AHMEDABAD UNIVERSITY
School of Engineering and Applied Science
2025-2026 Monsoon

MEC403 Manufacturing Systems and Operations
End-Term Examination
Monday 01 December 2025. 14:00 – 16:30

Name:	Roll no.	A U 2	Marks /70

1 All questions are compulsory.
2 Figures to right indicate full marks.
3 All acronyms carry their usual meaning.
4 Assume suitable data/assumptions wherever necessary and specify it clearly in your answers.

Q1

a) Hi-octane Refining Ltd (HRL) needs to locate an intermediate holding facility between its refinery plant (i.e. supply node) in Kolkata and four major distributors (Bhopal, Nagpur, Mumbai and Delhi, i.e. demand nodes)

Location	Bhopal	Nagpur	Mumbai	Delhi
(x,y) coordinates	(400,150)	(450,350)	(350,400	(25,450)
Demand (in Millions of Liters)	250	450	350	450

The supply at Kolkata (with (x, y) coordinates as (325,75)) is 1500 Million Liters.
Find the location of the intermediate holding facility based on Centre of Gravity.
Is it worthwhile to move gasoline directly from Kolkata to Bhopal rather than through the intermediate facility?. Justify or refute this statement.

b) Explain the competitive role of the driver like" Facilities" with reference to a Petroleum supply chain.

c) Annual demand for an item is 1800 units. The item can be produced at a constant rate of 3500 units per year. The unit cost is Rs 50, set-up cost is Rs 650, and the inventory carrying rate is 30 percent of the unit cost per unit per year. Find the optimal production quantity and number of production set- ups required per year. Write suitable assumptions with justification.

[Marks: 7+5+5=17.0]

Q2

a) Explain typical "wastes" (at least 6) in a service environment. Describe the service environment you are referring to and highlight how to reduce these wastes. Be specific in your response.

b) Explain the concept of Poka yoke with reference to the situation you have described in your Mini Project. Justify how this Poka Yoke is likely to reduce waste.

c) "ToC and TPS have contradictory perspectives to each other".
Justify OR criticize the above statement with reference to a real-life case of a manufacturing company engaged in consumer durables.

d) In recent years, purchasing has moved from a largely clerical job to a higher status profession (like Vice President-Procurement).
What are the likely reasons (at least 4) for this change with reference to a typical automobile manufacturing company?

[Marks: 10+3+3+2=18.0]

Q3

a) Hitesh Job Work (HJW) provides services for manufacturing clusters in Vadodara. Five customers submitted their orders at the beginning of the week.

Job (In order of arrival)	A	B	C	D	E
Processing time (days)	3	4	2	6	1
Due date (days Hence)	5	6	7	9	2

Compute the Average flow time, average delay for the following rules:
FCFS (First Come First Served), Shortest Processing Time (SPT) and EDD (Earliest Due Date).
Tabulate your results and comment on your results.

[Marks:5+2=7]

b) Mudra Fabricators Ltd (MFL) produces an item required for industrial consumption. The monthly forecast for the year 2026 is given below. MFL has a normal production capacity of 2200 units per month, and a current inventory of 1000 units left as part of the inventory in December 2025. This can be considered as the beginning inventory of Jan 2026.

Month	Jan	Feb	Mar	Apr
Forecast (units)	1500	1000	2600	2800

Production cost is Rs 70 per unit, inventory holding cost is Rs 1.5 per month per unit of ending inventory, overtime costs Rs 6.5 additional per unit, and there is Rs 5 per unit charge to change the production rate. The cost of under-time (production below full capacity) is Rs 3 per unit. The demand which is not satisfied is charged at Rs 9 per unit. MFL has the following plan:
PLANA: Producing at a uniform rate of full capacity every month (i.e. 2200 units per month).

i. You may make suitable assumptions and state them clearly.
ii. Compute the ending inventory every month for PLANA.
iii. Estimate the total cost of the above production plan.
iv. Give suggestions (at least 2) with adequate justification for improving the above plan with a view of reducing the total cost.

[Marks: 1+2+3+2=8]

c) Explain your learning (at least 6) in the Soda game (of assignment 9) OR in the ProdnInv game played in the class.

[Marks: 3]

Q4

a) An end item X is composed of two Bs and one C. Moreover, each B requires three Ds and one E, and each D requires four Es. Similarly, each C is made up of two Es and two Fs..
The available inventory on hand of each items B, C, D, and E are 4, 10, 8, and 60 units respectively. Note that the quantities of each item in the product structure tree refer only to the amounts needed to complete the assembly at the next higher level. Use this information to do the following:

i. Draw the BOM structure indicating clearly the tree (of end item X and respective components and sub-assemblies) diagram
ii. Determine the quantities B, C, D, E, and F needed to assemble one unit of X
iii. Determine the quantities of these components that will be required to assemble 10 units of Xs, considering the quantities on hand of various components. State your assumptions clearly.
iv. What are the challenges (at least 4) in implementing MRP for end item X

[Marks: 1.5+2.5+2+2=8]

b) Consider a three-stage assembly line comprising stages A, B and C. The processing time required at these stages is 2 minutes/unit, 4 minutes/unit and 3 minutes/unit respectively. There is a buffer inventory between A and B and between B and C.

i. Find the bottleneck stage in the above assembly line with proper justification.
ii. What is the effective capacity of the assembly (in units/hour)?
iii. According to the Theory of Constraints (ToC), indicate where the buffer should be placed? Why?
iv. Explain how you will apply ToC to the above assembly line.

[Marks: 0.5+1+1+1.5=4]

c) Explain at least 5 mechanisms by which the outcome of your Mini Project (Do not forget to mention the theme of your MiniP) can be improved further. Give justification for these. You may make necessary assumptions.

[Marks: 5]

---All the best---