Section

Q1 (30 marks) Choose the correct answer for the following multiple-choice questions:

(1) An automated production line is:
A) Consisting of multiple workstations that are automated.
B) A variable routing manufacturing system. Fixed
C) Is including a work handling system that transfers parts from one station to the next.
D) A + C
E) All of the above

(2) A storage buffer is:
A) A location in a production line where parts can be stored to increase cycle time
B) A location in a production line where parts can be collected to provide a bank of parts to supply the line
C) A location in a production line where parts can be temporarily stored to reduce the effect of station breakdowns
D) A + B
E) B+ C

(3) The three basic control functions that must be accomplished to operate an automated production line:
A) Self –diagnosis in order to safely and adequately prepare any faults in the workstations or handling system. → not basic
B) Sequence control to coordinate the sequence of actions of the transfer system and associated workstations
C) Safety monitoring and quality control
D) B + C
E) All of the above

4) As the number of workstation on an automated production line increases:
A) The line efficiency increases as the number of stations increases.
B) The line efficiency is unaffected because each additional station needs additional operating costs and maintenance, so in overall efficiency is unaffected.
C) The line efficiency decreases because each additional station increases the probability a line stop.

D) The line efficiency cannot be predicted by just increasing the number of workstations without increasing the handling systems units between stations.
E) The line efficiency is related to the other factors than the number of workstations.

(5) If a storage buffer is nearly always empty or nearly always full, this indicates a problem area that is:
A) A system reliability.
B) Processing technology – cutting tool technology, speeds and feeds.
C) Line balancing.
D) B + C
E) All of the above

(6) One of the following sentences is incorrect about multi-station assembly machine or line:
A) Faster cycle rate
B) More operations possible
C) More complex assembly design is possible to be handled.
D) Suited to robotic assembly
E) C + D

(7) The group technology (GT) is:
A) It is a manufacturing philosophy
B) Similarities among parts permit them to be classified into group technology (part family)
C) Exploits the part similarities by utilizing similar processes and tooling to produce them
D) A + B
E) A + C

(8) Cellular manufacturing is:
A) Implemented by manual or automated methods.
B) Organizing the production facilities into manufacturing cells that specialize in production of certain part families.
C) Application of group technology into manufacturing workstations, workstations do the same processes are grouped together. (this called process layout)
D) A + B
E) All of the above

(9) Cellular manufacturing are most applicable when:
A) The plant uses batch production and process type layout.
B) The plant uses mixed production and process type layout.
C) The parts can be grouped into part families.
D) A + C
E) B + C

(10) The main difference between cellular and flexible manufacturing is:
A) Flexible manufacturing is a highly automatic cellular manufacturing system.
B) Flexible manufacturing can produce several part families, while cellular manufacturing can only produce a part family or a limited range of part families.
C) Cellular manufacturing is a special case of process type layout, while flexible manufacturing is based on a hybrid process – product layout.

D) A flexible manufacturing cell has 2 or 3 stations, while a flexible manufacturing system has 4 or more stations.
E) A + D

(11) The main difference between a dedicated FMS and a random-order FMS is:
A) A dedicated FMS is designed to produce a limited variety of part styles.
B) A random-order FMS is designed to produce a wide variety of part styles.
C) A random-order FMS is more flexible and is more appropriate when the part family is large
D) A + C
E) All of the above.

(12) The main difference between a assembly design and product design is:
A) Assembly design is less complex than product design.
B) Assembly design consumes around 65% of the product design costs.
C) Assembly design consists at least of two parts, while product design consist of single part.
D) A + C
E) B + C

(13) The feed rate in the CNC machine is:
A) The distance, which the cutting tool goes during a complete machining job.
B) The velocity at which the cutter is advanced against the workpiece.
C) It is measured in either inch per revolution or millimeters per revolution.
D) A + C
E) B + C

one spindle revolution

(14) The main difference between the CNC machine and the industrial robot is:
A) Industrial robot can be utilized both in manufacturing and in assembly, while CNC machine is a computer-based manufacturing machine.
B) The degree of freedom (DOF) for the industrial robot is more than that of the CNC machine
C) The machine tool envelope for the industrial robot is much larger than the machine tool envelope for the CNC machine.
D) A + C
E) All of the above

(15) The difference between fixed routing and variable routing in manufacturing systems consisting of multiple workstations is?
A) Variable routing is suited for high volume production, while fixed routing is suited for small volume production.
B) In fixed routing, work units are transported through a variety of different station sequences. In variable routing, the work units always flow through the same sequence of workstations
C) In fixed routing, the work units always flow through the same sequence of workstations In variable routing, work units are transported through a variety of different station sequences.
D) Fixed routing is suited for low volume production, while variable routing is suited for hard different product production.
E) C + D

(16) A pallet fixture in work transport in a manufacturing system is:
A) A fixturing system that can facilitate the placement of the product to the workstations and the escapement of the product from the workstation.
B) A manual handling system that has many configurations, circular, in-line shuttle and indexing table depends on the capacity required by the manufacturing system.
C) A work holder that is designed to be transported by the material handling system.
D) B + C
E) All of the above

(17) Factors that can be used to classify manufacturing systems are:
A) Product volume and variety
B) Processes that are performed in the manufacturing systems, in terms of their type (assembly or manufacturing) and number.
C) Number of workstations, type ( automatic or manual) and their layout.
D) A + C
E) All of the above.

(18) The relation between manning level and automation level in a manufacturing system:
A) Directly correlated to each other.
B) The number of workers required to operate the manufacturing system tends to be reduced as the level of automation increases.
C) Inversely correlated to each other.
D) It is a direct relation, as number of workstations increase the number of workers operating these stations will increase as well.
E) B + C

(19) The cases of part or product variety in manufacturing systems are:
A) Soft variety (batch model) and hard variety (mixed model) and no variety (Unique model)
B) Soft variety (mixed model) and hard variety (batch model) and no variety (single model)
C) Hard variety (mixed model) and soft variety (batch model) and High volume.
D) Hard variety and soft variety.
E) C + D

(20) The capabilities that a manufacturing system must possess in order to be flexible are:
A) The ability to be adaptable in terms of hardware and software
B) To be able to identify different work units.
C) The ability to changeover of operating instructions.
D) The ability to changeover of the physical setup.
E) A + B

(21) Which of the following is incorrect regards the single-station automated cell:
A) A single-station automated cell is a fully-automated machine.
B) It is capable of attended operation for a time - period longer than one machine cycle.
C) A worker is required to be at the machine in order to continuously load and unload parts.
D) B + C
E) A + C

(22) Which of the following is incorrect regards single station manual cell:
A) Technologically, it is the easiest system to install and operate

B) It is the most flexible manufacturing system.
C) Economically, the least capital investment of all manufacturing systems
D) For High quantities, it results in the lowest cost per unit produced.
E) It requires the shortest amount of time to implement.

lowest

(23) Enablers that are required for unattended operation of mixed model automated production cell are:
A) A parts storage subsystem and a supply of parts to permit continuous operation.
B) Automatic handling of workparts between the storage system and the machine
C) Work unit identification.
D) A + C
E) A + B

subsystem

(24) A machining center is:
A) Capable of performing multiple machining operations on a work part in one setup.
B) It is CNC machine that is under NC program control.
C) It is an example about the application of multifunction station manned cell.
D) A + B
E) All of the above

(25) The main features of the CNC machining center:
A) Automatic handling and positioning of the work part.
B) Operating unattended for one work cycle.
C) Automatic tool-changer.
D) A + C
E) All of the above.

(26) A machine cluster is:



A) Two or more CNC machines working together.
B) A collection of machines that are loaded and unloaded manually.
C) A collection of two or more machines that are synchronously producing parts or products.
D) B + C
E) A + C

Tm= 25min

Tc

A CNC machining center has a programmed cycle time = 25.0 min for a certain part. The time to unload the finished part and load a starting work unit = 5.0 min.

Tm=20

Ts

Ts = 5min

7) If loading and unloading are done directly onto the machine tool table and no automatic storage capacity exists at the machine, what is the hourly production rate?

A) 8.0 pc/hr
B) 4.0 pc/hr
C) 1.0 pc/hr
D) 2.0 pc/hr
E) Cannot be determined.

no storage capacity.

no storage capacity → $TC = T_m + T_s$

$T_C = 25min + 5min$

$T_C = 30min$

$$\text{hourly production rate} = \frac{60}{T_C} = \frac{60}{30} = 2$$

★ $T_C$ : cycle time

★ $T_m$ : machining time

★ $T_s$ : unload finished & load starting time.

★ $T_r$ : repositioning time.

(28) If the machine tool has an automatic pallet changer so that unloading and loading can be accomplished while the machine is cutting another part, and the repositioning time = 30 sec, what is the hourly production rate?

storage capacity = 1

A) 2.35 pc/hr
B) 1.55 pc/hr
C) 3.25 pc/hr
D) 2.45 pc/hr
E) 4.50 pc/hr

storage capacity = 1 → $T_C = MAX\{T_m, T_s\} + T_r$

$T_C = MAX\{25\ min, 5\ min\} + 0.5\ min$

$T_C = 25\ min + 0.5\ min = 25.5\ min$

$\text{hourly production rate} = \frac{60}{T_C} = \frac{60}{25.5} = 2.35$

(29) If the machine tool has an automatic pallet changer that interfaces with a parts storage unit whose capacity is 12 parts, and the repositioning time = 30 sec, what are the total cycle time?

A) 20.0 min/pc
B) 25.5 min/pc
C) 30.0 min/pc
D) 10.0 min/pc
E) Cannot be determined.

storage capacity = 12 → $T_C = MAX\{T_m, T_s\} + T_r$

$T_C = MAX\{25\ min, 5\ min\} + 0.5\ min$

$T_C = 25\ min + 0.5\ min$

$T_C = 25.5\ min$

$\text{HOURLY PRODUCTION RATE} = \frac{60}{T_C} = \frac{60}{25.5} = 2.35$

(30) How long does it takes to perform the loading and unloading of the 12 parts by the human worker, and what is the time the machine can operate unattended between parts changes?

A) Time to load/unload = 60 min, UT = 4,1 hr
B) Time to load/unload = 40 min, UT = 4,1 hr
C) Time to load/unload = 60 min, UT = 2,1 hr
D) Time to load/unload = 120 min, UT = 8,2 hr
E) Time to load/unload = 30 min, UT = 2.05 hr

★ time to load/unload $= 5\ \frac{min}{pc}\ (12\ p/c) = 60\ min$

★ $UT = \left(25.5\ \frac{min}{part}\right)(12\ part) - \left(5\ \frac{min}{part}\right)(12\ part)$

$= 246\ min = 4.1\ hr.$

Q2) (6 marks)

A. During calibration, an Iron/Constantan thermocouple is zeroed (set to emit a zero voltage) at 0°C. At 750°C, it emits a voltage of 38.8 mV. A linear output/input relationship exists between 0°Cand 750°C. Determine:

(a) The transfer function of the thermocouple and $S = f(S)$ $S = C + mS$

(b) The temperature corresponding to a voltage output of 29.6 mV.

(a) $S = C + mS$

$38.8 = 0 + 750\ m$

$38.8 = 750\ m$

$m = 0.0517$ $S = 0.0517$

(b) $29.6 = 0.0517$

$S = 572.53\ C^\circ$

automobile alarm circuit used to detect certain undesirable conditions. A three switches sed to indicate the status of the door by the driver's seat, the ignition, and the headlights ctively. Design the logic circuit with these three switches as inputs so that the alarm wi

Q4) (10 marks) Given the controller equation:

$$A = \bar{B} \cdot \overline{(C \cdot (\bar{D} + E + \bar{C}) + \bar{F} \cdot C)}$$

A) Draw the logic combinational circuit for A..
B) Draw the ladder diagram for the combinational logic circuit in part A.
C) Simplify the expression A.
D) Draw the logic circuit for the simplified expression A.
E) Draw the ladder diagram for the simplified expression A.