CMR

INSTITUTE OF

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Internal Assesment Test – 1

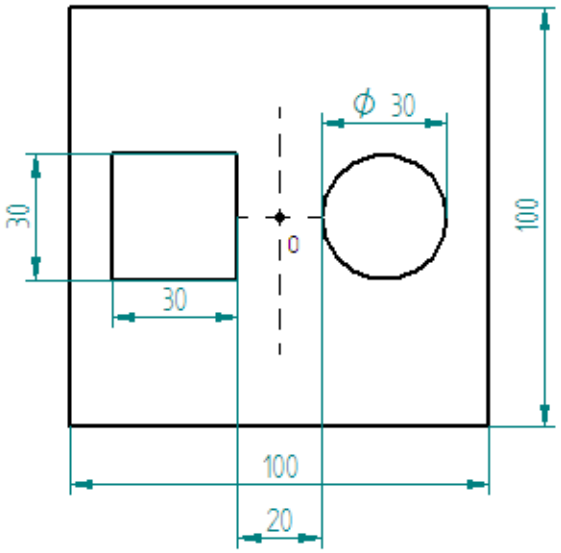
Sub: Computer Integrated Manufacturing				Code: 15ME62
Date: 5/03/2019	Duration: 90 mins	Max Marks: 50	Sem: 6	Branch (sections): ME (A,B)

Answer any FIVE FULL questions. Good luck!

		Marks	OBE	
			CO	RBT
1	List and compare the different types of Production Systems.	[10]	CO1	L1
2	Why should the present conventional manufacturing industry be automated? Explain with Specific reasons.	[10]	CO1	L1
3	Define Automation? Briefly explain different types of automation with one example..	[10]	CO1	L2
4	Define the terms: i) Production capacity, ii) Plant Capacity iii) Work-in-progress iv) Manufacturing lead time v) Utilization & Availability vi) Production Rate & MLT, vii) W/P &TIP ratio. Write a mathematical equation for each.	[10]	CO1	L2
5	There are 24 machines in the Manufacturing plant and the parts produced in a batch must be processed through an average of eight machines. 24 new batches are launched each week. Avg operation time is 6mins. Avg batch size is 30 parts, Avg setup time is 6 hours and avg. non operational time per batch is 12hours/machine. The plant operates an avg of 80 production hours per week and assume A=95%. Determine:1) Manufacturing Lead Time for an Avg port. 2) Production rate. 3) plant capacity 4) Plant Utilization	[10]	CO1	L3

6	Briefly explain 8 robot specifications along with any sub specifications if any with necessary diagrams.	[10]	CO4	L2
7	Define an industrial robot and List the complete classifications.	[10]	CO4	L2
8	Write the CNC program for the below:	[10]	CO4	L3

Route Sheet			*All dimensions are in mm.	
Billet size: 100x100x40			Material Aluminium	
Program number: 011			DWG:1	
Sl no.	Operation	Tool type	Tool dia	Spindle speed
1	Slotting	Slot cutter	5mm	2000rpm
Depth of cut (slot)	5			



1) The types of Production system are:

- Job shop production
- Batch production
- Mass production
- **Job shop production:** The distinguishing feature of job shop production is low volume. The manufacturing lot sizes are small, often one of a kind. Job shop production is commonly used to meet specific customer orders, and there is a great variety in the type of work the plant must do. Therefore, the production equipment must be flexible and general-purpose to allow for this variety of work. Also, the skill level of job shop workers must be relatively high so that they can perform a range of different work assignments. Examples of products manufactured in a job shop include space vehicles, aircraft, machine tools, special tools and equipment, and prototypes of future products. Construction work and shipbuilding are not normally identified with the job shop category, even though the quantities are in the appropriate range. Although these two activities involve the transformation of raw materials into finished products, the work is not performed in a factory.
- **Batch production:** This category involves the manufacture of medium-sized lots of the same item or product. The lots may be produced only once, or they may be produced at regular intervals. The purpose of batch production is often to satisfy continuous customer demand for an item. However, the plant is capable of a production rate that exceeds the demand rate. Therefore, the shop produces to build up an inventory of the item. Then it changes over to other orders. When the stock of the first item becomes depleted, production is repeated to build up the inventory again. The manufacturing equipment used in batch production is general-purpose but designed for higher rates of production. Examples of items made in batch-type shops include industrial equipment, furniture, textbooks, and component parts for many assembled consumer products (household appliances, lawn mowers, etc.). Batch production plants include machine shops, casting foundries, plastic molding factories, and press working shops. Some types of chemical plants are also in this general category.
- **Mass production:** This is the continuous specialized manufacture of identical products. Mass production is characterized by very high production rates, equipment that is completely dedicated to the manufacture of a particular product, and very high demand rates for the product. Not only is the equipment dedicated to one product, but the entire plant is often designed for the exclusive purpose of producing the particular product. The equipment is special-purpose rather than general-purpose. The investment in machines and specialized tooling is high. In a sense, the production skill has been transferred from the operator to the machine. Consequently, the skill level of labour in a mass production plant tends to be lower than in a batch plant or job shop.

2) The need for automation are:

(i) To Increase the Productivity Rate of Labour

(ii) To Decrease the Cost of Labour

(iii) To Minimize the Effect of Shortage of Labour

(iv) To Obtain High Quality of Products

(v) A Non-automation nigh Cost is Avoided

(vi) To Decrease the Manufacturing Lead Time

(vii) To upgrade the Safety of Workers.

(viii) Reduction of in-process inventory.

(ix) To obtain product variety much easily.

(x) Can be implemented in regions where human activity isn't feasible

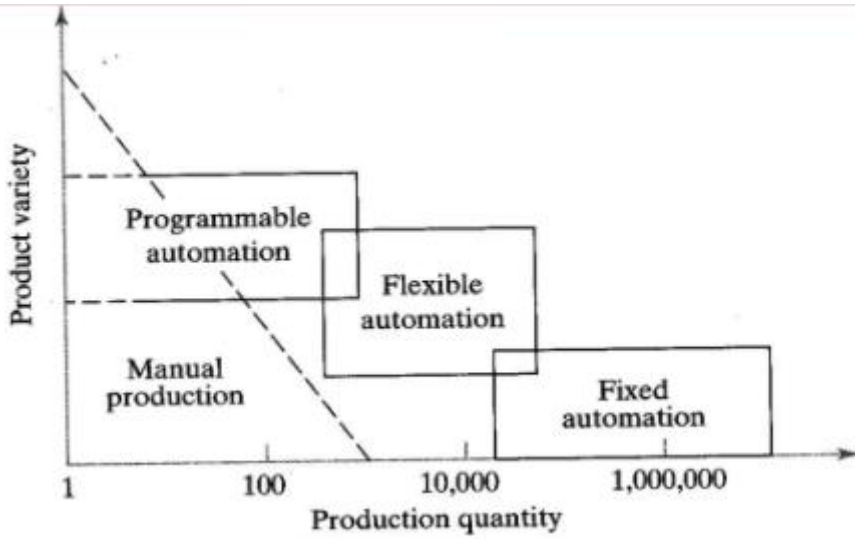
3) Automation is defined as "a technology concerned with the application of mechanical, electronics and computer based systems to operate and control production ".

(1) **Fixed Automation:-** It is the automation in which the sequence of processing or assembly operations to be carried out are fixed by the equipment configuration. In fixed automation, the sequences of operations (which are simple) are integrated in a piece of equipment. Therefore, it is difficult to automate changes in the design of the product. It is used where high volume of production is required Production rate of fixed automation is high. In this automation, no new products are processed for a given sequence of assembly operations. Features:- i) High volume of production rates, ii) Relatively inflexible in product variety (no new products are produced). Ex:- Automobile industries … etc.

(2) **Programmable Automation:-** It is the automation in which the equipment is designed to accommodate various product configurations in order to change the sequence of operations or assembly operations by means of control program. Different types of programs can be loaded into the equipment to produce products with new configurations (i.e., new products). It is employed for batch production of low and medium volumes. For each new batch of different configured product, a new control program corresponding to the new product is loaded into the equipment. This automation is relatively economic for small batches of the product. Features:- i) High investment in general purpose, ii) Lower production rates than fixed automation, iii) Flexibility & Changes in products configuration, iv) More suitable for batch production. Ex:- Industrial robot, NC machines tools… etc.

(3) **Flexible Automation:-** A computer integrated manufacturing system which is an extension of programmable automation is referred as flexible automation. It is developed to minimize the time loss between the changeover of the batch production from one product to another while reloading.

The program to produce new products and changing the physical setup i.e., it produces different products with no loss of time. This automation is more flexible in interconnecting work stations with material handling and storage system. Features:- i) High investment for a custom engineering system. ii) Medium Production rates iii) Flexibility to deal with product design variation, iv) Continuous production of variable mixtures of products. Ex:- Flexible manufacturing systems (FMS)



4) The production terminology:

a) Production capacity: Refers to the number of products that a production facility can produce under certain operating conditions.

$$PC = \frac{(WS_W HR_P)}{n_m}$$

b) Plant capacity: the number of total production output a plant can deliver under certain conditions.

c) Work-in-Progress: (WIP) is the amount of product currently located in the factory that is either being processed or is between processing operations.

$$WIP = \frac{PC\ U}{S_W H}(MLT)$$

d) Availability: The availability is sometimes used as a measure of-reliability for equipment. It is especially germane for automated production equipment. Availability is defined using two other reliability terms, the mean lime between failures (MTBF) and the mean time to repair (MTTR).

$$Availability = \frac{MTBF - MTTR}{MTBF}$$

Utilization refers to the amount of output of a production facility relative to its capacity.

$$U = \frac{Output}{Capacity}$$

e) MLT: IS the total time required to process a given part throughout the plant.

$$MLT = \sum_{i=1}^{n_m} \left(T_{sui} + QT_{oi} + T_{noi} \right)$$

f) WIP-TIP ratio :

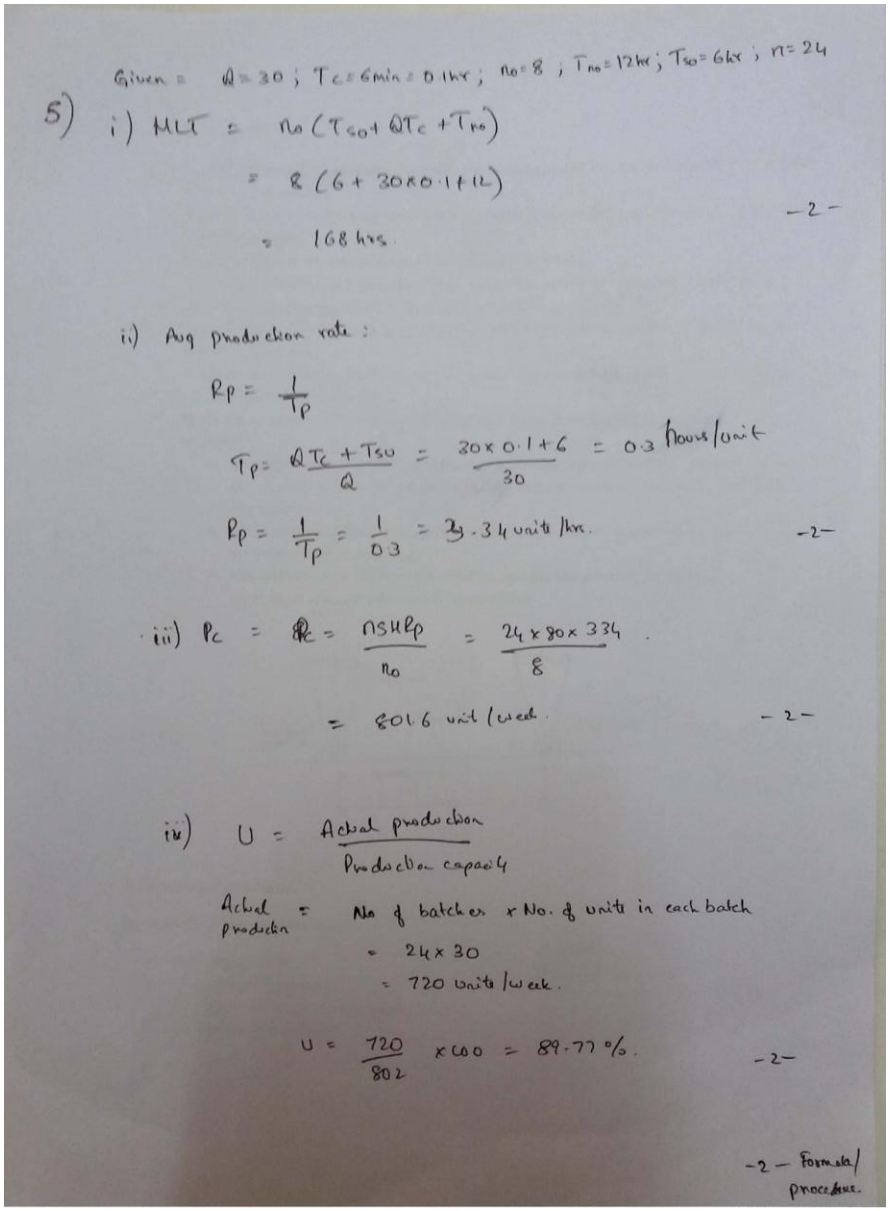
$$TI\,\mathrm{P}\ ratio = \frac{MLT}{n_m T_0}$$

-
-

$$WI\,\mathrm{P}\ ratio = \frac{WIP}{Number\ of\ machine\ proces\sin g}$$

$$Number\ of\ proces\sin g\ machine = WU\,\frac{QT_0}{T_{su} + QT_0}$$

5)



Given = $Q = 30$; $T_c = 6\text{min} = 0.1\text{hr}$; $n_o = 8$; $T_{no} = 12\text{hr}$; $T_{so} = 6\text{hr}$; $n = 24$

5) i) $MLT = n_o(T_{so} + QT_c + T_{no})$

$= 8(6 + 30 \times 0.1 + 12)$

$= 168\ \text{hrs}$ — 2 —

ii) Avg production rate :

$R_p = \frac{1}{T_p}$

$T_p = \frac{QT_c + T_{su}}{Q} = \frac{30 \times 0.1 + 6}{30} = 0.3$ hours/unit

$R_p = \frac{1}{T_p} = \frac{1}{0.3} = 3.34$ units/hr. — 2 —

iii) $P_c = R_c = \frac{nSH_p}{n_o} = \frac{24 \times 80 \times 3.34}{8}$.

$= 801.6$ unit/week. — 2 —

iv) $U = \frac{\text{Actual production}}{\text{Production capacity}}$

Actual production = No of batches × No. of units in each batch

$= 24 \times 30$

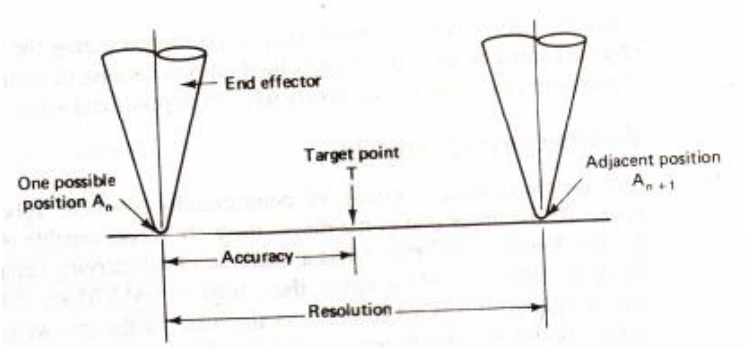
$= 720$ units/week.

$U = \frac{720}{802} \times 100 = 89.77\ \%$. — 2 —

— 2 — Formula/ procedure.

6) Robot specifications:

- Number of axes: This specifies the number of independent degrees of freedom that wrist end can manipulate.
- Capacity: It refers to the load carrying ability of the robot. Higher the load carrying capacity lower the accuracy.
- Speed: It refers to the distance moved by the tool in unit time.
- Operating environment: it represents the environment where a robot can work effectively.
- Work volume: is the space which the robot can manipulate its wrist.
- Reach & stroke: The distance covered by the end of the wrist to the centre of the body of robot is called reach.
  The distance covered by the wrist and along with the corresponding link without touching the work part is called as stroke.
- Performance parameters: the performance of a robot is measured in terms of of robots moment.
  - Spatial resolution: it refers to the smallest possible moment which a robot can move in its work volume. It depends on two factors: Control resolution mechanical inaccuracies
  - Accuracy: the ability to position the wrist end at a desired target with in robots work volume is called as accuracy.
  - Repeatability: the ability of the robot to position the wrist of the robot at the same point again and again is called as repeatability.



7) Classification of a robot:

- Based on the physical configuration:
  - Polar configuration
  - cylindrical configuration
  - Cartesian co-ordinate configuration
  - jointed arm configuration

- Based on the type of drive system
  - Hydraulic drive system
  - Pneumatic drive system
  - Electric drive system
  -
- Based on the control system and dynamic performance
  - Limited sequence robots
  - Playback robots with point to point control
  - Playback robots with continuous Path controls
  - Intelligent robots

- Based on position of robots
  - Mobile robots
  - Stationary robots

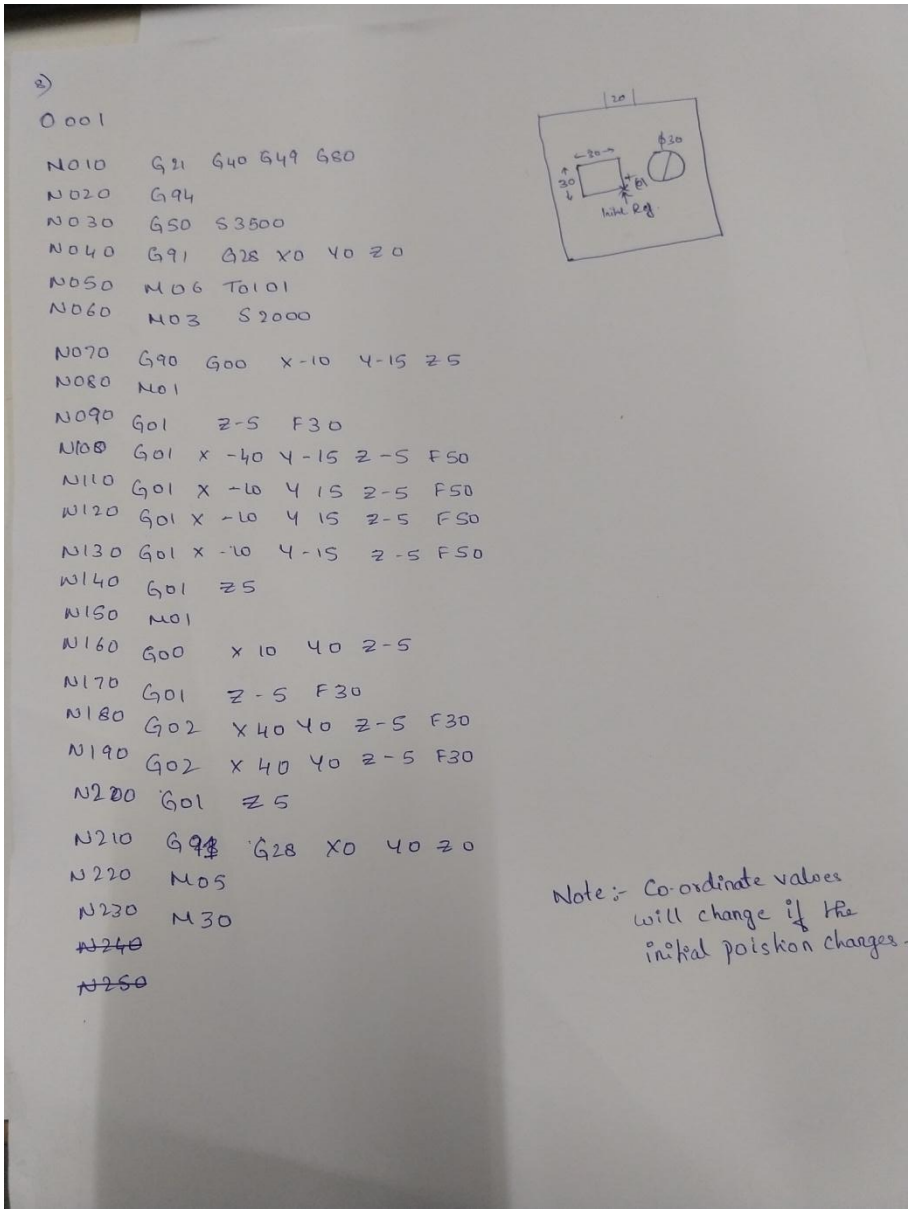
- Based on area of application
  - Domestic robots
  - industrial robots
  - defence robots
  - research robots

- Based on the type of controllers
  - On off controller
  - Proportional controller
  - Integral controllers
  - Proportional plus integral controllers
  - Proportional plus derivative controllers
  - Proportional + integral + derivative controller

- Based on the type of end effectors
  - Grippers
  - Tools

- Based on the type of programming methods
  - Manual programming
  - Walk through programming
  - Lead through programming
  - Offline programming

8)



2)

O 0 0 1

N010 G21 G40 G49 G80
N020 G94
N030 G50 S3500
N040 G91 G28 X0 Y0 Z0
N050 M06 T0101
N060 M03 S2000

N070 G90 G00 X-10 Y-15 Z5
N080 M01
N090 G01 Z-5 F30
N100 G01 X -40 Y-15 Z-5 F50
N110 G01 X -40 Y 15 Z-5 F50
N120 G01 X -40 Y 15 Z-5 F50
N130 G01 X -40 Y-15 Z-5 F50
N140 G01 Z5
N150 M01
N160 G00 X 10 Y0 Z-5
N170 G01 Z-5 F30
N180 G02 X40 Y0 Z-5 F30
N190 G02 X 40 Y0 Z-5 F30
N200 G01 Z5
N210 G91 G28 X0 Y0 Z0
N220 M05
N230 M30
~~N240~~
~~N250~~

Note :- Co-ordinate values will change if the initial poisition changes.