

**CORK INSTITUTE OF TECHNOLOGY
INSTITIÚID TEICNEOLAÍOCHTA CHORCAÍ**

Semester 2 Examinations 2010/11

Module Title: Maths for Manufacturing

Module Code: MATH 6009

School: Business

**Programme Title: Higher Certificate in Good Manufacturing Practice and
Technology – Year 1**

Programme Code: SGMPR_6_Y1

External Examiner(s): Dr. P. Kirwan

Internal Examiner(s): Ms. J. English

Instructions: Answer THREE questions.
All questions carry equal marks (Total marks = 90)

Duration: 2 HOURS

Sitting: Summer 2011

Requirements for this examination: Formulae Attached, Mathematics Tables,
and Graph Paper.

Note to Candidates: Please check the Programme Title and the Module Title to ensure that you are attempting the correct examination.
If in doubt please contact an Invigilator.

Q1.

- a) Simplify, giving your answer in positive indices only

$$\frac{(a^2b^{-3})^2}{(ab)^{-1}} \times \frac{\sqrt[3]{a^3b^6c^9}}{\sqrt{a^2b^4}} \quad (6 \text{ marks})$$

- b) Solve for x:

$$\frac{4^x}{8^{2x-5}} = 2 \quad (6 \text{ marks})$$

- c) Evaluate and express your answer in scientific notation

$$\frac{(27.29 \times 10^4 - 14.67 \times 10^2)}{(3 \times 10^3 + 3 \times 10^2)} \quad (6 \text{ marks})$$

- d) The sag S at the centre of a wire is given by the formula: $S = \sqrt{\frac{3d(L-d)}{8}}$

Make L the subject of the formula and evaluate L , correct to 3 decimal places, when $d = 1.75$ and $S = 0.80$.

(6 marks)

- e) Evaluate the following correct to 2 decimal places.

$$a = \frac{BR^n(R-1)}{R^n - 1}, \text{ where } R=1.07, B=95500, n=8. \quad (6 \text{ marks})$$

Q2. The following table shows the turnover in millions of pounds of 100 private companies in Ireland.

Turnover (millions of euro)	Number of Companies
0 but less than 50	18
50 but less than 100	25
100 but less than 150	15
150 but less than 200	20
200 but less than 250	13
250 but less than 400	5
400 but less than 450	4

- (a) Calculate the mean and standard deviation for this distribution. (12 marks)
- (b) Calculate (i) the median and (ii) the mode of the data. (8 marks)
- (c) Calculate the Coefficient of Variation for the data. (4 marks)
- (d) Compute the coefficient of skewness and comment on the result obtained. (6 marks)

Q3. Over the past nine years, sales figures for a particular company have been recorded on a quarterly basis. The figures are listed below and are in €000's.

Quarterly Sales (€1000's):

23.8	28.1	23.2	22.5	21.3	22	23.2	27.4	23.5
30.1	29.9	20.7	24.6	26.5	21.1	24.6	21.6	24
27.2	20.3	23.1	23.4	27.8	20.4	25.4	23.1	25.6
23.2	21.7	21.2	22.9	22.7	22.9	20.5	21.3	21.9

- (a) Form a frequency distribution table with six classes of equal width. (12 marks)
- (b) Draw the corresponding ogive for the data. (10 marks)
- (c) Use the ogive to estimate (i) the median (ii) the third quartile and (iii) the Inter-Quartile Range (IQR) (8 marks)

Q4. The table below shows the income from green fees at the SANDY HILLS golf course for the years 2002 to 2004. The figures are recorded on a quarterly basis.

Income: €1000's

YEAR	QUARTER			
	I	II	III	IV
2008	142	423	715	185
2009	191	568	827	226
2010	245	692	934	271

- (a) Plot the data on a time series graph. (5 marks)
- (b) Calculate a four quarter centered moving average (*trend*) for the data and plot this on your graph in (i). (12 marks)
- (c) Calculate the seasonal variation (*seasonal index*) for each of the four quarters. (8 marks)
- (d) Seasonally adjust the figures for quarters III and IV in 2010. (5 marks)

Q5. A survey of eight houses in a given area was conducted in which the U-factor and the weekly heating cost for each house was determined. The results are tabulated as follows:

U-factor (W/Km²), (x)	1.3	1.2	1.1	1.1	1	0.9	0.8	0.7
Heating Costs (€'s), (y)	35	31	32	29	31	27	25	26

- (a) Plot the data on a scatter diagram. (5 marks)
- (b) Use the method of least squares to calculate the regression line of y in terms of x and plot the line on your graph in (a). (12 marks)
- (c) Calculate the co-efficient of correlation for the data and interpret your result. (7 marks)
- (d) If a U-factor of 0.5 (W/km²) is calculated, what would be the predicted weekly cost of heating the house? (6 marks)

Statistical Formulae

1. Mean :

$$\bar{x} = \frac{\sum fx}{\sum f}$$

2. Standard Deviation:

$$\sigma = \sqrt{\frac{\sum f(x-\bar{x})^2}{\sum f}} \quad \text{or} \quad \sigma = \sqrt{\frac{\sum fx^2}{\sum f} - \left(\frac{\sum fx}{\sum f}\right)^2}$$

3. Median = $L_M + C_M \left(\frac{\frac{1}{2}N - F_{M-1}}{f_M} \right)$

4. Mode = $L + C \left(\frac{D_1}{D_1 + D_2} \right)$

5. Skewness = $\frac{3(\text{Mean} - \text{Median})}{\sigma} = \frac{\text{Mean} - \text{Mode}}{S.D.}$

6. Coefficient of Variation = $\frac{\sigma}{\bar{x}} * 100$

7. Standard Units : $Z = \frac{x - \bar{x}}{\sigma}$

8. Least Square Line: $y = a + bx$

$$b = \frac{n \sum xy - \sum x \sum y}{n \sum x^2 - (\sum x)^2}$$

$$a = \frac{\sum y - b \sum x}{n}$$

9. Coefficient of Correlation:

$$r = \frac{n \sum xy - \sum x \sum y}{\sqrt{(n \sum x^2 - (\sum x)^2)(n \sum y^2 - (\sum y)^2)}}$$

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$$\text{Median} = L_M + C_M \left(\frac{\frac{1}{2}N - F_{M-1}}{f_M} \right)$$

$$\text{Mode} = L + C \left(\frac{D_1}{D_1 + D_2} \right)$$

$$\text{Skewness} = \frac{3(\text{Mean} - \text{Median})}{S.D.} = \frac{\text{mean} - \text{mode}}{\text{standard deviation}}$$

$$\text{Coefficient of Variation} = \frac{\sigma}{\bar{x}} \times 100$$

$$\text{Standard Units} \quad Z = \frac{x - \bar{x}}{\sigma}$$

Least Squares Line: $y = a + bx$

$$b = \frac{n \sum xy - \sum x \sum y}{n \sum x^2 - (\sum x)^2} \quad a = \frac{\sum y - b \sum x}{n}$$

Coefficient of Correlation:

$$r = \frac{n \sum xy - \sum x \sum y}{\sqrt{(n \sum x^2 - (\sum x)^2)(n \sum y^2 - (\sum y)^2)}}$$