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THE NATIONAL UNIVERSITY OF IRELAND, CORK

COLAISTE NA hOLLSCOIL, CORCAIGH
UNIVERSITY COLLEGE, CORK

SUMMER EXAMINATIONS, 2003

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. What is understood by the terms "depreciation" and "capital allowance"

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.

2. 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.

3. Explain what is meant by "statistical quality control" giving the main areas of application and the techniques used.
A critical dimension of a component that is produced by an automatic machine has a design value of 50 ± 0.05 mm. On taking 10 samples of 5 items in each, the values obtained were 50.01 mm as the mean and 0.03mm as the mean sample range. Draw the control charts for the process and comment on the process capability. If the wear on the tooling causes the dimensions to increase at the rate of 0.01 mm per 1,000 components what is the production quantity between resets.
Explain the consequence of using the 'allowable drift'.

4. (a) Describe briefly a typical failure rate curve for a batch of components.
In the system shown, redundancy is built-in by having two components in parallel.
Reliability of each component is given by (with the usual notations)

$$R(t) = \bar{e}^{\lambda t}$$

If the failure rate of each component is 1 failure per 15,000 hours, determine the reliability of the system after 10,000 hours of operation

(b) Indicate briefly where RUN tests are used.

Determine using an Above/Below the mean (A/B) test, (with 95% confidence limits) whether the variation in the following set of observations is due to random causes

10.5, 10, 12, 11.5, 13, 12, 10, 9

given: expected no. of runs = $\frac{N}{2} + 1$

$^{\delta}A/B = \sqrt{\frac{N-1}{4}}$ where N is the number of observations

(c) A pilot study was carried out to examine the machine utilization in a factory. In the pilot study using 50 random observations, it was found that the machines were idle on 10 occasions.How many observations are required in the main study so that the results of the study on machine utilization is within ± 4% of the true value, if 95% confidence limits are acceptable.

5. A firm manufactures a component for use in its assembly plant. The production rate at the manufacturing facility is 5,000 items per week while the demand rate at the assembly facility is constant at 500 items per week. The components are sent to the assembly plant in batches at the end of the manufacturing cycle. The holding costs at the two facilities are €0.01 per week per component. The set up costs at the manufacturing facility is €500 per batch while there is **no** set-up costs at the assembly facility.
Sketch the stock charts (stock level vs time) at the two facilities. Starting from first principles determine the EOQ and the duration of the assembly cycle, so that the cost (per unit time) to the firm is a minimum.

If the demand at the assembly facility is variable with a mean of 500 per week and a standard deviation of 100 per week, determine the safety stock that must be maintained to give a service level of 99% (assume other parameters remain the same)

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

7. Explain briefly as to how costs can be controlled when the duration of a project is shortened.

For the net work shown determine the following:
(1) Early start, late finish and the float for each activity.
(2) Critical path or paths
(3) Probability of completing the project 2 days ahead of schedule.
(4) The minimum size of workforce required to complete the project on schedule assuming that the workers can carry out all tasks.

Activity	**Mean Duration days**	**Standard Deviation days**	**Resource Requirements Man-days**
A	5	1	25
B	3	.5	18
C	7	1	21
D	8	2	16
E	4	.5	20
F	5	1	15
G	2	.5	8
H	6	1	24
I	4	1	20
J	3	.5	15
K	7	1	21