, production capacity, utilization and availability	C01	L2
5	manufacturing lead time, work-in- process, numerical problems.	C01	L2
6	Fundamentals, system configurations, applications	C01	L2
7	automated flow lines, buffer storage	C01	L2
8	control of production line, analysis of transfer lines, analysis of flow lines without storage, partial automation	C01	L2
9	analysis of automated flow lines with storage buffer	C01	L2
10	fundamentals of automated assembly systems, numerical problems.	C01	L2
c	**Application Areas**	**CO**	**Level**
1	Manufacturing	CO1	L2
2	Production	CO1	L2
d	**Review Questions**	-	-
1	What is automation? Explain different types of automation	CO1	L2
2	Explain the following terms: i) Manufacturing lead time ii) Production rate iii) Production capacity	CO1	L2
3	In a manufacturing plant a part is produced in a batch size of 60 units. The batch must be routed through 8 operations to complete it. Average set up time 5 hr/operation. Average operation time is 10 min. Average non-operation time is 7 hrs/operation. Determine: i) Manufacturing lead time in number of days of the plant runs 8 hrs shift/day. ii) Production rate of the plant.	CO1	L2
4	Explain the various methods of work part transport in an automated flow line.	CO1	L2
5	What are the symbols used in an automated flow line?	C01	L2
6	Sketch and explain the linear walking beam mechanism.	C01	L2
7	Explain the upper bound approach and lower hound approach in analyzing transfer lines without storage buffer.	C01	L2
8	Define automation and CIM with the aid of conceptual model of manufacturing.	C01	L2
9	Define the term plant capacity with a mathematical relation.	C01	L2
10	The average part produced in a certain batch manufacturing plant must be processed through of 8 machines. 20 new batches at. launched each week. Operating time is 8 min,average setup time is 8 hrs, batch size is 30 units,	C01	L2

	average non-operation time is 15 hr/machine. Number of machines available in the plant is 20. The plant operates on an average of 80 production hrs/week. Determine (i) MLT (ii) Rp (iii) PC (iv) U (v) WIP(vi) WIP ratio (vii) TIP ratio.		
e	**Experiences**	-	-
1			

Module – 2

Title:	**CAD and Computer Graphics Software: Computerized Manufacture Planning and Control System:**	Appr Time:	10 Hrs
a	***Course Outcomes***	-	**Blooms**
-		-	**Level**
1	To Understand the CAD and design applications by computer graphics and to expose students to process planning and control by computerized system	CO2	L2
b	***Course Schedule***	-	-
Class No	**Module Content Covered**	**CO**	**Level**
1	The design process, applications of computers in design,,,	CO2	L2
2	software configuration, functions of graphics package	CO2	L2
3	constructing the geometry. Transformations: 2D transformations, translation	CO2	L2
4	rotation and scaling, homogeneous transformation matrix,	CO2	L2
5	concatenation, numerical problems on transformations.	CO2	L2
6	Computer Aided Process Planning, Retrieval and Generative Systems,	CO2	L2
7	benefits of CAPP, Production Planning and Control Systems, typical activities of PPC System,	CO2	L2
8	computer integrated production management system, Material Requirement Planning,	CO2	L2
9	inputs to MRP system, working of MRP, outputs and benefits,	CO2	L2
10	Capacity Planning, Computer Aided Quality Control, Shop floor control.	CO2	L2
c	**Application Areas**	**CO**	**Level**
1	Software	CO2	L2
2	Planning department	CO2	L2
d	**Review Questions**	-	-
1	Explain with a neat sketch the software configuration of a graphics system.	CO2	L2
2	Explain the Computer aided design process with a ne at block diagram.	CO2	L2
3	Explain Retrieval type CAPP system with the help of a block diagram.	CO2	L2
4	Describe the inputs to the MRP system.	CO2	L2
5	Explain the functions of a graphics package.	CO2	L2
6	A square with an edge length of 10 units is located on the origin with one of the edge at an angle of 30° with positive x-axis. Calculate the new position of the square if it is rotated about z-axis by an angle of 30° in clockwise direction.	CO2	L4
7	Explain Generative type CAPP system with the help of a block diagram.	CO2	L2
8	What is Material requirement planning? Explain the structure of MRP system.	CO2	L2
9	Explain the following I) Capacity Planning ii) Computer Aided Quality Control	CO2	L2

10	What is homogeneous transformation matrix and explain briefly.	CO2	L2
e	**Experiences**	-	-
1			

E1. CIA EXAM – 1

a. Model Question Paper - 1

Crs Code:	17ME62	Sem:	VI	Marks:	40	Time:	75 minutes
Course:	Computer Integrated Manufacturing						

-	-	**Note: Answer any 2 questions, each carry equal marks.**	**Marks**	**CO**	**Level**
1	a	What is automation? Explain different types of automation	5	CO1	L2
	b	Explain the following terms: i) Manufacturing lead time ii) Production rate iii) Production capacity	5	CO1	L2
	c	In a manufacturing plant a part is produced in a batch size of 60 units. The batch must be routed through 8 operations to complete it. Average set up time 5 hr/operation. Average operation time is 10 min. Average non-operation time is 7 hrs/operation. Determine: i) Manufacturing lead time in number of days of the plant runs 8 hrs shift/day. ii) Production rate of the plant.	10	CO1	L4
2	a	Explain the various methods of work part transport in an automated flow line.	5	CO1	L2
	b	What are the symbols used in an automated flow line?	5	CO1	L2
	c	Sketch and explain the linear walking beam mechanism.	10	CO1	L2
3	a	Explain with a neat sketch the software configuration of a graphics system.	5	CO2	L2
	b	Explain the Computer aided design process with a neatblock diagram.	5	CO2	L2
	c	Explain Retrieval type CAPP system with the help of a block diagram.	10	CO2	L2
4	a	A square with an edge length of 10 units is located on the origin with one of the edge at an angle of 30° with positive x-axis. Calculate the new position of the square if it is rotated about z-axis by an angle of 30° in clockwise direction.	10	CO2	L2
	b	Explain Generative type CAPP system with the help of a block diagram.	5	CO2	L2
	c	What is Material requirement planning? Explain the structure of MRP system.	5	CO2	L2

b. Assignment -1

Model Assignment Questions							
Crs Code:	17ME62	Sem:	VI	Marks:	10	Time:	90 – 120 minutes

Course:	Computer Integrated Manufacturing		

Note: Each student to answer 2-3 assignments. Each assignment carries equal mark.

SNo	USN	Assignment Description	Marks	CO	Level
1		What is automation? Explain different types of automation	10	CO1	L2
2		Explain the following terms: i) Manufacturing lead time ii) Production rate iii) Production capacity	10	CO1	L2
3		In a manufacturing plant a part is produced in a batch size of 60 units. The batch must be routed through 8 operations to complete it. Average set up time 5 hr/operation. Average operation time is 10 min. Average non-operation time is 7 hrs/operation. Determine: i) Manufacturing lead time in number of days of the plant runs 8 hrs shift/day. ii) Production rate of the plant.	10	CO1	L2
4		Explain the various methods of work part transport in an automated flow line.	10	CO1	L2
5		What are the symbols used in an automated flow line?	10	CO1	L2
6		Sketch and explain the linear walking beam mechanism.	10	CO1	L2
7		Explain the upper bound approach and lower hound approach in analyzing transfer lines without storage buffer.	10	CO1	L2
8		Define automation and CIM with the aid of conceptual model of manufacturing.	10	CO1	L2
9		Define the term plant capacity with a mathematical relation.	10	CO1	L2
10		The average part produced in a certain batch manufacturing plant must be processed through of 8 machines. 20 new batches at. launched each week. Operating time is 8 min,average setup time is 8 hrs, batch size is 30 units, average non-operation time is 15 hr/machine. Number of machines available in the plant is 20. The plant operates on an average of 80 production hrs/week. Determine (i) MLT (ii) Rp (iii) PC (iv) U (v) WIP(vi) WIP ratio (vii) TIP ratio.	10	CO1	L2
11		Explain with a neat sketch the software configuration of a graphics system.	10	CO2	L2
12		Explain the Computer aided design process with a neat block diagram.	10	CO2	L2
13		Explain Retrieval type CAPP system with the help of a block diagram.	10	CO2	L2
14		Describe the inputs to the MRP system.	10	CO2	L2
15		Explain the functions of a graphics package.	10	CO2	L2
16		A square with an edge length of 10 units is located on the origin with one of the edge at an angle of 30° with positive x-axis. Calculate the new position of the square if it is rotated about z-axis by an angle of 30° in clockwise direction.	10	CO2	L2
17		Explain Generative type CAPP system with the help of a block diagram.	10	CO2	L2
18		What is Material requirement planning? Explain the structure of MRP system.	10	CO2	L2
19		Explain the following I) Capacity Planning ii) Computer Aided Quality Control	10	CO2	L2
20		What is homogeneous transformation matrix and explain briefly.	10	CO2	L2

E2.E2. CIA EXAM – 2

a. Model Question Paper - 2

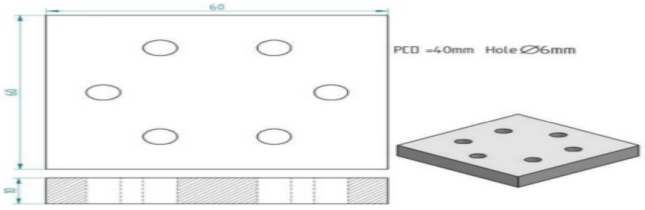
<table>
<tr><td>Crs Code:</td><td>17ME62</td><td>Sem:</td><td>VI</td><td>Marks:</td><td>40</td><td>Time:</td><td colspan="3">75 minutes</td></tr>
<tr><td>Course:</td><td colspan="8">Computer Integrated Manufacturing</td></tr>
<tr><td>-</td><td>-</td><td colspan="5">Note: Answer any 2 questions, each carry equal marks.</td><td>Marks</td><td>CO</td><td>Level</td></tr>
<tr><td>1</td><td>a</td><td colspan="5">Define FMS. Explain the types of FMS.</td><td>5</td><td>CO3</td><td>L2</td></tr>
<tr><td></td><td>b</td><td colspan="5">Enumerate the advantages of group technology.</td><td>5</td><td>CO3</td><td>L2</td></tr>
<tr><td></td><td>c</td><td colspan="5">Explain various components of FMS with a neat block diagram</td><td>10</td><td>CO3</td><td>L2</td></tr>
<tr><td></td><td></td><td colspan="5"></td><td></td><td>CO3</td><td></td></tr>
<tr><td>2</td><td>a</td><td colspan="5">What is Automated Storage and Retrieval Systems</td><td>5</td><td>CO3</td><td>L2</td></tr>
<tr><td></td><td>b</td><td colspan="5">Explain the following terms in line balancing. i) Minimum rational Work element ii) Precedence diagram iii) Cycle time iv) Balance delay</td><td>5</td><td>CO3</td><td>L2</td></tr>
<tr><td></td><td>c</td><td colspan="5">A new product is to be assembled in a plant, the data gives the precedence relationship and elemental times
<table><tr><td>Element</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td></tr><tr><td>Time ‘T_e’(min)</td><td>1.0</td><td>0.5</td><td>0.8</td><td>0.3</td><td>1.2</td><td>0.2</td><td>0.5</td><td>1.5</td></tr><tr><td>Immediate predecessor</td><td>-</td><td>-</td><td>1,2</td><td>2</td><td>3</td><td>3,4</td><td>4</td><td>5,6,7</td></tr></table>Using largest Candidate rule method,
i) Construct the precedence diagram for this job</td><td>10</td><td>CO3</td><td>L2</td></tr>
<tr><td></td><td></td><td colspan="5"></td><td></td><td></td><td></td></tr>
<tr><td>3</td><td>a</td><td colspan="5">Explain the fundamental steps involved in development of part programming for milling
and turning.</td><td>5</td><td>CO4</td><td>L2</td></tr>
<tr><td></td><td>b</td><td colspan="5">State the advantages ,disadvantages and applications of CNC machine tools.</td><td>5</td><td>CO4</td><td>L2</td></tr>
<tr><td></td><td>c</td><td colspan="5">Write the Part program to mill the profile of the part as shown in fig 1
 

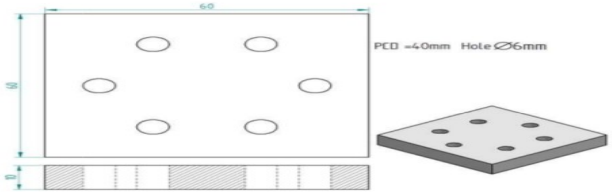
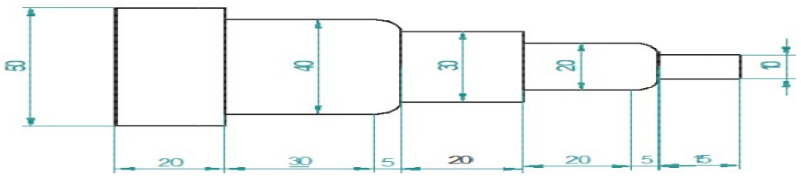
fig. 1</td><td>10</td><td>CO4</td><td>L2</td></tr>
<tr><td></td><td></td><td colspan="5"></td><td></td><td></td><td></td></tr>
<tr><td>4</td><td>a</td><td colspan="5">Explain with a neat sketch the T-R-L AND T-R-R robots.</td><td>5</td><td>CO4</td><td>L2</td></tr>
<tr><td></td><td>b</td><td colspan="5">Explain the different configurations of robot with neat sketches</td><td>5</td><td>CO4</td><td>L2</td></tr>
<tr><td></td><td>c</td><td colspan="5">Explain the following with reference to precision of robot
a) Spatial resolution ii) Accuracy iii) Repeatability</td><td>10</td><td>CO4</td><td>L2</td></tr>
<tr><td></td><td></td><td colspan="5"></td><td></td><td></td><td></td></tr>
</table>

b. Assignment – 2

<table>
<tr><td colspan="8">Model Assignment Questions</td></tr>
<tr><td>Crs Code:</td><td>17ME62</td><td>Sem:</td><td>VI</td><td>Marks:</td><td>10</td><td>Time:</td><td>90 – 120 minutes</td></tr>
</table>

Course:	Computer Integrated Manufacturing		

Note: Each student to answer 2-3 assignments. Each assignment carries equal mark.

SNo	USN	Assignment Description	Marks	CO	Level
1		Define FMS. Explain the types of FMS.	10	CO3	L2
2		Enumerate the advantages of group technology.	10	CO3	L2
3		Explain various components of FMS with a neat block diagram	10	CO3	L2
4		Enumerate the advantages of line technology.	10	CO3	L2
5		What is Automated Storage and Retrieval Systems	10	CO3	L2
6		Explain the following terms in line balancing. i) Minimum rational Work element ii) Precedence diagram iii) Cycle time iv) Balance delay	10	CO3	L2
7		A new product is to be assembled in a plant, the data gives the precedence relationship and elemental times Element 1 2 3 4 5 6 7 8 Time 'T_e'(min) 1.0 0.5 0.8 0.3 1.2 0.2 0.5 1.5 Immediate predecessor - - 1,2 2 3 3,4 4 5,6,7 Using largest Candidate rule method, i) Construct the precedence diagram for this job	8	CO3	L4
8		Explain the objectives of line balancing.	10	CO3	L2
9		Use Kilbridge and Westers method to assign the workstation to each element and compute the balance delay and balance efficiency. . **(10 Marks)** Work element 1 2 3 4 5 6 7 8 9 10 11 12 T_e(min) 0.25 0.45 0.35 0.4 0.32 0.2 0.27 0.7 0.6 0.38 0.5 0.43 Preceded by - 1 1 1 2 2,3 4 4 5 6,7 8 9,10,11	10	CO4	L4
10		Expalin Mixed Model line balancing and computerized line balancing methods.	10	CO4	L2
11		Explain the fundamental steps involved in development of part programming for milling and turning.	10	CO4	L2
12		State the advantages ,disadvantages and applications of CNC machine tools.	10	CO4	L2
13		Write the Part program to mill the profile of the part as shown in fig 1  fig. 1	10	CO4	L3
14		Write the Part program to turn the profile of the part as shown in fig.1 (C 	8	CO4	L3
15		Explain four methods of programming the robot.	8	CO4	L2
16		Explain with a neat sketch the T-R-L AND T-R-R robots.	8	CO4	L2

17		Explain the different configurations of robot with neat sketches	8	CO4	L2
18		Explain the following with reference to precision of robot a) Spatial resolution ii) Accuracy iii) Repeatability	8	CO4	L2

D3. TEACHING PLAN - 3

Module – 5

Title:	**Additive Manufacturing Systems:** **Future of Automated Factory:**	Appr Time:	10 Hrs
a	***Course Outcomes***	-	**Blooms**
-		-	**Level**
1	Understand the additive manufacturing techniques and hybrid communication	CO8	L2
b	***Course Schedule***		
Class No	**Module Content Covered**	**CO**	**Level**
1	Basic principles of additive manufacturing	CO5	L2
2	slicing CAD models for AM, advantages and limitations of AM technologies, Additive manufacturing processes	CO5	L2
3	Photo polymerization, material jetting, binder jetting, material extrusion, Powder bed sintering techniques, sheet lamination	CO5	L2
4	direct energy deposition techniques, applications of AM.	CO5	L2
5	Recent trends in manufacturing, Hybrid manufacturing	CO5	L2
6	Industry 4.0, functions, applications and benefits.	CO5	L2
7	Components of Industry 4.0, Internet of Things (IOT), IOT applications in manufacturing,	CO5	L2
8	Big-Data and Cloud Computing for IOT, IOT for smart manufacturing	CO5	L2
9	influence of IOT on predictive maintenance, industrial automation, supply chain optimization	CO5	L2
10	supply-chain & logistics, cyber-physical manufacturing systems.	CO5	L2
c	**Application Areas**		
1	Special Purpose Machine	CO5	L2
2	Communication	CO5	L2
d	**Review Questions**		
1	Explain with a neat sketch the Sheet lamination process.	CO5	L2
2	Explain with a neat sketch the Direct energy deposition technique.	CO5	L2
3	Explain the different stages involved in additive manufacturing process.	CO5	L2
4	Explain with a neat sketch the Selective laser sintering process	CO5	L2
5	Explain how big data and cloud computing can support IOT.	CO5	L2
6	Explain the application and benefits of Industry 4.0	CO5	L2
7	Define IOT. Explain the applications of IOT in manufacturing.	CO5	L2
8	What are the components of Industry 4.0? Explain.	CO5	L2

9	Explain Big-Data and Cloud Computing for IOT, IOT for smart manufacturing	CO5	L2
10	Briefly explain influence of IOT on predictive maintenance.	CO5	L2
11	What is supply-chain & logistics.	CO5	L2
12	Explain cyber-physical manufacturing systems.	CO5	L2
e	**Experiences**	-	-
1			
2			

E3. CIA EXAM – 3

a. Model Question Paper - 3

Crs Code:	15EC71	Sem:	VII	Marks:	40	Time:	75 minutes
Course:	MICROWAVE AND ANTENNAS						

-	-	**Note: Answer all questions, each carry equal marks. Module : 5**	**Marks**	**CO**	**Level**
1	a	Briefly explain influence of IOT on predictive maintenance.	5	CO9	L2
	b	What is supply-chain & logistics.	5	CO9	L2
	c	Explain cyber-physical manufacturing systems.	10	CO9	L2
		OR			
1	a	Define IOT. Explain the applications of IOT in manufacturing.	5	CO9	L2
	b	What are the components of Industry 4.0? Explain.	5	CO9	L2
	c	Explain Big-Data and Cloud Computing for IOT, IOT for smart manufacturing	10	CO9	L2
2	a	Explain the Basic principles of additive manufacturing	5	CO10	L2
	b	What is slicing CAD models for AM, advantages and limitations of AM technologies,	5	CO10	L2
	c	List and explain Additive manufacturing processes	10	CO10	L2
		OR			
2	a	Explain with a neat sketch the Sheet lamination process.	5	CO10	L2
	b	Explain with a neat sketch the Direct energy deposition technique.	5	CO10	L2
	c	Explain the different stages involved in additive manufacturing process.	10	CO10	L2

D3. TEACHING PLAN - 3

Module – 5

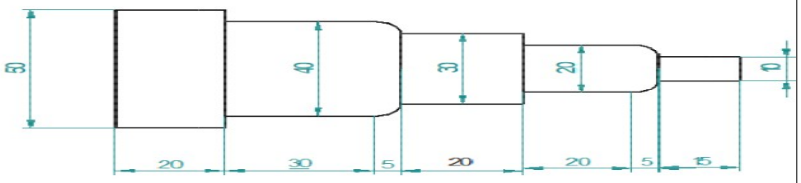
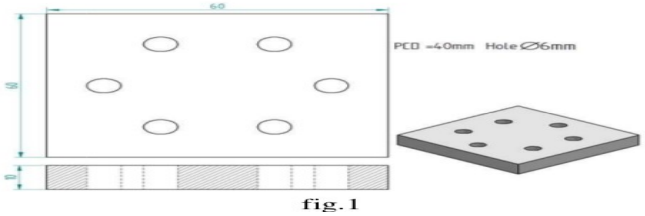
Title:	**Additive Manufacturing Systems:** **Future of Automated Factory:**	Appr Time:	10 Hrs
a	***Course Outcomes***	-	**Blooms**
-		-	**Level**
1	Understand the additive manufacturing techniques and Hybrid communication	CO5	L2
b	***Course Schedule***		
Class No	**Module Content Covered**	**CO**	**Level**

1	Basic principles of additive manufacturing	CO5	L2
2	slicing CAD models for AM, advantages and limitations of AM technologies, Additive manufacturing processes	CO5	L2
3	Photo polymerization, material jetting, binder jetting, material extrusion, Powder bed sintering techniques, sheet lamination	CO5	L2
4	direct energy deposition techniques, applications of AM.	CO5	L2
5	Recent trends in manufacturing, Hybrid manufacturing	CO5	L2
6	Industry 4.0, functions, applications and benefits.	CO5	L2
7	Components of Industry 4.0, Internet of Things (IOT), IOT applications in manufacturing,	CO5	L2
8	Big-Data and Cloud Computing for IOT, IOT for smart manufacturing	CO5	L2
9	influence of IOT on predictive maintenance, industrial automation, supply chain optimization	CO5	L2
10	supply-chain & logistics, cyber-physical manufacturing systems.	CO5	L2
c	**Application Areas**		
1	Special Purpose Machine	CO5	L2
2	Communication	CO5	L2
d	**Review Questions**		
1	Explain with a neat sketch the Sheet lamination process.	CO5	L2
2	Explain with a neat sketch the Direct energy deposition technique.	CO5	L2
3	Explain the different stages involved in additive manufacturing process. .	CO5	L2
4	Explain with a neat sketch the Selective laser sintering process	CO5	L2
5	Explain how big data and cloud computing can support IOT.	CO5	L2
6	Explain the application and benefits of Industry 4.0	CO5	L2
7	Define IOT. Explain the applications of IOT in manufacturing.	CO5	L2
8	What are the components of Industry 4.0? Explain.	CO5	L2
9	Explain Big-Data and Cloud Computing for IOT, IOT for smart manufacturing	CO5	L2
10	Briefly explain influence of IOT on predictive maintenance.	CO5	L2
11	What is supply-chain & logistics.	CO5	L2
12	Explain cyber-physical manufacturing systems.	CO5	L2
e	**Experiences**	-	-
1			
2			

F. EXAM PREPARATION

1. University Model Question Paper

Course:	Computer Integrated Manufacturing					Month / Year	May /2018	
Crs Code:	17ME62	Sem:	VI	Marks:		Time:	180 minutes	
	Note	Answer all FIVE full questions. All questions carry equal marks.				**Marks**	**CO**	**Level**
1	a	Define Manufacturing lead time Production rate, Utilization & availability ,Work inprocess with mathematical expressions				8	CO1	L2

	b	An average of 10 new orders is started through a certain factory each month. An order consists of an average 75 parts to be processed through 8 machines in the factory .The operation tome is 25 min.The non operation time is 10 hours and the setup time is 5hrs.The plant operates 175 hrs/month and there are 20 machines in the plant. Determine i)Manufacturing lead time ii) Plant capacity iii) Utilization iv) Work in process v) TIP ratio.	8	CO1	L4
		OR			
	a	Differentiate between upper bound and lower bound approach to analyse automated flow lines without storage buffers.	8	CO1	L2
	b	A transfer line has ten station with an ideal cycle time of 30 sec. The frequency of the line stop occurrence is 0.06stop/cycle on an average. When a stop occurs, it takes an average of 5 min to make repairs. Determine i) Average production time ii) Average production rate iii) Line efficiency iv) Proportion of down time	8	CO1	L4
2	a	Explain the functions of a graphics package.	8	CO2	L2
	b	A square with an edge length of 10 units is located on the origin with one of the edge at an angle of 30° with positive x-axis. Calculate the new position of the square if it is rotated about z-axis by an angle of 30° in clockwise direction.	8	CO2	L4
		OR			
	a	Explain Generative type CAPP system with the help of a block diagram.	8	CO2	L2
	b	What is Material requirement planning? Explain the structure of MRP system.	8	CO2	L2
3	a	Explain various components of FMS with a neat block diagram.	8	CO3	L2
	b	Explain applications and benefits of FMS.	8	CO3	L2
		OR			
	a	Explain the objectives of line balancing.	8	CO3	L2
	b	Write the Part program to turn the profile of the part as shown in fig.1 	8	CO3	L3
4	a	State the advantages ,disadvantages and applications of CNC machine tools.	8	CO4	L2
	b	Write the Part program to mill the profile of the part as shown in fig 1  fig. 1	8	CO4	L3
		OR			
	a	Explain four methods of programming the robot.	8	CO4	L2
	b	Explain with a neat sketch the T-R-L AND T-R-R robots.	8	CO4	L2

5	a	Explain the different stages involved in additive manufacturing process.	8	CO5	L2
	b	Explain with a neat sketch the Selective laser sintering process	8	CO5	L2
	a	Explain how big data and cloud computing can support IOT.	8	CO5	L2
	b	Explain the application and benefits of Industry 4.0 .	8	CO5	L2

2. SEE Important Questions

Course:		Computer Integrated Manufacturing					Month / Year	May /2018	
Crs Code:		17ME62	Sem:	VI	Marks:		Time:	180 minutes	
	Note	Answer all FIVE full questions. All questions carry equal marks.					-	-	
Module	Qno.	Important Question					**Marks**	**CO**	**Year**
1	1	Define Manufacturing lead time Production rate, Utilization & availability ,Work in process with mathematical expressions					8	CO1	2018
	2	An average of 10 new orders is started through a certain factory each month. An order consists of an average 75 parts to be processed through 8 machines in the factory .The operation tome is 25 min.The non operation time is 10 hours and the setup time is 5 hrs.The plant operates 175 hrs/month and there are 20 machines in the plant. Determine I) Manufacturing lead time ii) Plant capacity iii) Utilization iv) Work in process v) TIP ratio.					8	CO1	2018
	3	Explain with neat sketches the fixed, flexible and programmable automations					8	CO1	2018
	4	The parts produced in a batch manufacturing plant must be processed through an average of six machines. There are 20 new batches of parts launched each week. Other data are as follows. Average operation time: 6 minutes ,Average set up tome:5 hours, Average non-operation time:600 minutes, Average batch size:50 parts. There are 24 machines in the plant and the plant operates 70 hours per week. Determine)Manufacturing lead time ii) Plantcapacity iii)Workinprocess iv)Plant utilization.					8	CO1	2018
2	1	Explain general configuration of automated flow lines with a neat sketch.					8	CO2	2018
	2	A 22 station in line transfer machine has an ideal cycle time of 0.55 min.The probability of station break down is p=0.01.Average downtime =8 min per line stop. use the upper bound approach and determine: i) Ideal production rate ii) Frequency of line stops iii) Average actual production rate iv) Line efficiencyCO2					8	CO2	2018
	3	Explain with a neat sketch the software configuration of a graphics system .					8	CO2	2018
	4	Explain the Computer aided design process with a neat block diagram .					8	CO2	2018
3	1	Explain Retrieval type CAPP system with the help of a block diagram.					8	CO3	2018
	2	Describe the inputs to the MRP system .					8	CO3	2018
	3	Define FMS. Explain the types of FMS.					8	CO3	2018

	4	Enumerate the advantages of group technology.	8	CO3	2018
4	1	Explain the fundamental steps involved in development of part programming for milling and turning.	8	CO4	2018
	2	Explain the different configurations of robot with neat sketches	8	CO4	2018
	3	Explain the following with reference to precision of robot a) Spatial resolution ii) Accuracy iii) Repeatability	8	CO4	2018
	4	Explain applications and benefits of FMS.	8	CO4	2018
5	1	Explain with a neat sketch the Sheet lamination process.	8	CO5	2018
	2	Explain with a neat sketch the Direct energy deposition technique.	8	CO5	2018
	3	Define IOT. Explain the applications of IOT in manufacturing.	8	CO5	2018
	4	What are the components of Industry 4.0? Explain.	8	CO5	2018

G. Content to Course Outcomes

1. TLPA Parameters

Table 1: TLPA

Module-#	Course Content or Syllabus	Content Teaching Hours	Blooms' Learning Levels for Content	Final Blooms' Level	Identified Action Verbs for Learning	Instruction Methods for Learning	Assessment Methods to Measure Learning
A	*B*	*C*	*D*	*E*	*F*	*G*	*H*
1	**Introduction to CIM and Automation:**Automation in Production Systems, automated manufacturing systems-types of automation, reasons for automating, Computer Integrated Manufacturing,computerized elements of a CIM system, CAD/CAM and CIM. Mathematical models and matrices: production rate, production capacity, utilization and availability, manufacturing lead time, work-in- process, numerical problems. **Automated Production Lines and Assembly Systems:** Fundamentals, system configurations, applications, automated flow lines, buffer storage, control of production line, analysis of transfer lines, analysis of flow lines without storage, partial automation, analysis of automated flow lines with storage buffer, fundamentals of automated assembly systems, numerical problems.	10	L2	L2		Chalk and board	CIA and Assignment
2	**CAD and Computer Graphics Software:** The design process, applications of computers in design, software configuration, functions of graphics package, constructing the geometry.	10	L2	L2		Chalk and board	CIA and Assignment

	Transformations: 2D transformations, translation, rotation and scaling, homogeneous transformation matrix, concatenation, numerical problems on transformations. **Computerized Manufacture Planning and Control System:** Computer Aided Process Planning, Retrieval and Generative Systems, benefits of CAPP, Production Planning and Control Systems, typical activities of PPC System, computer integrated production management system, Material Requirement Planning, inputs to MRP system, working of MRP, outputs and benefits, Capacity Planning, Computer Aided Quality Control, Shop floor control.						
3	**Flexible Manufacturing Systems:** Fundamentals of Group Technology and Flexible Manufacturing Systems, types of FMS, FMS components, Material handling and storage system, applications, benefits, computer control systems, FMS planning and design issues, Automated Storage and Retrieval Systems, AS/RS and Automatic parts identification systems and data capture. **Line Balancing:** Line balancing algorithms, methods of line balancing, numerical problems on largest candidate rule, Kilbridge and Wester method, and Ranked Positional Weights method, Mixed Model line balancing, computerized line balancing methods.	10	L2	L2		Chalk and board	CIA and Assignment
4	**Computer Numerical Control:** Introduction, components of CNC, CNC programming, manual part programming, G Codes, M Codes, programming of simple components in turning, drilling and milling systems, programming with canned cycles. Cutter radius compensations. **Robot Technology:** Robot anatomy, joints and links, common robot configurations, robot control systems, accuracy and repeatability, end effectors, sensors in robotics. Robot programming methods: on-line and off-line methods. Robot industrial applications: material handling, processing and assembly and inspection.	10	L2	L2		Chalk and board	CIA and Assignment
5	**Additive Manufacturing Systems:** Basic principles of additive manufacturing, slicing CAD models for AM, advantages and limitations of AM technologies, Additive	10	L2	L2		Chalk and board	CIA and Assignment

	manufacturing processes: Photo polymerization, material jetting, binder jetting, material extrusion, Powder bed sintering techniques, sheet lamination, direct energy deposition techniques, applications of AM. Recent trends in manufacturing, Hybrid manufacturing. **Future of Automated Factory:** Industry 4.0, functions, applications and benefits. Components of Industry 4.0, Internet of Things (IOT), IOT applications in manufacturing, Big-Data and Cloud Computing for IOT, IOT for smart manufacturing, influence of IOT on predictive maintenance, industrial automation, supply chain optimization, supply-chain & logistics, cyber-physical manufacturing systems.						

2. Concepts and Outcomes:

Table 2: Concept to Outcome

Module-#	Learning or Outcome from study of the Content or Syllabus	Identified Concepts from Content	Final Concept	Concept Justification (What all Learning Happened from the study of Content / Syllabus. A short word for learning or outcome)	CO Components (1.Action Verb, 2.Knowledge, 3.Condition / Methodology, 4.Benchmark)	Course Outcome **Student Should be able to ...**
A	*I*	*J*	*K*	*L*	*M*	*N*
1	Students will be able to understand integration os systems	CIM	CIM and Automation	Scenerio of manufacturing	Understand integration of computers	Understand the knowledge of CIM and Automation
2	Students will be able to understand concept of planning	CAD and Process Planning	CAPP	Outline of planning	Understand Process planning	Understand the CAD and design applications by computer graphics and different process planning
3	Students will be able to understand new manufacturing systems	FMS	FMS	Vision in many operation in a single cell.	Understand Higher mode of manufacturing	Understand the fundamentals of FMS, line balancing and assembly lines
4	Students will be able to understand	CNC and Robot	Automation	Integration of systems	Understand automation	Understand the CNC programming and robot configuration

	automation					
5	Students will be able to understand new technology	Additive Manufacturing and Hybrid communication	New age technology	3D printing and advanced communication.	Understand JIT technology	Understand the additive manufacturing techniques and hybrid communication