Q 1. A company manufactures 10 products in small batches. Scheduling is done such that a batch is processed completely without interruption. There are three identical parallel machines on which the batches are to be processed. The processing time for each batch is given in the following table. Each batch needs a setup time of 20 minutes.

(A) If the objective is to reduce both the make-span time and mean flow time for the schedule, how should the batches be processed on these processors?

Job	1	2	3	4	5	6	7	8	9	10
Proc Time	200	340	680	140	320	300	250	430	500	300

(B) The company is also trying to implement lean manufacturing practices and succeeds in reducing the setup time by 10 minutes. There are two options
1. Reduce the batch size to half with setup time as 10 minutes
2. Keep the batch size same with setup time as 10 minutes

The manager wants to make a choice based on the impact (in %) of these options on Make-span time, Mean flow time, Average w.i.p inventory and Machine utilization **(10)**

Q 2. A machine is being observed for failures due to one of its sub assembly units. The data collected for failure times is given below

N(T)	1	2	3	4	5	6	7	8	9	10
T	87	149	203	253	301	346	390	432	473	513

Maintenance planner has option of either implementing corrective or preventive maintenance. Corrective Maintenance (CM) cost is Rs. 2000 and Preventive maintenance cost is Rs. 5000. After data analysis, the engineer decides to go for PM. Is his decision correct? If yes why ? What should be the optimal PM interval? Assume power law model is appropriate in this situation and PM brings back the subsystem to as good as new condition.

If one observes constant failure rate, which maintenance (PM or CM) will be preferred. Prove this using the power law model.

(5)

Q 3. A continuous production plant, producing a chemical, consists of three major units in series. When any unit in the series fails, the plant fails (it can be assumed that the probability of two or more units failing at the same time is negligible). A study was made to determine the performance of the entire plant. Availability and maintenance cost per gallon are to be used as performance measures. Historical data was collected for the three units. For the first unit, 1 failure was observed in 43800 hrs. For the second unit, 3 failures were observed in 26280 hrs and for the third unit, 2 failures were observed in 35040 hrs. Mean time to repair for the first, second and the third unit was 18, 24 and 83 hrs respectively. If the plant operates 8760 hrs in a year, what is its availability for the year ? If breakdown cost per failure is Rs. 100000, production loss per hr of failure is Rs. 150000 and scrap cost per failure is Rs. 50000, what is the maintenance cost per gallon of production for the year if the production rate is 100 gallons/hr ? **(5)**

Q 4. A computer manufacturing company wants to balance its assembly line. The activities, along with their required predecessors, and the corresponding times are given in the following table. It is required to produce 300 PCs per day. The line can run 7 hrs per day. Use RPW method to balance the line. **(5)**

Activity	Description	Activity time (sec)	Predecessors
A	Install system chassis	55	-
B	Install internal speakers	30	A
C	Install power supply	50	A
D	Install fan	42	A
E	Install CPU in system board	20	-
F	Install RAM in system board	25	-
G	Mount system board in chassis	45	A, E, F
H	Connect units to power supply	60	B, C, D, G
I	Install video card	36	H
J	Install drive chassis	42	H
K	Install CD drive	30	J
L	Install hard disk	40	J
M	Install floppy drive	36	J
N	Attach panels & cover	40	I, K, L, M

Q 5. Explain the working of heuristic to minimize machine idle times. What are the main drawbacks of this heuristic ? How is it similar/dissimilar to the 'Next Best' heuristic to minimize sequence dependent setup times ?

(5)