

**CORK INSTITUTE OF TECHNOLOGY
INSTITIÚID TEICNEOLAÍOCHTA CHORCAÍ**

Autumn Examinations 2017/18

Module Title: Technological Mathematics 2 (Elec) (C.A.)

Module Code: MATH6045

School: School of Mechanical, Electrical & Process Engineering.

Programme Title: Bachelor of Engineering in Electronic Engineering – Year 1
Bachelor of Engineering (Honours) in Electronic Engineering – Year 1
Bachelor of Engineering in Electrical Engineering – Year 1
Bachelor of Engineering (Honours) in Electrical Engineering – Year 1

Programme Code: EELXE_7_Y1
EELES_8_Y1
EELEC_7_Y1
EEPSY_8_Y1

External Examiner: Dr. J. Cruickshank

Internal Examiners: Ms. M. Brennan, Mr. D. O'Shea.

Instructions: Answer all three questions.

Duration: 2 hours

Sitting: Autumn 2018

Requirements for this examination: Formulae & Tables Book

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

1. (a) Given the following complex numbers:

$$Z_1 = 12 - j5,$$

$$Z_2 = -2 + j3,$$

$$Z_3 = 8\angle 60^\circ,$$

$$Z_4 = 3\angle(-25^\circ),$$

$$Z_5 = 20e^{j\frac{2\pi}{3}}$$

and showing all your workings.

(i) Write Z_5 in rectangular form.

(ii) Write Z_4 in exponential form.

(iii) Evaluate $\frac{Z_1}{Z_2}$, giving your answer in rectangular form.

(iv) Evaluate $Z_3 \cdot Z_4$, giving your answer in polar form.

(v) Evaluate $(Z_4)^3$, giving your answer in polar form. (19 marks)

(b) A 200 volt, 50 hertz electrical circuit is comprised of a 25 ohm resistor in series with an inductive reactance of 30 ohms and a capacitive reactance of 20 ohms. Determine:

(i) The impedance in both rectangular form and polar form.

(ii) The current and the circuit phase angle.

(iii) The voltages across the resistor and the capacitor.

(iv) The capacitance. (15 marks)

2. (a) Differentiate each of the following:

(i) $y = 5x^2 - \frac{2}{3x^4} + 10\sqrt[5]{x}$

(ii) $y = (5\sin 4\theta)(3e^{2\theta})$

(iii) $y = \sqrt{3x^2 - 4x + 5}$

(iv) $y = \frac{\ln(3t-4)}{\cos(5t+2)}$ (20 marks)

(b) Determine the equation of the tangent to the curve $y = 2x^2 - 3x + 5$ at $x = 2$. (5 marks)

(c) The curve $f(x) = x^3 - 3x + 1$ has a local maximum, a local minimum and a point of inflexion. Find the coordinates of each and use differentiation to distinguish between them. (8 marks)

3. (a) Integrate each of the following:

(i) $\int \left(\frac{5x^7 - 4x^3 + 2x^2 - 10x}{x^3} \right) dx$

(ii) $\int (8\theta + 8)(\cos(\theta^2 + 2\theta)) d\theta$ (12 marks)

(b) Find the particular solution of $f'(x) = 10x - 5$, given that $f(2) = 5$. (3 marks)

(c) Evaluate $\int_1^4 (2e^{0.5t} + 3t^2) dt$ (4 marks)

(d) Find the area enclosed between the curve $y = x^2 + 4x - 12$ and the x -axis. (9 marks)

(e) An alternating voltage is given by $v = 50\sin(20\pi t)$ volts. Use integration to find the mean value over the interval $t = 0$ to $t = 0.025$ seconds. (5 marks)