Loughborough University

MANUFACTURING PLANNING AND CONTROL

(22WSB203)

Semester 2 2023 In-Person Examination

This examination is to take place in-person at a central University venue under exam conditions. The standard length of time for this paper is **2 hours**

You will not be able to leave the exam hall for the first 30 or final 15 minutes of your exam. Your invigilator will collect your exam paper when you have finished.

Help during the exam

Invigilators are not able to answer queries about the content of your exam paper. Instead, please make a note of your query in your answer script to be considered during the marking process.

If you feel unwell, please raise your hand so that an invigilator can assist you.

Answer **ALL FOUR** questions

Questions carry the marks shown.

You may use a calculator for this exam. It must comply with the University's Calculator Policy for In-Person exams, in particular that it must not be able to transmit or receive information (e.g. mobile devices and smart watches are **not** allowed).

1.

a) Explain the terms ‘Fixed Costs’ and ‘Variable Costs’ and ‘Unit Cost’. Is the unit cost always lower when more units are produced? Give reasons for your answer. [6 marks]

b) **Figure Q1b** shows the bill of materials for product XYZ and the required number of each part is shown in brackets. Standard times are given in **Table Q1b**. Perform a rough cut capacity check for the Machine Shop and Assembly. Assume that 2000 of XYZ need to be completed in the 13 week period. All employees work a 40 hour week. Efficiency rates are 0.98 for the Machine Shop and 0.96 for Assembly. The company aims for a utilization rate of 0.90. The Machine Shop has 8 employees and Assembly has 1 employee.

i. Prepare a Bill of Labour showing the time required for each item in each department, [2 marks]

ii. Calculate available time and capacity for each department [2 marks]

iii. calculate required time and capacity for each department [2 marks]

iv. using parts (ii) and (iii), is there sufficient capacity available to meet the MPS requirement? What are your recommendations to the production manager? [3 marks]

Department	Component	Run Time per unit (hrs)	Setup Time per Lot (hrs)	Lot size (units)
Machine Shop	Component A	0.25	2.00	50
Machine Shop	Component B	0.35	2.50	25
Machine Shop	Component C	0.20	2.00	100
Assembly	Product XYZ	0.40	0	1

Table Q1b: Standard times for product XYZ and Components A, B & C.

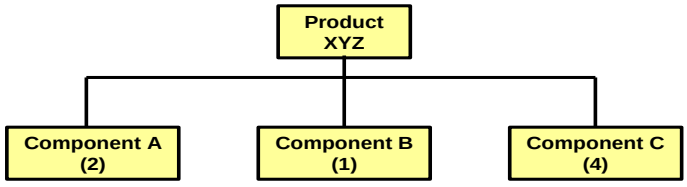

Figure Q1b: Bill of Materials for product XYZ

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2.

a) Explain the purpose of Materials Requirements Planning (MRP) and draw a diagram to show the main inputs and outputs of an MRP system [3 marks]

b) The Bills of Material (BOM) for products A and B and components C and E are shown in Figure: Q2. The number of each component required is shown in brackets, for example product A contains 2 C components, 2 D components and 2 E components. Explain the purpose and use of low level coding and show how it is used to calculate the materials required for the production of A and B [3 marks]

c) What is the difference between independent demand and dependent demand in the context of products A and B and components C, D and E? Determine a materials requirements plan for C, D and E for the next 8 periods using the information in Table Q2_1 and Table Q2_2. Give your solution as 3 tables (1 for C, 1 for D and 1 for E). Each table should include projected requirements, available on hand inventory, scheduled receipts and planned order releases [7 marks]

d) Describe the following:

i. Regenerative MRP [1 mark]

ii. Net-Change MRP. [1 mark]

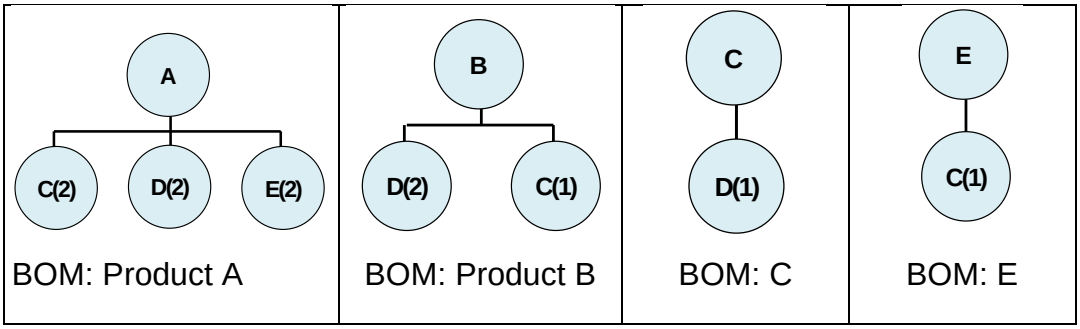

Figure: Q2

MPS Quantity Start Dates								
Weeks	1	2	3	4	5	6	7	8
Product A		125		95		150		130
Product B			80			70		

Table: Q2_1

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Inventory Record Data			
	C	D	E
Lot sizing rule	Fixed order Quantity 400	Fixed order Quantity 800	Lot For Lot
Lead Time	2 weeks	1 week	3 weeks
Scheduled Receipts	None	800 (week 1)	200 (week 2)
Start Inventory	625	350	85

Table: Q2_2

3.

a) Explain the differences between forward scheduling and backwards scheduling [2 marks]

b) How does scheduling differ for Repetitive Manufacture and for Job Shops? [3 marks]

c) What is the purpose of simple priority rules (give examples)? Table Q3_1 gives details of jobs waiting to be processed. Use the Shortest Processing Time and the Earliest Due Date priority rules to schedule these jobs. Calculate the average job flow time and makespan and compare the performance of these rules. [6 marks]

Job ID	Processing Time inc. Set-up (hr)	Collection Time (Business hours from now)
XR1	7	21
XR4	5	15
XR2	14	16
XR5	3	22
XR3	10	20

Table Q3_1

d) Clearly explain the necessary steps to apply Johnson's rule to the set of jobs shown in table Q3_2. Produce a job sequence and calculate the Makespan [4 marks]

Job Identity	Operation time on Machine 1	Operation time on Machine 2
A	30	35
B	40	15
C	15	40
D	25	25
E	10	45
F	30	20

Table Q3_2

/continued

4.

a) Describe the characteristics of each of the four types of manufacturing operations classified as VATI plants. For each basic type, include a sketch, a description of its characteristics and examples of processes and/or products. [6 marks]

b) Briefly discuss the purpose of layout design, explaining why a good layout reduces production costs. [3 marks]

c) Company X requires an output of 100 vehicles of a particular type per day. The production line works two shifts, each of 7 hours productive output. If the work content of the model is 306 standard minutes, what is the cycle time and how many workstations are required? [2 marks]

d) Explain why it is important to balance the work between work centres on a production line. If a production line produces 3200 units every 8 hour shift and the standard time for each unit is 3 minutes, calculate the cycle time and the minimum number of work centres required on the line. Assume 21 work centres are to be used on the line. Find the Balancing Loss (%) and Balancing Delay. [4 marks]

J. A Harding