Version DCM/8

MET2
MANUFACTURING ENGINEERING TRIPOS PART IIA

Thursday 30 April 2015 9 to 12

Paper 3

Module 3P4: OPERATIONS MANAGEMENT

Module 3P5: INDUSTRIAL ENGINEERING

*Answer all questions from sections **A** and **B**.*

*Answers to sections **A** and **B** must appear in two separate booklets.*

All questions carry the same number of marks.

*The **approximate** percentage of marks allocated to each part of a question is indicated in the right margin.*

*Write your candidate number **not** your name on the cover sheet.*

STATIONERY REQUIREMENTS
20 page answer booklet x 2
Rough work pad

SPECIAL REQUIREMENTS TO BE SUPPLIED FOR THIS EXAM
CUED approved calculator allowed
Engineering Data Book
3P5 Data Sheet

10 minutes reading time is allowed for this paper.

You may not start to read the questions printed on the subsequent pages of this question paper until instructed to do so.

SECTION A

1 (a) (i) Describe what is meant by *production capacity* and *capacity planning* for a factory.

[10%]

(ii) Describe five factors that can reduce the production capacity of a factory and in each case indicate how the impact of the factor on capacity can be minimised.

[20%]

(b) A manufacturing company is setting up a new factory and is considering two options for the key processing equipment.

Option 1: a single machine of type A directly feeding into a single machine of type B;

Option 2: Three machines of type C in parallel, directly feeding into any one of three machines of type D in parallel.

The product produced by Option 1 is identical to that produced by Option 2. The factory works for eight hours per day. Processing and setup times for the four machine types are as follows:

Option	Machine	Process time (seconds)	Setup time (seconds)
1	A	6	1500
	B	8	1000
2	C	30	50
	D	60	20

(i) Two batch sizes are being considered of 100 and 1000 units respectively. The machines must be set up before each batch. For each batch size, determine which option you would choose in order to maximise capacity. Justify your recommendations and state any assumptions you make.

[30%]

(Cont.

(ii) For both processing options, and for both batch sizes, calculate the utilisation rate for all four machine types, defined as the % of time in which the machine is processing. Explain why your results differ for the two batch sizes. State any assumptions you make.

[20%]

(iii) Discuss the effects of variations in processing times and machine breakdowns on your answers in (i) and (ii).

[20%]

(TURN OVER

2 (a) (i) Explain what is meant by a *job shop*. Under what circumstances is such an operating approach appropriate? Illustrate your answer using several typical examples.

[10%]

(ii) How and why does the management of a job shop differ from that for other types of operations?

[20%]

(iii) Job shop scheduling methods can be used to schedule many types of operations. Give three non-manufacturing examples that could use job shop scheduling.

[10%]

(b) You have received an order from a customer to process six jobs for delivery on the following due dates:

Job	A	B	C	D	E	F
Processing time (days)	1	5	2	3	2	4
Due date (From current day)	7	8	7	6	10	9

The customer will pay your costs plus £1000 for each job completed before or on the specified due date. However if a job is completed late then there will be a £500 penalty for each day which that job is late.

(i) Should you accept some or all of this order, and if so, how should you schedule the jobs?

[30%]

(ii) Comment on the sensitivity of the answer in part (b)(i) to changes in the penalty for lateness.

[20%]

(iii) If there were no penalties for lateness, how should you schedule the jobs? Give your reasons.

[10%]

SECTION B

3 (a) Briefly outline the three main principal groups of motion economy used in the Develop step of Method Study. Identify five examples of good practice principles. [15%]

(b) Workers are employed to remove defective product from a food processing line. What factors could contribute to a lack of attention to the task and how could you overcome them? [10%]

(c) A workshop is lit by 50 high bay metal halide lights positioned at a height of 5 metres. If they were repositioned at a height of 3 metres how many could be removed while maintaining the same level of illuminance at floor level? Discuss the advantages and disadvantages of this change. [15%]

(d) Explain what is meant by *Total Productive Maintenance (TPM).* Describe its benefits. [20%]

(e) Explain Juran's Cost of Quality Model. How does it differ from Crosby's Zero Defects idea? [15%]

(f) Describe the Six Sigma Define, Measure, Analyse, Improve and Control (DMAIC) technique. What are the limitations of this technique? [25%]

(TURN OVER

4 (a) Discuss the reasons why time standards are required for manufacturing operations. [20%]

(b) An engineer repeatedly measures the time taken for a worker to assemble a product with the following results:

1st observed time	49.5 s
2nd observed time	48.8 s
3rd observed time	54.1 s
4th observed time	53.7 s.
5th observed time	47.5 s.

Over a period of 10 days, a supervisor carries out 400 random observations of the same worker, and notices that the worker is working productively on 298 occasions. During this period the worker attends for 70 hours and produces 3400 assembled products.

Calculate 95% confidence limits for the time to perform the assembly operation using (i) the engineer's study time and (ii) the supervisor's sample. [35%]

(c) Explain the significance of the Learning Curve in time study. What steps can be taken to improve individual learning and what steps can be taken to improve group learning? [20%]

(d) You have been asked to plan in detail the layout of a new factory. Describe the stages you would go through, the factors you would take into account and the analytical tools and techniques that you would use. [25%]

END OF PAPER