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

COLAISTE NA hOLLSCOIL, CORCAIGH
UNIVERSITY COLLEGE, CORK

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Autumn Examinations, 2006
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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 the terms 'reliability' , 'failure rate' and 'failure density function'.
A manufacturing process under continuous operation breaks down in a random manner. The mean failure rate is one breakdown in 70 hours, which can be taken as constant. What is the reliability function and the probability density function of failure for the process? Determine the probability that the process can run for 100 hours without a breakdown. **[10 marks]**

(b) The reliabilities of components after 250 hours of operation in the system shown are: $R_A =0.90$, $R_B = 0.85$, $R_{C1}=0.95$, $R_{C2}=0.98$, and $R_{C3}=0.9$

The system is configured such that, in the subsystem C1-C2-C3, any two of the components have to be functional for the system to operate. Determine the reliability of the system.

If it is assumed that the failure rate for the system is constant at that time, determine the MTBF of the system.
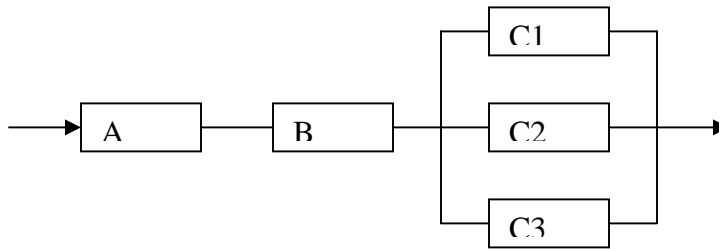
[10 marks]

2. . (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]**

3. Describe briefly the differences and the areas of application of 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. **[4 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%. **[8 marks]**

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

4. a) For the network shown, determine the following:
the "early start", "late finish" , the total float for each of the activities,
the critical path/paths and the probability of completing the project 2 days ahead
of schedule **[10 marks]**

activity	Mean Expected Duration (days)	Standard Deviation (days)	
A	4	1	
B	7	2	
C	12	2.5	
D	5	1	
E	10	2	
F	10	3	
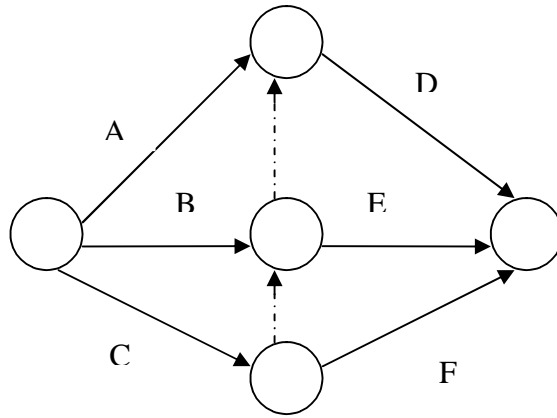
b) What is a 'Flow Augmenting path' in a maximal flow problem.
In the network shown, the capacities of the arcs are as indicated. The sources S1 and S2 have capacities of 10 and 14 respectively. Determine, using the 'Maximal flow algorithm', the flow in each arc when the maximum flow takes place through the network. Indicate the Flow augmenting paths used.   **[10 marks]**
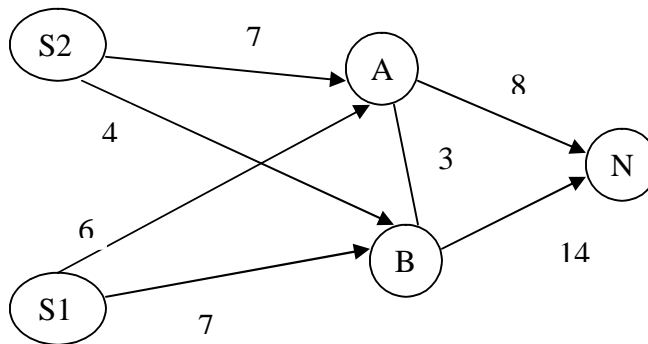
5.(a)   Data below refers to two machines capable of producing a component

	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]**

6.

Write short notes on **two** of the following: **(10 marks each)**
   (a) value analysis
   (b) material handling systems in factories
   (c) Job Design

7.   A company manufactures two products X and Y by blending three different types of feedstock A, B and C. There are two different blending processes which yield both the products, X & Y, but in different quantities. The blending quantities and the output from the two processes per production run are shown in the table. The table also shows the quantities of feedstock available and the minimum quantities that have to be produced. The profit per 1000kg of X &Y are €600 & €900 respectively. Formulate the LP model and determine by graphical means the number of runs required from each process to maximize profit and the profits made.

	INPUT Feedstock (in 1000 kg)			OUTPUT Products (in 1000 kg)	
	A	B	C	X	Y
Process 1	5	7	5	9	7
Process 2	3	9	4	5	9
Total available	1500	1900	1000		
Minimum Production				500	300

     [20 marks]