OLLSCOIL NA hEIREANN, CORCAIGH
THE NATIONAL UNIVERSITY OF IRELAND, CORK

COLAISTE NA hOLLSCOIL, CORCAIGH
UNIVERSITY COLLEGE, CORK

SUMMER EXAMINATIONS, 2005

B.E. DEGREE (ELECTRICAL)

Engineering Management
ME4001

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Time allowed: *3 hours*

Answer *five* questions.

All questions carry equal marks.

The use of a Casio fx570w or fx570ms calculator is permitted.

1. (a) Explain briefly the techniques used in statistical quality control, giving situations where they are used. **[6 marks]**

(b) Determine the producer's risk and consumer's risk for the following single acceptance sampling plan using the Poisson distribution.

AQL	=	2%
LTPD	=	4%
Sample Size	=	200
Batch Size	=	5000
Acceptance Criterion	=	"If the number of defects is less than or equal to 2 – accept the batch"

[7 marks]

(c) Indicate briefly where RUN tests are used.

Determine using the UP/DOWN run test and using 95% confidence limits whether the following set of observations is due to random causes

15, 16, 16.5, 14, 14.5, 15, 14.5, 14, 15, 16

Given: Expected number of runs $= \frac{2N-1}{3}$

$$\delta_{U/D} = \sqrt{\frac{16N-29}{90}}$$

[7 marks]

2. (a) Data below refers to two machines capable of producing a component

	M/C 1	M/C 2
Purchase Cost	€50,000	€100,000
Salvage Value	€5,000	€10,000
Expected Life	5 years	8 years
Production Rate (components per hour)	3 per hr	5 per hr
Cost of operation of M/C per hour	€8.00 per hr	€6.00 per hr
Annual maintenance cost	€1,000	€1,500
Raw material cost per component	€2.00	€2.00
Overheads	€3.00 per hr	€3.00 per hr

Using a BE chart determine which of the two machines is more economical, if the annual demand is 6000 per year. (15% interest rate is to be used to calculate the annual costs and taxation can be neglected). **[10 marks]**

(b) Determine also whether a 15% yield criterion is met under the following conditions (other conditions remaining as above in (a)).

Tax rate of 25%; selling price of each component is €9.00
Depreciation charge is tax allowable and is "straight line" to zero book value over 3 years. **[10 marks]**

3. A firm makes 3 products X, Y and Z which are manufactured by processing through machines A, B and C. The manufacturing time (in hrs) at each machine for each product is given in the table.

	Hours per Component		
	A	**B**	**C**
X	2	2	3
Y	3	4.5	2
Z	5	5	6

The available capacities of the machines A, B and C are 450 hrs, 600 hrs and 600 hrs respectively. The labour and machine costs are €20.00 per hour on each of the machines. The material costs of the products A, B and C are €60, €30 and €20, while the selling prices are €300, €310 and €410 respectively. Formulate the LP model and determine the quantity of each product to be manufactured so as to maximise profit. **[16 marks]**

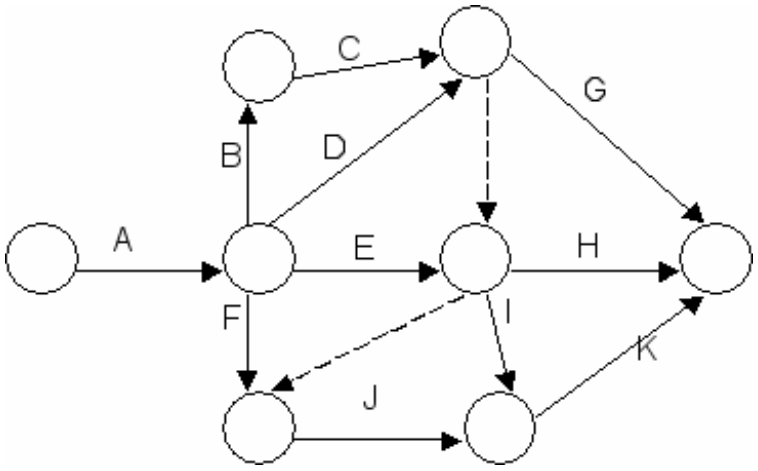
If the product X can be manufactured either by processing it through machines A, B and C, as above or processing it through machine A for 2 hrs and machine B for 6 hrs (or a combination of the two processes), formulate the LP model to obtain the quantities manufactured in each process, other parameters remaining as above (formulate only). **[4 marks]**

4. Explain briefly as to how cost control can be effected when the duration of a project is to be shortened. **[4 marks]**

Determine the following in respect of the network diagram shown. **[16 marks]**

(i) the "early start", "late finish" and the total float for each of the activities
(ii) the critical path
(iii) the probability of completing the project 2 days ahead of schedule
(iv) cost of reducing the duration of the project by 4 days ahead of schedule

Activity	Mean Expected Duration (days)	Standard Deviation (days)	Crash Cost Per Day **€**
A	4	1	90
B	18	2	90
C	4	0.5	100
D	6	0.75	100
E	20	1.25	80
F	8	1	100
G	24	2	80
H	22	1.5	80
I	2	0.25	100
J	5	1	100
K	20	1.5	80



5. What are the shortcomings of applying statistical inventory management techniques in a production environment? **[4 marks]**

The manufacturing capacity of a factory for a component is 10,000 per week, while the demand is 1,000 per week. If the manufacturing cost of the component is €30.00 and the set up cost of the machines is estimated at €1,000.00, determine the economic order quantity. The inventory costs can be taken as 26% of the cost of the component per year.

If the variable costs (holding and set-up costs) per week are allowed to vary up to 10% of its minimum value and that the size of the batch produced must be in multiples of the weekly production capacity, determine

(a) the range of the production quantity
(b) the batch size to give the lowest costs
(c) the increase in cost for the batch produced over the cost for EOQ

Derive any formulae you may use. (State clearly any assumption made).
[16 marks]

6. (a) Describe briefly a typical failure rate curve for a batch of components.

In the system shown the reliability of each component can be described by

$$R_i(t) = e^{-\lambda i.t}$$

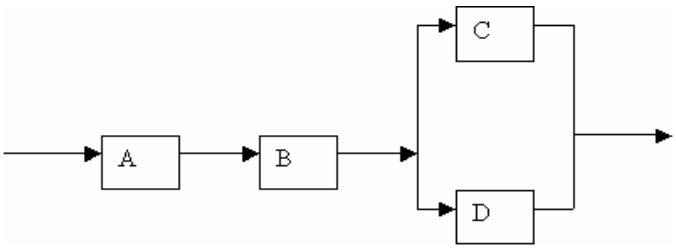
Determine the system reliability after 250 hours of operation

$\lambda_A = \lambda_C = 0.1$ per 1000 hrs

$\lambda_B = \lambda_D = .15$ per 1000 hrs

(Assume D is a redundant component doing the same function as C)

If the system reliability can also be approximated by the above equation, determine the MTBF of the system. **[10 marks]**



(b) The failure density function for a system can be approximated by

$$f(t) = \frac{2}{a} - \frac{2t}{a^2}$$
$$where \quad t \leq a$$

Determine the following for the above function: Unreliability function, Reliability function, Failure rate function and the function governing the 'Expected number of operating hours'. Hence calculate their values after two years of operation, when a = 10 years **[10 marks]**

7. Discuss briefly the different types of layout of facilities in a factory giving the advantages/disadvantages of each type and situations where each should be used. **[20 marks]**