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

COLAISTE NA hOLLSCOIL, CORCAIGH
UNIVERSITY COLLEGE, CORK

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AUTUMN EXAMINATIONS, 2005
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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 $= \dfrac{2N-1}{3}$

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

[7 marks]

2. (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
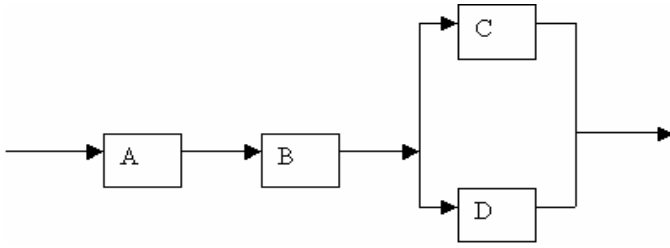
$$R_i(t) = e^{-\lambda i.t}$$

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

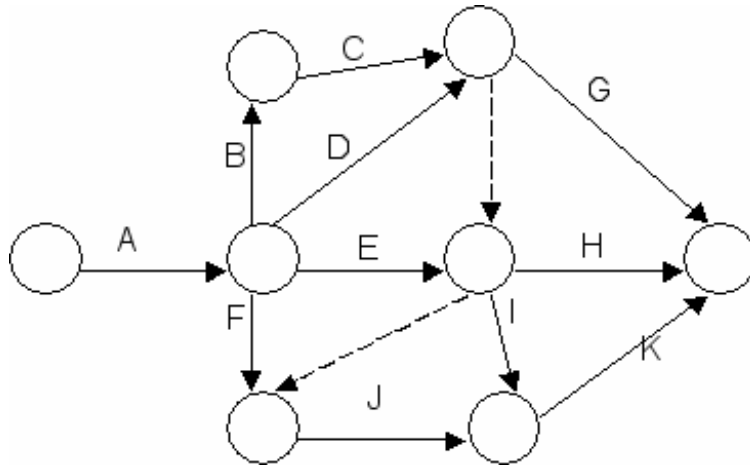$$f(t) = \frac{2}{a} - \frac{2t}{a^2}$$

$$where \quad t \leq a$$

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]**

3. 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

4. What is understood by the terms "depreciation" and "capital allowance" (**3 marks**)

   An existing piece of equipment, which has a book value of zero, is to be replaced by a new machine with the same production capacity and is to be used for 5 years. The new machine costs €50,000 with an annual running cost of €3,000 per year. The estimated salvage value after 5 years is €15,000.
   The running cost of the existing equipment is €6,000 per year and the salvage value is €5,000, which is expected to remain constant over the 5 years.
   The tax rate is 40% and the method of depreciation is "straight line" over eight years to zero book value. Determine whether the purchase of the new equipment is cost effective when the cash flow analysis is carried out using a 15% yield criterion. Assume that all depreciation charges can be off set against the profits for tax purposes. (**17 marks**)

5. A manufacturer has a range of products P1, P2 and P3, assembled from three critical components C1, C2 and C3. The supply of these components is limited to 10,000, 1,500 and 2,000 items per week respectively. The requirement of these components for each product is as given in table.

	Product		
Component	**P1**	**P2**	**P3**
C1	2	4	8
C2	1	1	2
C3	2	2	1

   The maximum demand for P2 is estimated at 200 per week while the demand for P1 and P3 is unlimited. The profit from each of P1, P2 and P3 are €40, €50 and €75 respectively. Determine the production rates of each of the products to maximize profits. (**20 marks**)

6. What is understood by "work study" ? Give a brief account of its methods and applications in industrial environments. (**20 marks**)

7. What are the main differences between statistical inventory management and MRP systems. (**4 marks**)

In a factory the production rate of an item is 1,000 items per day while the internal demand is 1,000 per week. The cost of a manufactured item is €10 and the set up cost is €850.00 while the annual carrying cost is 26%. If the manufacturing batch size is to be multiples of daily production quantity, determine the optimum batch size. (**6 marks**)

If the demand is variable with a standard deviation of 100 items/week and a lead time of 3 weeks (from the reorder point to the start of production) determine the minimum safety stock to be maintained to give a service level of 97%. (**6marks**)

Derive any formulae you may use and assume a 5 day working week.(**4 marks**)