Roll No.													

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

TEST 1

Sem & AY: Odd Sem 2019-20 | **Date:** 27.09.2019

Course Code: MEC 310 | **Time:** 11.00AM to 12.00PM

Course Name: FLEXIBLE MANUFACTURING SYSTEMS | **Max Marks:** 40

Program & Sem: B.Tech (MEC) & V DE | **Weightage:** 20%

Instructions:

(i) All the questions are compulsory

Part A [Memory Recall Questions]

Answer all the Questions. Each Question carries one mark. (5Qx1M=5M)

1. Which of the following types of layout configurations is/are used in FMS?
   (a) In-line (b) Loop (c) Ladder (d) all of the above
   (C.O.NO.3)[Knowledge]
2. Which of the following code will give circular interpolation in counter clockwise direction?
   (a) G00 (b) G56 (c) G69 (d) G03 (C.O.NO.1)[Knowledge]
3. Cellular manufacturing is also known as
   (a) Manufacturing Technology (b) Production Technology (c) Group Technology
   (d) all of the above (C.O.NO.3)[Knowledge]
4. Cellular manufacturing is an approach whereby production can be done in
   (a) Small batches (b) Medium batches (c) Large batches (d) any of the above
   (C.O.NO.2)[Knowledge]
5. The flexible manufacturing system layout which is the most complex and most flexible is called.
   (a) open field layout (b) ladder layout (c) closed loop layout
   (d) none of the above.
   (C.O.NO.3)[Knowledge]

Part B [Thought Provoking Questions]

Answer all the Questions. Each Question carries five marks. (4Qx5M=20M)

6. Define a manufacturing system. What are the components of a manufacturing system?

(C.O.NO.2)[Comprehension]

7. Write briefly about the different types of (C.O.NO.2)[Comprehension]

8. What are the basic components of a NC system (C.O.NO.1)[Comprehension]

9. Explain briefly about ladder layout used in FMS (C.O.NO.3)[Comprehension]

Part C [Problem Solving Questions]

Answer both the Questions. Each Question carries seven and half marks. (2Qx7.5M=15M)

10. What is cellular manufacturing? What are the objectives of group technology?

(C.O.NO.2)[Comprehension]

11. Write the part program to drill the holes as shown in Figure 1 for the component with dimensions 100mm x 100mm x10mm with drill diameter of 20 and 30 mm. Assume suitable data for speed and feed

(C.O.NO.1)[Application]

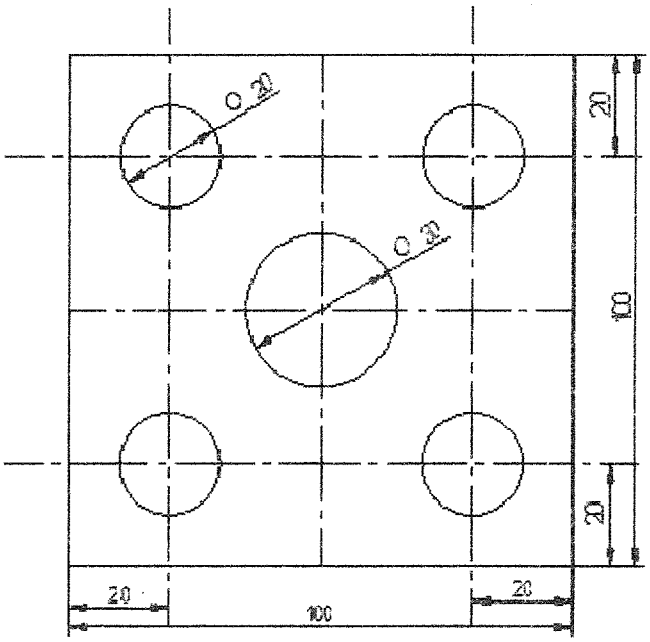


Fig - I

SCHOOL OF ENGINEERING

Semester: V

Course Code: MEC 310

Course Name: **FLEXIBLE MANUFACTURING SYSTEMS**

Date: 27-09-2019

Time: 1 Hour

Max Marks: 40

Weightage: 20%

Extract of question distribution [outcome wise & level wise]

Q.NO.	C.O.NO	Unit/Module Number/Unit /Module Title	Memory recall type [Marks allotted] Bloom's Levels	Thought provoking type [Marks allotted] Bloom's Levels	Problem Solving type [Marks allotted]	Total Marks
			K	C	A	
1	3	2	1			01
2	1	1	1			01
3	3	2	1			01
4	2	2	1			01
5	3	2	1			01
	Total Marks	05				
6	2	1		2		05
7	2	2		2		05
8	1	1		2		05
9	3	2		2		05

	Total Marks	20				
10	2	2			2	7.5
11	1	1			3	7.5
12	1	1			4	7.5
	Total Marks	15				

K =Knowledge Level C = Comprehension Level, A = Application Level

Note: While setting all types of questions the general guideline is that about 60%

Of the questions must be such that even a below average students must be able to attempt, About 20% of the questions must be such that only above average students must be able to attempt and finally 20% of the questions must be such that only the bright students must be able to attempt.

[I hereby certify that All the questions are set as per the above guide lines. Dr Sathish Babu]

Reviewers' Comments

Annexure- II: Format of Answer Scheme

SCHOOL OF ENGINEERING

SOLUTION

Semester: V

Course Code: MEC310

Course Name: FLEXIBLE MANUFACTURING SYSTEMS

Date: 27-09-2019

Time: 1 Hour

Max Marks: 40

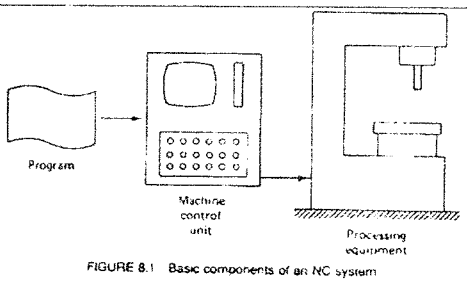
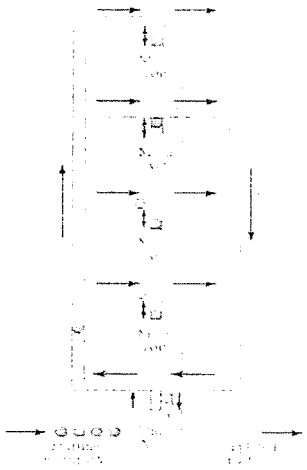
Weightage: 20%

Part A (5Q x 1M =5 Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
1	a	01 Mark	2 min
2	d	01 Mark	2 min
3	c	01 Mark	2 min
4	a	01 Mark	2 min
5	a	01 Mark	2 min

Part B (4Q x 5M - 20 Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
6	We define a manufacturing system to be a collection of integrated equipment and human resources, whose function is to perform one or more processing and/or assembly operations on a starting raw material, part, or set of parts. Components of manufacturing systems A manufacturing system consists of several components. In a given system, these components usually include: • Production machines plus tools, fixtures, and other related hardware • Material handling system	Definition 2 Marks Explanation 3 Marks	5 min

	•Computer systems to coordinate and/or control the above components • Human workers		
7	Different types of FMS: Single machine cell, Flexible manufacturing cell, Flexible manufacturing system	Listing the types ½ marks Explanation for each type 1.5 (1.5 x 3= 4.5 marks)	5 min
8	 FIGURE 8.1 Basic components of an NC system Explanation about Program, MCU and Processing equipment	Diagram- 1 mark Explanation 4 marks	5 min
9	Ladder layout diagram  This consists of a loop with rungs upon which workstations are located. The rungs increase the number of possible ways of getting from one machine to the next, and obviates the need for a secondary material handling system. It reduces average travel distance and minimizes congestion in the handling system, thereby reducing transport time between stations.	Diagram 1 mark Explanation 4 marks	5 min

Part C (2Q x 7.5M =15 Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
10	Application of group technology in which dissimilar machines or processes are aggregated into each of which is dedicated to the production of a part family or limited group of families Typical objectives of cellular manufacturing: • To shorten manufacturing leadtimes • To reduce WIP • To improve quality • To simplify production scheduling • To reduce setup times • To reduce inventory	Definition 1.5 mark 6 Objectives each 1 mark	15 min
11	**N001 G40 G80 G21** **N002 G28 G91 X0 Y0 Z0** N003 T01 M06 S1000 N004 G90 G00 Z10 N005 G01 Z-10 N006 X100 Y0 N007 X100 Y100 N008 X0 Y100 N009 X0 Y0 N010 Z2 N011 G00 Z100 M05 **N012 T01 M06 S800** **N013 G82 X20 Y20 Z-12 R2 F125 M03** **N014 X80 Y20** **N015 X80 Y80** **N016 X20 Y80** **N017 G80 Z2 M05** **N018 T02 M06 S800**	Initiating the program 2 marks Defining drilling locations 2 marks Defining about feed and speed 2 marks	15 min

	N019 G82 X50 Y50 Z-12 R2 F125 M03 **N020 G80 Z2 M05** **N021 G01 X0 Y0 Z100** **N022 M30**	Executing and stopping 1.5 marks	
12	Computer numerical control (CNC) is defined as an NC system whose (Machine Control Unit) MCU is based on a dedicated microcomputer rather than on a hard-wired controller. **Features of CNC** • Storage of more than one part program: With improvements in computer storage technology newer CNC controllers have sufficient capacity to store multiple programs. Controller manufacturers generally offer one or more memory expansions as options to the MCU whereas conventional (hard-wired) MCVs are limited to punched tape as the input medium for entering part programs. CNC controllers generally possess multiple data entry capabilities, such as punched tape (if the machine shop still uses punched tape), magnetic tape, and floppy diskette. RS-232 communications with external computers, and manual data input (operator entry of program). • Program editing at the machine tool: CNC permits a part program to be edited while it resides in the MCU computer memory. Hence, the process of testing and correcting a program can be done entirely at the machine, rather than returning to the programming office to, correct the tape • Fixed cycles and programming subroutines. The increased memory capacity and the ability to program control computer, provide the opportunity to store frequently used machining cycles as macros that can be called by the part program. Instead of writing the full instructions for the particular cycle into every program, a call statement is included in the part program to indicate that the macro cycle should be executed • Interpolation: Some of the interpolation schemes are normally executed only on a CNC system because of the computational requirements. • Positioning features for setup: Setting up the machine tool for a given work part involves installing and aligning a fixture on the machine tool table. This must be accomplished so that the machine axes are established	Definition ½ mark Any 7 features each 1 mark	15 min

with respect to the workpart. The alignment task can be facilitated using certain features made possible by software options in a CNC system.

• Cutter length and size compensation: In older style controls, cutter dimensions had to be set very precisely to agree with the tool path defined in the part program. Alternative methods for ensuring accurate tool path definition have been incorporated into CNC controls.

•Acceleration and deceleration calculations: This feature is applicable when the cutter moves at high feed rates. It is designed to avoid tool marks on the work surface that would be generated due to machine tool dynamics when the cutter path changes abruptly.

Roll No.													

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

TEST – 2

Sem & AY: Odd Sem 2019-20 | **Date**: 16.11.2019

Course Code: MEC 310 | **Time**: 11.00 AM to 12.00 PM

Course Name: FLEXIBLE MANUFACTURING SYSTEMS | **Max Marks**: 40

Program & Sem: B.Tech & V | **Weightage**: 20%

Instructions:

(i) All the questions are compulsory

Part A [Memory Recall Questions]

Answer all the Questions. Each Question carries one marks. (5Qx1M=5M)

1. Fork lift truck is used for
   (a) lifting and lowering (b) vertical transportation
   (c) both 'a' and 'b' (d) none of the above
   (C.O.NO.4)[Knowledge]
2. Economy in material handling can be achieved by
   (a) employing gravity feeds (b) minimizing distance travelled
   (c) by carrying material to destination without using labour
   (d) all the above (C.O.NO.5)[Knowledge]
3. Which of the following is not correct about fixture
   (a) Its used to hold the workpiece (b) its used to position the workpiece
   (c) its used to locate the workpiece (d) its used to guide the cutting tool
   (C.O.NO.4)[Knowledge]
4. Under which process characteristics can material handling be justified
   (a) high repeatability (b) line flows (c) high volumes (d) all of the above
   (C.O.NO.4)[Knowledge]
5. Material handling carries the following processes except which of the following
   (a) handling materials (b) moving an assembly (c) drilling hole (d) storing the product
   (C.O.04) [Knowledge]

Part B [Thought Provoking Questions]

Answer all the Questions. Each Question carries five marks. (4Qx5M=20M)

6. Define material handling system. List its basic components

(C.O.NO.4)[Knowledge]

7. List and discuss any 2 types of Automated Guided Vehicle System commonly used in material handling (C.O.NO.4) [Comprehension]

8. Write briefly about applications of material handling systems (C.O.NO.4) [Knowledge]

9. Define tool management. Discuss briefly about tool delivery and tool room service in FMS (C.O.NO.4) [Knowledge]

Part C [Problem Solving Questions]

Answer both the Questions. Each Question carries seven and half marks.

(2Qx7.5M=15M)

10. Explain the salient features considered while designing modular fixtures in FMS (C.O.NO.5) [Comprehension]

11. The figure shows machine component incidence matrix for 4M x 5C problem. Form cells using single linkage cluster analysis method by finding similarity coefficients.

(C.O.NO.3) [Application]

		Components				
		I	II	III	IV	V
	I	1	0	1	0	0
Machines	II	0	1	1	0	1
	III	1	0	0	1	0
	IV	0	0	1	0	1

SCHOOL OF ENGINEERING

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

Semester: V

Course Code: MEC 310

Course Name: **FLEXIBLE MANUFACTURING SYSTEMS**

Date: 16-112019

Time: 1 Hour

Max Marks: 40

Weightage: 20%

Extract of question distribution [outcome wise & level wise]

Q.NO	C.O.NO	Unit/Module Number/Unit /Module Title	Memory recall type [Marks allotted] Bloom's Levels	Thought provoking type [Marks allotted] Bloom's Levels	Problem Solving type [Marks allotted]	Total Marks
			K	C	A	
1	3	3	Knowledge			01
2	1	4	Knowledge			01
3	3	3	Knowledge			01
4	2	3	Knowledge			01
5	2	3	Knowledge			01
	Total Marks	05				
6	2	3		Knowledge		05
7	2	4		Comprehensive		05
8	1	3		Knowledge		05
9	3	4		Knowledge		05

	Total Marks	20				
10	2	2			Comprehensive	7.5
11	1	1			Application	7.5
	Total Marks	15				

K =Knowledge Level C = Comprehension Level, A = Application Level

Note: While setting all types of questions the general guideline is that about 60%

Of the questions must be such that even a below average students must be able to attempt, About 20% of the questions must be such that only above average students must be able to attempt and finally 20% of the questions must be such that only the bright students must be able to attempt.

Annexure- II: Format of Answer Scheme

SCHOOL OF ENGINEERING

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

SOLUTION

Semester: V
Course Code: MEC310
Course Name: FLEXIBLE MANUFACTURING SYSTEMS

Date: 16-11-2019
Time: 1 Hour
Max Marks: 40
Weightage: 20%

Part A (5Q x 1M =5 Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
1	c	01 Mark	2 min
2	d	01 Mark	2 min
3	c	01 Mark	2 min
4	d	01 Mark	2 min
5	c	01 Mark	2 min

Part B (4Q x 5M = 20 Marks)

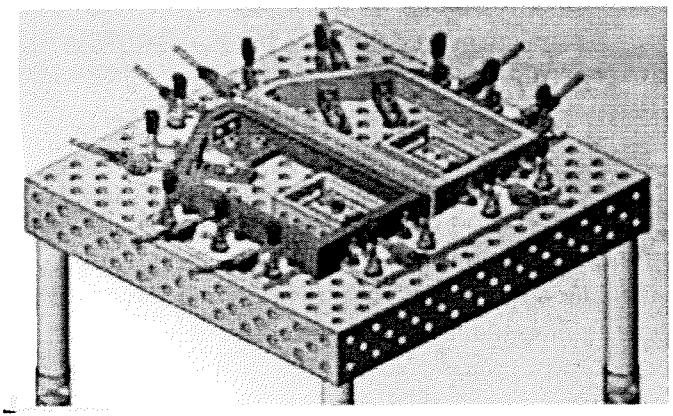
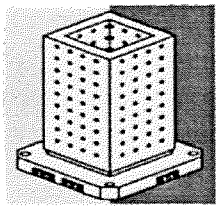
Q No	Solution	Scheme of Marking	Max. Time required for each Question
6	**Material handling** is defined as "the movement, storage, protection and control of materials throughout the manufacturing and distribution process including their consumption and disposal". **Components of a Material handling equipment includes:** (1) transport equipment (2) storage systems, (3) unitizing equipment and (4) identification and tracking systems	Definition 3 Marks 2 Mark (1/2 x 4=2)	5 min

7	**Types of AGVS and Applications** Automated guided vehicles can be divided into the following three categories: (1) Driverless trains. (2) Pallet trucks and (3) Unit load carriers	Listing the types ½ mark each (1/2 x 2=1)	5 min
	A ***driverless train*** consists of a towing vehicle (which is the AGV) that pulls one or more trailers 10 form a train. as in Figure. It was the first type of AGVS to be introduced and is still widely used today. A common application is moving heavy payloads over large distances in warehouses or factories with or without intermediate pickup and drop-off points along the route. For trains consisting of five to ten trailers, this is an efficient transport system. **Automated guided pellet truck:** are used to move palletized loads along predetermined routes. In the typical application the vehicle is backed into the loaded pallet by a human worker who steers the truck and uses its forks to elevate the load slightly. Then the worker drives the pallet truck to the guide path, programs its destination, and the vehicle proceeds automatically to the destination for unloading. **AGV unit load carriers** are used to move unit loads from one station to another. They are often equipped for automatic loading and unloading of pallets or tote pans by means of powered rollers, moving belts, mechanized lift platforms, or other devices built into the vehicle deck.	Explanation for each type 2 marks each (2 x 2= 4 marks)	

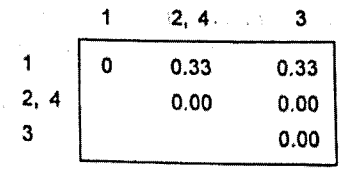
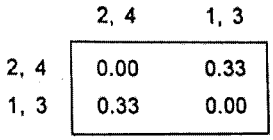
8	Applications of material handling systems: Industrial trucks — Moving light loads in a factory Industrial trucks powered — Movement of pallet loads and palletized containers in a factory or warehouse AGVS — Movement of pallet loads and palletized containers in a factory or warehouse; Moving work in process along variable routes; In low and medium production Conveyours powered — Moving products along a manual assembly line; Sortation of items in a distributioncenter Cranes — Moving large and heavy items in factories	Any 5 applications	5 min
9	Tool management can be defined as the capability of having the correct tools on the appropriate machines at the right time while maintaining acceptable utilization of manufacturing resources **Tool service** Tool room service is a necessary support function dealing principally with preparing, servicing, organizing and controlling the vast array of perishable tools, inserts, tool holders and tool components. The principal elements of tool room service are: • Buildup and teardown of tool assemblies. • Inventors of tools, tool components and related tool assembly instructions • Control of idle (returning and least used) tool assemblies along with • Determining tool disposition (what to do with these tools). • Actively maintaining machine tool data for the remaining tool life of returning and idled tool assemblies. **Tool Delivery** Tool delivery addresses the tool management function relative to moving the tools between the tool room and the various tool magazines of each machine tool in the FMS. This includes transporting the tools to and from the machine tool	Definition 1 mark Explanation (2 x 2=4)	5 min

	requiring those tools, and loading and unloading the tool magazines once the tool arrive at the machines. If the demand for tools based on the variety of part mix is high enough, complete automation of the tool delivery and distribution function may be necessary.		

Part C (2Q x 7.5M =15 Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
10	A modular fixturing system is composed of standardized components that allow for flexible arrangement and interchangeability between different applications. The versatility of the components makes it a viable alternative to traditional fixturing methods because a single modular fixture system is capable of doing the same work as numerous dedicated fixturing systems. **Tooling Plates and Blocks** The fundamental components of a workholding or modular fixturing system are the tooling plates or tooling blocks, which are commonly referred to as fixture plates, grid blocks, or tombstones.  Modular fixture  Tooling plate The multipurpose holes (MTP holes) on both the tooling plates and blocks allow for accurate aligning or fastening of other components in a number of locations. Flex plates offer the ability to work on any given fixture away from the machine, free from any space constraints. A flex base plate resides on a machining center pallet and will accept other flex tooling plates or blocks to be fastened onto it, which allows for fast changeover between applications. The two tapered pins allow for accurate and consistent locating when mounting other flex plates to the base.	Explanation 6 marks Diagrams 1.5 marks	15 min

11	In this case, a = Total number of components visiting both machines = 1(component 3) b = Number of components visiting machine 1 but not machine 2 = 1 (component 1) c = Number of components visiting machine 2 but not machine 1 = 2 (component 2 and 5) We know that $$S_{ij} = \frac{a}{(a+b+c)} = \frac{1}{(2+1+2)} = 0.2$$ Similarly, compute similarity coefficient between other pair of machines. Figure 2.11 shows similarity coefficient matrix. M/c j M/c i 		1	2	3	4
---	---	---	---	---
1	0	0.2	0.33	0.33
2		0.0	0.00	0.67
3			0.00	0.00
4				0.00 | Similarity coefficient matrix. As seen from Figure as the number of common operations between machines are increasing, value of similarity coefficient will also increase (for example $S_{2,4}$). If the machines do not have common machining operations, it is obvious that similarity coefficient will be zero (for example $S_{2,3}$). *Step 2:* As seen from Figure 2.11 machines 2 and 4 have high similarity coefficient. Group these two machines together and update the matrix. Now, compute similarity between ungrouped machines (i.e., 1, 3) and grouped machines (i.e., 2, 4). Compute similarity between machine 1 and group (2, 4) using Eq. as: $$S_{1,(2,4)} = \text{Max}\ \{S_{1,2}, S_{1,4}\} = \text{Max}\ \{0.2, 0.33\} = 0.33$$ Similarly $$S_{(2,4),3} = \text{Max}\ \{S_{2,3}, S_{4,3}\} = 0.00$$ The updated matrix using the aforementioned procedure is shown in Figure -	Finding coefficients 2 marks	15 min

	 **FIGURE 2.12** Updated matrix. The maximum value in the table corresponds to machines 1, 3. Hence, form the new group with machines 1 and 3. The revised matrix after grouping machines 1 and 3 is shown in Figure 2.13.  **FIGURE 2.13** Revised matrix Since, no machines are left, stop the procedure. The final solution is: Cell 1: 2, 4 Cell 2: 1, 3	Updating matrix 2 marks Updating second matrix 2 marks Final allocation 1.5 marks	

Roll No												

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

END TERM FINAL EXAMINATION

Semester: Odd Semester: 2019 - 20
Course Code: MEC 310
Course Name: FLEXIBLE MANUFACTURING SYSTEMS
Program & Sem: B.Tech (MEC) & V (DE-I)

Date: 20 December 2019
Time: 9:30 AM to 12:30 PM
Max Marks: 80
Weightage: 40%

Instructions:
(i) Read the all questions carefully and answer accordingly.

Part A [Memory Recall Questions]

Answer all the Questions. Each Question carries 2 marks. (5Qx2M=10M)

1. Define automation in manufacturing system (C.O.No.1) [Knowledge]
2. What are the four basic principles used in lean manufacturing system? (C.O.No.5) [Knowledge]
3. What is the role of flexible manufacturing system in production? (C.O.No.2) [Knowledge]
4. Name any four types of AGVS used in material handling system (C.O.No.3) [Knowledge]
5. List any four types of tool strategies used in FMS tool management system (C.O.No.4) [Knowledge]

Part B [Thought Provoking Questions]

Answer all the Questions. Each Question carries 5 marks. (4Qx10M=40M)

6. What are the benefits of using group technology in a production system? (C.O.No.3) [Comprehension]
7. "Application of cellular manufacturing reduces number of machines required for processing parts compared to conventional manufacturing". Justify with an example. (C.O.No.4) [Comprehension]
8. On what basis do we select material handling equipment in a flexible manufacturing system? (C.O.No.3) [Comprehension]
9. Outline any ten advantages of using FMS in a production facility. (C.O.No.2) [Comprehension]

Part C [Problem Solving Questions]

Answer both the Questions. Each Question carries 15 marks. **(2Qx15M=30M)**

10. The following figure shows 4 x 4 machine component incidence matrix. Form machine cells and part family using ROC method

[15 M] (C.O.No.2) [Application]

		Components			
		I	**II**	**III**	**IV**
	I	1	1	0	0
Machines	**II**	0	0	1	1
	III	0	0	1	1
	IV	1	1	0	0

11. Explain briefly the working of a dual card Kanban system used in Toyota production facility.

[15 M] (C.O.No.5) [Comprehension]

SCHOOL OF ENGINEERING

END TERM FINAL EXAMINATION

Extract of question distribution [outcome wise & level wise]

Q.NO.	C.O.NO (% age of CO)	Unit/Module Number/Unit /Module Title	Memory recall type [Marks allotted] Bloom's Levels	Thought provoking type [Marks allotted] Bloom's Levels	Problem Solving type [Marks allotted]	Total Marks
			K	C	A	
1	1	1	2			2
2	5	5	2			2
3	2	2	2			2
4	3	3	2			2
5	4	4	2			2
6	3	3		10		10
7	4	4		10		10
8	3	3		10		10
9	2	2		10		10
10	2	2			15	15
11	5	5			15	15
	Total Marks		10	40	30	80

K =Knowledge Level C = Comprehension Level, A = Application Level

Note: While setting all types of questions the general guideline is that about 60%

Of the questions must be such that even a below average students must be able to attempt, About 20% of the questions must be such that only above average students must be able to attempt and finally 20% of the questions must be such that only the bright students must be able to attempt.

I hereby certify that all the questions are set as per the above guidelines.

Faculty Signature: Vishy
12-12-19

Reviewer Commend:

Format of Answer Scheme

SCHOOL OF ENGINEERING

SOLUTION

Semester: Odd Sem. 2019-20
Course Code: MEC310
Course Name: FLEXIBLE MANUFACTURING SYSTEMS
Program & Sem: B.Tech & V Sem

Date: 20.12.2019
Time: 3 HRS
Max Marks: 80
Weightage: 40%

Part A (5Q x 2M = 10Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
1	Automation can be defined as a technology concerned with the application of mechanical, electronic, and computer-based systems to operate and control production.	**Definition 2 marks**	**8 min**
2	Lean production is based on four principles 1. minimize waste 2. perfect first-time quality 3. flexible production lines 4. continuous improvement	**Any 4 Each 0.5 marks (0.5 x 4=2)**	**8 min**
3	A flexible manufacturing system (FMS) is an arrangement of machines, interconnected by a transport system. The transporter carries work to the machines on pallets or other interface units so that work-machine registration is accurate, rapid and automatic. A central computer controls both machines and transport system.	**Definition 2 marks**	**8 min**
4	Automated guided vehicles can be divided into the following three categories: (1) Driverless trains. (2) Pallet trucks and (3) Unit load carriers (4) AGV assembly line vehicles	**Each 0.5 marks (0.5 x 4=2)**	**8 min**
5	The tool strategies employed in FMS are: • Mass Exchange • Tool sharing • Tool migration • Assigned tools	**Each 0.5 marks (0.5 x 4=2)**	**8 min**

Part B (4Q x 10M =40 Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
6	1. Engineering Design: • Design Standardization and redundancy avoidance. • Rapid design retrieval. • Reduce number of new similar parts and elimination of duplicate parts. 2. Manufacturing: • Reduction of part steps and associative costs and time. • Improve estimation of machine tool requirements. • Improve quality and communication. Manufacturing Engineering: • Standardization of routings. • Use of common tooling and avoidance of new tooling. • Reduced tools and fixtures to be used. 4. Production Control: • Reduced in process inventory. • Easier location of production difficulties. • Improved equipment monitoring and scheduling.	(Any 10, each carries 1 mark) (1 x 10= 10)	20 min
7	$\frac{MU_{tr}}{MU_{cm}} \times nm_{tr} \times \frac{1}{PF}$ (7.2) MU_{tr} = Machine utilization in traditional machining MU_{cm} = Machine utilization in cellular manufacturing nm_{tr} = Number of machines in traditional machining Therefore, Number of machines required for cellular manufacturing $= \frac{0.85}{0.85} \times 50 \times \frac{1}{1.22}$ $= 40.98$ $= 41$ machines (approx.) As you can see, number of machines required is reduced from 50 to 41. This enables in saving substantially in terms of capital investment required for machines, maintenance, labour and floor space. If average cost of machine is assumed to be Rs. 600,000. Then, investment required for machines by conventional and cellular method of manufacturing will be Conventional 50 machines × Rs 6 lacs = Rs 300/- lacs Cellular 41 machines × Rs 6 lacs = Rs 246/- lacs	Explanation for Justifying 5 marks Example and calculation 5 marks	20 min
8	**Properties of the material:** • Whether it is solid, liquid or gas, and in what size, shape and weight it is to be moved, are important considerations and can already lead to a preliminary elimination from the range of available equipment under review. **Layout and characteristics of the building:** • Another restricting factor is the availability of space for handling. Low-level ceiling may preclude the use of hoists or cranes, and the presence of supporting columns in awkward places can limit the size of the material-handling equipment. **Production flow**	Each 2 marks. (Any 5) (5 x 2=10)	20 min

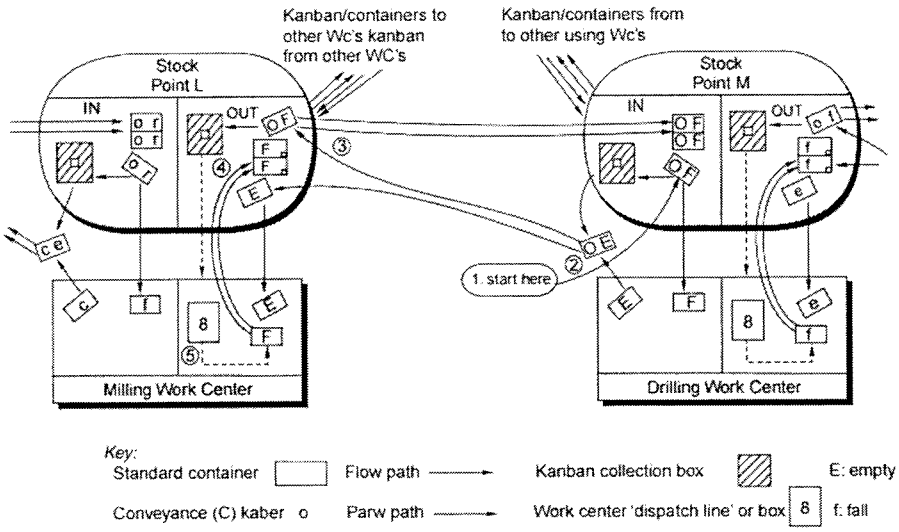
	• If the flow is fairly constant between two fixed positions that are not likely to change, fixed equipment such as conveyors or chutes can be successfully used. **Cost considerations (Economic justification)** • Several cost elements need to be taken into consideration when comparisons are made between various items of equipment that are all capable of handling the same load. **Nature of operations** Selection of equipment also depends on nature of operations like whether handling is temporary or permanent, whether the flow is continuous or intermittent and material flow pattern-vertical or horizontal.		
9	• Produce a variety of items under one roof • Produce more product more quickly • Improved efficiency • Improved product routing • To reduce setup time • Reduce time for product completion • Utilize human workers better • Serve a variety of vendors simultaneously • To improve quality of products	Each point 1 mark (1 x 10= 10)	20 min

Part C (2Q x 15M = 30Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
10	***Solution:*** Compute the weight for rows using the following procedure: Count the number of columns. In this case it is 4. Assign a weight of 2^3 to first column, 2^2 to the second column and so on as shown in Figure 2.29. The procedure is similar to similarity coefficient fuzzy logic approach.	Assigning weights = 1.5 marks	30 min
	Components 2^3 2^2 2^1 2^0 1 2 3 4 Machines 1: 1 1 0 0 2: 0 0 1 1 3: 0 0 1 1 4: 1 1 0 0		
	FIGURE 2.29 Computation of weights.		
	Compute the weight of first row (Eq. 2.24) as: $1 \times 2^3 + 1 \times 2^2 + 0 \times 2^1 + 0 \times 2^0 = 12$ Similarly, weight of the second row is calculated as: $0 \times 2^3 + 0 \times 2^2 + 1 \times 2^1 + 1 \times 2^0 = 3$ Weights computed for different rows are shown in Figure 2.30.		
	Components 2^3 2^2 2^1 2^0 1 2 3 4 Machines 1: 1 1 0 0 — 12 2: 0 0 1 1 — 03 3: 0 0 1 1 — 03 4: 1 1 0 0 — 12	Updating matrix= 6 marks	
	FIGURE 2.30 Weights for different rows.		
	Arrange the matrix in the descending order of the weights of the rows obtained. In case of tie choose arbitrarily. Rearranged matrix is shown in Figure 2.31. Repeat the procedure till there is no change in the order of rows.		
	As seen from Figure 2.31, there is no change in the order of the rows. Now similarly compute the weight for columns (Eq. 2.29). The computed value of weights is shown in Figure 2.32.		
	1 2 3 4 1: 1 1 0 0 — 2^3 4: 1 1 0 0 — 2^2 2: 0 0 1 1 — 2^1 3: 0 0 1 1 — 2^0 Weights 12 12 3 3	Udating matrix=6 marks	
	FIGURE 2.32 Weights for columns.		
	As seen from the Figure 2.32 there is no change in the order of columns. Hence, the final block diagonal form is as shown in Figure 2.33.		
	Components 1 2 3 4 Machines 1: 1 1 0 0 4: 1 1 0 0 3: 0 0 1 1 2: 0 0 1 1	Final allocation= 1.5 marks	
	FIGURE 2.33 Final block diagonal form.		
11	The steps involved are explained • Find the note "Start here". The C-kanban is detached and placed in a collection box for Stock Point M.	Explanation 12 marks	30 min

- 2. The container that is most recently emptied in Drilling is taken to Stock Point M and a Ckanban is attached to it.
- 3. The empty container and C-kanban are taken to Stock Point L where the C-kanban is detached and re-attached to a full container, which is taken back to Stock Point M.
- . The full container taken to Stock Point M had a P-kanban attached to it. Before leaving Stock Point L, the P-kanban was detached and placed in the Stock Point L collection box.
- 5. The P-kanban in the Stock Point L collection box are taken to Milling hourly where they go into a dispatch box and become the list of jobs to be worked on next at the Milling Station.
- 6. For every job that is completed, parts go into an empty container from Stock Point L, and a P-kanban is attached. The full container is then moved back to Stock Point L.

Diagram 3 marks



Dual card Kanban for milling and drilling process