(i) maximum production rate of the FMC, (3)

(ii) corresponding production rates of each product, (4)

(iii) utilization of each machine in the system and (4)

(iv) number of busy servers at each station. (4)

Table 16(b)

Part j	Part mix pj	Operation k	Description	Station i	Process time t_{ijk}
A	0.2	1	Load	1	3 min
		2	Mill	2	20 min
		3	Drill	3	12 min
		4	Unload	1	2 min
B	0.3	1	Load	1	3 min
		2	Mill	2	15 min
		3	Drill	3	30 min
		4	Unload	1	2 min
C	0.5	1	Load	1	3 min
		2	Drill	3	14 min
		3	Mill	2	22 min
		4	Unload	1	2 min

Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 90867

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2022.

Sixth / Seventh Semester

Mechanical Engineering

ME 8691 — COMPUTER AIDED DESIGN AND MANUFACTURING

(Common to Mechatronics Engineering)

(Regulations 2017)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. A certain part is produced in a batch size of 100 units. The batch must be routed through five operations to complete the processing of the parts. Average setup time is 3 hours/operation and average operation time is 0.1 hours. Average non-operation time due to handling, delays, inspections, etc., is 7 hours for each operation. Determine how many days it will take to complete the batch, assuming the plant runs one 8-hr shift/day.

2. List and differentiate the types of 2D geometric transformations.

3. Differentiate between interpolated curves, analytical curves and approximated curves.

4. Write the limitations of Hermite curves.

5. What is Gouraud-Shading?

6. What is meant by "Application Programming Interface (API)"?

7. Mention the basic components of an NC system?

8. Differentiate between the point-to-point and continuous path control in a motion control system.

9. What s the composite part concept, as the term is applied in group technology?

10. Write the four basic components of a flexible manufacturing system.

PART B — (5 × 13 = 65 marks)

11. (a) Given the triangle, described by the homogeneous points matrix below, scale it by a factor 3/4, keeping the centroid in the same location. Use

(i) separate matrix operation and (5)

(ii) condensed matrix for transformation. (8)

$$[P]=\begin{pmatrix}2 & 2 & 0 & 1\\ 2 & 5 & 0 & 1\\ 5 & 5 & 0 & 1\end{pmatrix}$$

Or

(b) Describe the 'general process of design' characterized by Shigley. Also illustrate the design process using computer aided design.

12. (a) What do you understand by Boundary Representation (B-rep) technique of solid modeling? Explain briefly the data structure of B-rep solid model.

Or

(b) Write about NURBS and list their important advantages.

13. (a) Explain the Initial Graphics Exchange Specification methodology.

Or

(b) Discuss the following standard used in graphics programming: Graphical Kernel System.

14. (a) Discuss the types of stepper motors with neat sketches and write the advantages and disadvantages of stepper motors.

Or

(b) What is meant by APT? Briefly explain the geometric and motion statements with respect to APT programming.

15. (a) The following Table 1 lists the weekly quantities and routings of ten parts that are being considered for cellular manufacturing in a machine shop. Parts are identified by letters and machines are identified numerically. For the data given,

(i) develop the part-machine incidence matrix, and (6)

(ii) apply the rank order clustering technique to the part-machine incidence matrix to identify logical part families and machine groups. (7)

Table 15(a)

Part	Weekly quantity	Machine routing	Part	Weekly quantity	Machine routing
A	50	3 → 2→ 7	F	60	5 →1
B	20	6 → 1	G	5	3 → 2→ 4
C	75	6→ 5	H	100	3 → 2 → 4 → 7
D	10	6 → 5 → 1	I	40	2 → 4 → 7
E	12	3 → 2 → 7 → 4	J	15	5 → 6 → 1

Or

(b) Describe the five categories of layout configurations that are found in a flexible manufacturing system.

PART C — (1 × 15 = 15 marks)

16. (a) Write an NC program to machine the simple aluminum pin shown in the Figure 1. A 50.8 mm diameter blank 63.5 mm long is to be used. Mention all your programming assumptions. Let 1 inch = 25.4 mm.

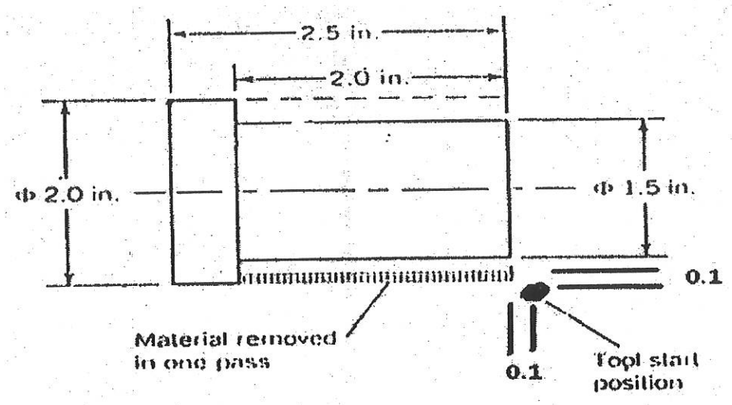

Figure 16(a)

Or

(b) A flexible manufacturing cell consists of two machining workstations plus a load/unload station. The load/unload station is station 1. Station 2 performs milling operations and consists of one server (one CNC milling machine). Station 3 has one server that performs drilling (one CNC drill press). The three stations are connected by a part handling system that has one work carrier. The mean transport time is 2.5 min. The FMC produces three parts, A, B, and C. The part mix fractions and process routings for the three parts are presented in the Table 2 below. The operation frequency f_{ijk} = 1.0 for all operations. Determine