Total No. of Questions: 6 *Total No. of Printed Pages:3*

Enrollment No......................................

Knowledge is Power

Faculty of Engineering

End Sem (Odd) Examination Dec-2022

ME3EL04 Manufacturing Automation

Programme: B.Tech. Branch/Specialisation:ME

Duration: 3 Hrs. **Maximum Marks: 60**

Note: All questions are compulsory. Internal choices, if any, are indicated.Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d.

Q.1	i.	A Flexible automation implements which of the following: (a) More variety, More quantity (b) Less variety , less quantity (c) Medium variety , Medium quantity (d) Medium variety , More quantity	**1**
	ii.	Which among these is not the reason for automation in an industry? (a) Eliminate manual and clerical works (b) Avoid the high cost of automation (c) Improve work safety (d) Reduce lead time	**1**
	iii.	The main function of a primary industries are ______. (a) Outsourcing (b) Manufacturing products (c) Exploit natural resources (d) Servicing	**1**
	iv.	The drawback of a product type plant layout is- (a) High initial investment for the specialized facilities (b) Skilled labour to operate machines (c) High cost of inspection (d) Production time is longer, requiring more goods in inventory	**1**
	v.	_________ is not a discrete manufacturing industry. (a) Distillation (b) Forging (c) Casting (d) Plastic moulding	**1**
	vi.	Binary operation is under _________ control. (a) Continuous (b) Discrete (c) Both (a) and (b) (d) None of these	**1**

P.T.O.

	vii.	FMS was first conceptualized for _______. (a) Casting (b) Machining (c) Moulding (d) Robotics	**1**
	viii.	________ is not a function of material handling systems. (a) Temporary storage (b) Convenient accesses (c) Work part configurations (d) Labour works	**1**
	ix.	Inspection of variable includes _____. (a) Gauging (b) Countings (c) Measuring Fraction defect rate (d) Measuring diameter	**1**
	x.	A partially distributed inspection can be followed in _____. (a) Inspections located between groups of processes (b) Every step of processing (c) Start and end step of processes (d) Only at the middle of the processes	**1**
Q.2	i.	List any two works which cannot be automated.	**2**
	ii.	Write the classification of automated manufacturing system.	**3**
	iii.	Explain the ten strategies of automation.	**5**
OR	iv.	Describe the three stages of automation migration strategy with neat diagram.	**5**
Q.3	i.	What are the two basic operations in manufacturing?	**2**
	ii.	Describe the primary and secondary operations required to get the final form of a product.	**8**
OR	iii.	Explain the various types of plant layout with neat diagram.	**8**
Q.4	i.	Define a continuous variable	**3**
	ii.	Explain with neat diagram the various types of continuous control systems with neat diagram.	**7**
OR	iii.	Describe about direct digital control with its various components.	**7**
Q.5	i.	Illustrate the different tests for flexibility of an automated system.	**4**
	ii.	With neat sketch explain the various types of FMS.	**6**
OR	iii.	Discuss the automated storage / retrieval system (AS/RS) control, and write down four objectives.	**6**

Q.6		Attempt any two:	
	i.	Explain the contact and non - contact inspection techniques.	**5**
	ii.	Describe the CMM structure with neat sketch.	**5**
	iii.	Write down applications and any five benefits of coordinate measuring machine (CMM).	**5**

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Scheme of Marking

Faculty of Engineering

End Sem (Odd) Examination Dec-2020

Manufacturing Automation (T) - ME3EL04 (T)

Programme: B.Tech. Branch/Specialisation:

Q.1	i.	(c)Medium variety , Medium quantity	1
	ii.	(b)Avoid the high cost of automation	1
	iii.	(c)Exploit natural resources	1
	iv.	(a) High initial investment for the specialized facilities	1
	v.	(a)Distillation	1
	vi.	(b)Discrete	1
	vii.	(b)Machining	1
	viii	(d)Labour works	1
	ix.	(d)Measuring diameter	1
	x.	(a) Inspections located between groups of processes.	1

Q.2 i. (a)Equipment maintenance.(b)Programming and computer operation. -1 marks **2**

• Engineering project work. • Plant management. -1 marks

ii. Manufacturing systems can be classified into three basic types: **3**

(1) fixed automation, -1 marks

(2) programmable automation, -1 marks

and (3) flexible automation. -1 marks

iii. Specialization of operations. **5**

1.The first strategy involves the use of special-purpose equipment designed to perform one operation with the greatest possible efficiency.This is analogous to the specialization of labor, which is employed to improve labor productivity.

2. Combined operations. Production occurs as a sequence of operations. -2 marks

3. Simultaneous operations

4. Integration of operations.

5. Increased flexibility.

6. Improved material handling and storage.

7. On-line inspection. -2 marks

8. Process control and optimization.

9. Plant operations control.

10. Computer-integrated manufacturing (CIM). -1 marks

OR i. Phase 1: Manual production using single-station manned cells operating independently. 1

Phase 2: Automated production using single-station automated cells operating independently. 2

Phase 3: Automated integrated production using a multi-station automated system 2

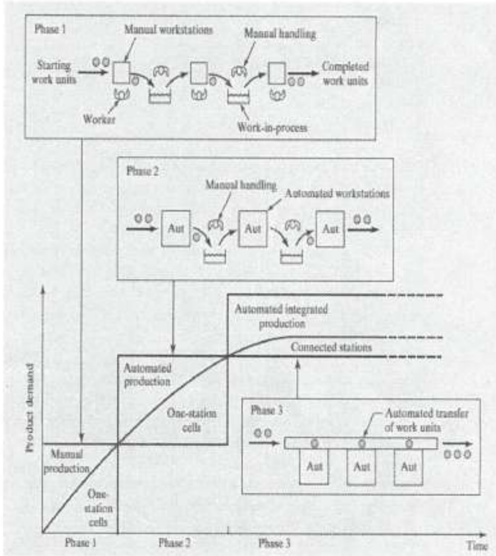

Figure 1 : A typical automation migration strategy.
Key "Aut ": automated workstation.

Q.3	i.	Processing operation and assembly operation	-1 marks -1 marks	2
	ii.	More than one processing operation is usually required to transform the starting material into final form. The operations are performed in the particular sequence to achieve the geometry and/or condition defined by the design specification. Three categories of processing operations are distinguished: (1) shaping operations, (2) property-enhancing operations, and (3) surface processing operations. -4 marks The classification used here is based on the state of the starting material. There are four categories: 1. Solidification processes. 2. Particulate processing. 3. Deformation processes. 4. Material removal processes. -4 marks		8
OR	iii.	This type of layout is a fixed position layout, shown in Figure 2 (a), in which the product remains in a single location during its entire fabrication. Examples of such products include ships, aircraft, railway locomotives, and heavy machinery. The individual parts that comprise these large products are often made in factories that have a process layout, in which the equipment is arranged according to function or type. The lathes are in one department, the milling machines are in another department, and so on, as in Figure 2 (b). -2 marks The processing or assembly of different parts or products is accomplished in cells consisting of several workstations or machines. The term cellular manufacturing is often associated with this type of production. Each cell is designed to produce a limited variety of part configurations; that is, the cell specializes in the production of a given set of similar parts or products, according to the principles of group technology . The layout is called a cellular layout, depicted in Figure 2(c). The collection of stations is designed specifically for the product to maximize efficiency. This is a product layout, in which the workstations are arranged into one long line, as depicted in Figure 2 (d), or into a series of connected line segments. -2 marks		8

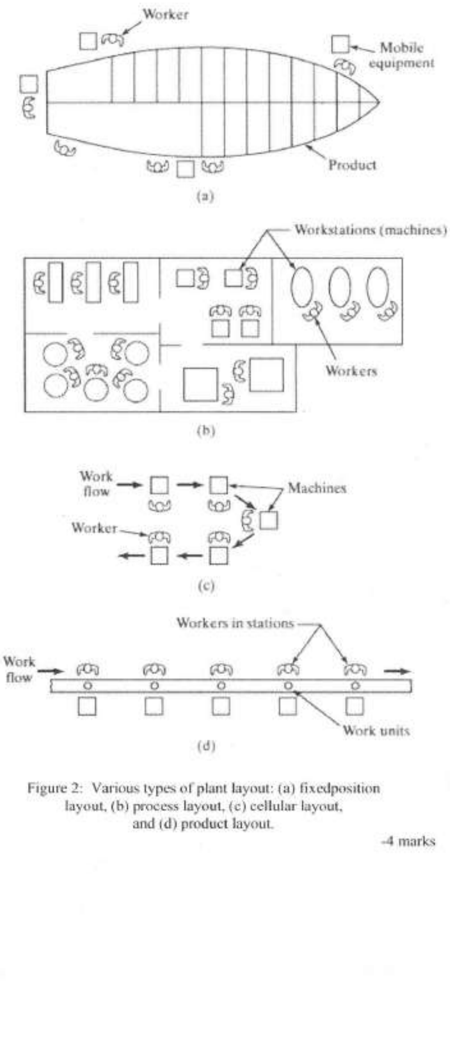

Figure 2: Various types of plant layout: (a) fixedposition layout, (b) process layout, (c) cellular layout, and (d) product layout.

-4 marks

Q.4 i. A continuous variable (or parameter) is one that is uninterrupted as time proceeds,at least during the manufacturing operation. A continuous variable is generally an analog. **3**

ii. **7**

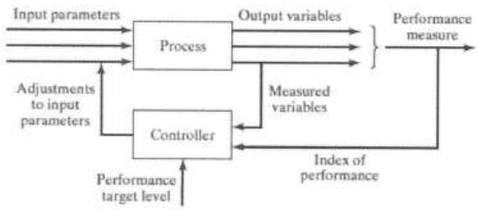

Figure 3: Regulatory control. -2 marks

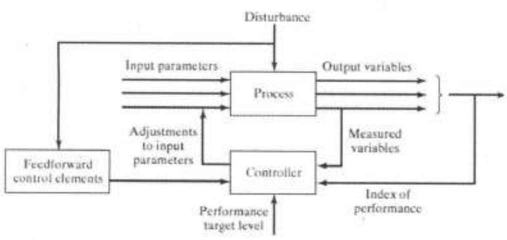

Figure 4: Feedforward control, combined with feedback control.
-2 marks

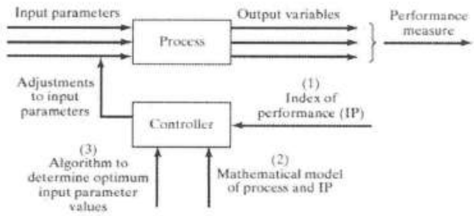

Figure 5: Steady-state (open loop) optimal control.
-3 marks

OR iii. **7**

Direct Digital Control.

DDC was certainly one of the important steps in the development of computer process control. This computer-control mode had its limitations, whichmotivated improvements leading to modern computer-control technology. DDC is a computer process-control system in which certain components in a conventional analog control system are replaced by the digital computer. The regulation of the process is accomplished by the digital computer on a time-shared, sampled-data basis rather than by the many individual analog components working in a dedicated continuous manner.
-3 marks

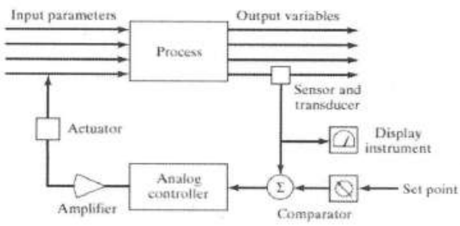

Figure 6: A typical analog control loop.
-2 marks

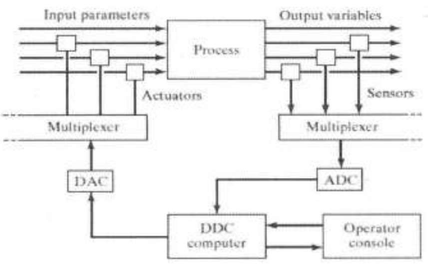

Figure 7: Components of a DDC system.

-2 marks

Q.5 i. To qualify as being flexible, an automated manufacturing system should satisfy the following four tests of flexibility: 4

1. Part-variety test. Can the system process different part or product styles in a mixedmodel (non-batch) mode? -1 marks

2. Schedule-change test. Can the system readily accept changes in production schedule, that is, changes in part mix and/or production quantities? -1 marks

3. Error-recovery test. Can the system recover gracefully from equipment malfunctions and breakdowns, so that production is not completely disrupted? -1 marks

4. New-part test. Can new part designs be introduced into the existing part mix with relative ease if their features qualify them as being members of the part family for which the system was designed? Also, can design changes be made in existing parts without undue challenge to the system? -1 marks

ii. 6

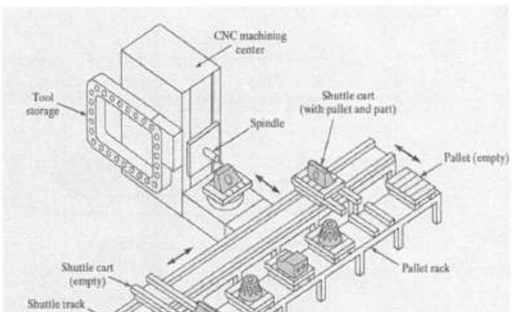

Figure 8: Single Machine cell consisting of one CNC machining center and parts storage unit.

-2 marks

Flexible manufacturing systems can be distinguished according to the kinds of operations they perform: processing operations or assembly operations. An FMS is usually designed to perform one or the other but rarely both. A difference that is applicable to machining systems is whether the system will process rotational parts or nonrotationalparts. Flexible machining systems with multiple stations that process rotational parts are less common than systems that process nonrotational parts. Two other ways to classify flexible manufacturing systems are by number of machines and level of flexibility.

Number of Machines. Flexible manufacturing systems have a certain number of processing machines. The following are typical categories: (1) single-machine cell, (2) flexible manufacturing cell, and (3) flexible manufacturing system. -2 marks

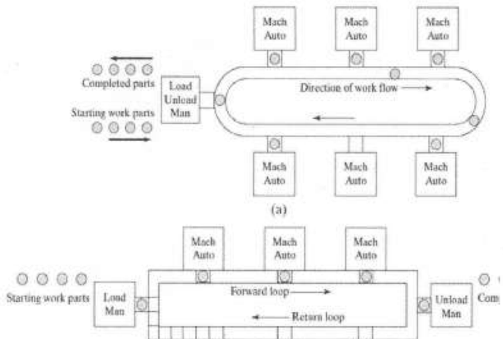

Figure 12: FMS loop layout with secondary part-handling system at each station to allowunobstarcted flow on the loop. and (b) rectangular layout for recirculation of empty pallets to the parts loading section. Key: Load = parts loading station, Unload = parts unloading station, Mach = machining station, Man = manual station, Auto = automated station.

-2 marks

Q.6 i. **Contact inspection** involves the use of a mechanical probe or other device that makes contact with the object being inspected. The purpose of the probe is to measure or gage the object in some way. By its nature, contact inspection is often concerned with some physical dimension of the part. Accordingly, these techniques are widely used in the manufacturing industries, in particular in the production of metal parts (machining, stamping, and other metalworking processes). Contact inspection is also used in electrical circuit testing. The principal contact inspection technologies are the following: 5

• Conventional measuring and gaging instruments

• Coordinate measuring machines (CMMs) and related techniques to measure Mechanical dimensions

• Stylus-type surface texture measuring machines to measure surface characteristics such as roughness and waviness

• Electrical contact probes for testing integrated circuits and printed circuit boards. Conventional techniques and CMMs compete with each other in the measurement and inspection of part dimensions.
-2 marks

Reasons why these contact inspection methods are technologically and commercially important include the following:

• They are the most widely used inspection technologies today.

• They are accurate and reliable.

• In many cases, they represent the only methods available to accomplish the inspection.

Noncontact Inspection Technologies. Noncontact inspection methods utilize a sensor located at a certain distance from the object to measure or gage the desired features. The noncontact inspection technologies can be classified into two categories: optical and nonoptical. Optical inspection technologies use light to accomplish the measurement or gaging cycle.

Noncontact inspection offers certain advantages over contact inspection, including the following:

• They avoid damage to the part surface that might result from contact inspection.

• Inspection cycle times are inherently faster. Contact inspection procedures require the contacting probe to be positioned against the part, which takes time. Most of the noncontact methods use a stationary probe that does not need repositioning for each part.

• Noncontact methods can often be accomplished on the production line without the need for any additional handling of the parts, whereas contact inspection usually requires special handling and positioning of the parts.

• It is more feasible to conduct 100% automated inspection, since noncontact methods have faster cycle times and reduced need for special handling. -3 marks

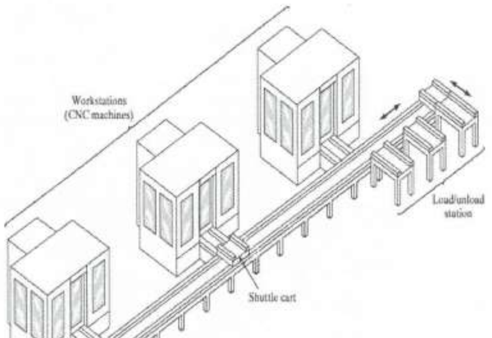

Figure 9: A flexible manufacturing cell consisting of three identical processing stations (CNC machining centers), a load/unload station, and a parts-handling system.
-2 marks

OR iii. ~~Describe the fms layout with suitable~~ digram. ?

Discuss AS/RS Control & write down its four objectives

Discussion of AS/RS Control - 4 Marks
Four Objectives - 2 Marks

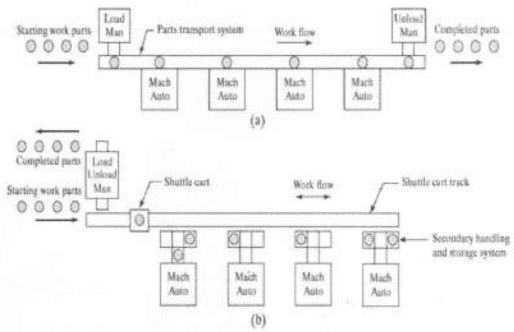

Figure 10: FMS in-line layouts: (a) one-direction flow similar to a transfer line, (b) linear transfer system with secondary parts-handling and storage system at each station to facilitate flow in two directions. Key: Load = parts loading station, Unload = parts unloading station, Mach = machining station, Man = manual station, Auto = automated station. -2 marks

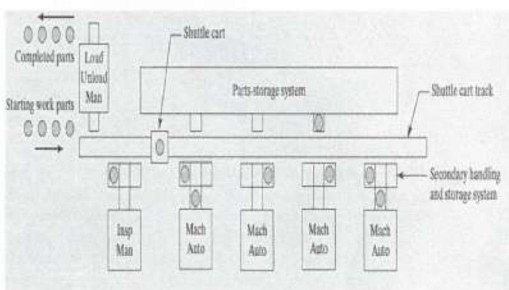

Figure 11: FMS in-line layout with integrated part-storage system. Key: Load = parts loading station, Unload = parts unloading station, Mach = machining station, Man = manual station, Auto = automated station.

-2 marks

ii. 5

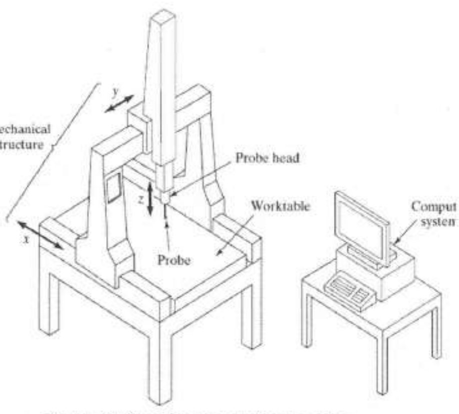

Figure 13: Coordinal measuring machine.
-3 marks

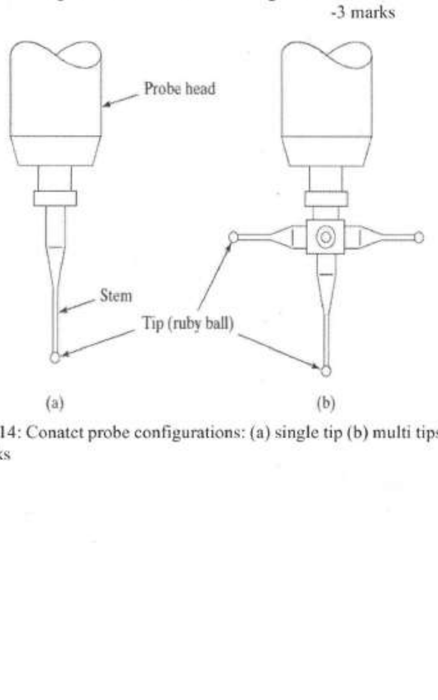

Figure 14: Conatct probe configurations: (a) single tip (b) multi tips
-2 marks

?
iii. ii 5

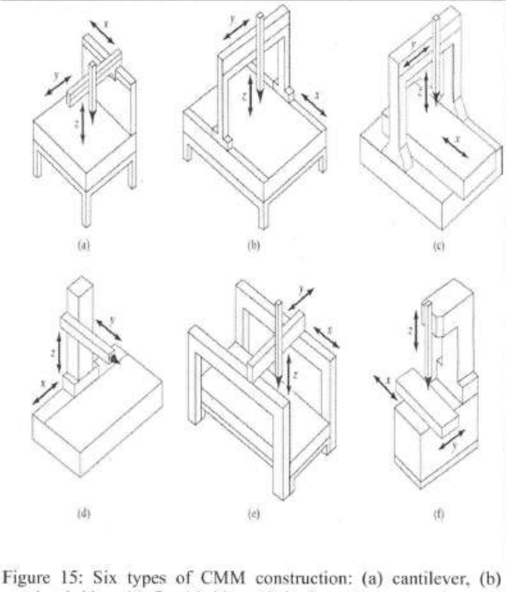

Figure 15: Six types of CMM construction: (a) cantilever, (b) moving bridge, (c) fixed bridge, (d) horizontal arm (moving ram type), (e) gantry, and (f) column. -5 marks

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Q.6 iii) Applications - 2
Benefits - 3