SINGAPORE POLYTECHNIC

2019/2020 SEMESTER ONE MID SEMESTER TEST

ENGINEERING MATHEMATICS II Time allowed: 1.5 hrs

2nd Year Full-Time

School of Chemical and Life Sciences
DCHE

School of Electrical and Electronic Engineering
DASE, DCPE, DEB, DEEE, DES, DESM

School of Mechanical and Aeronautical Engineering
DARE, DBEN, DCEP, DME, DMRO

Instructions:

1. The Singapore Polytechnic Examination rules are to be complied with.
2. This paper consists of 3 **printed** pages.
3. Answer all the 5 questions.
4. Unless otherwise stated, correct all your decimal answers to **two** decimal places.
5. Except for sketches, graphs and diagrams, no solutions are to be written in pencil. Failure to do so will result in loss of marks.

1. (a) Integrate the following:

(i) $\int\left[\left(4u-1\right)^5+\frac{7}{2u+5}\right]du$

(ii) $\int 2\sin^2 2\theta\, d\theta$

(iii) $\int \cot^2 4\theta\, d\theta$

(b) Evaluate the integral $\int_{-1}^{1}\frac{5}{e^{3x-2}}\,dx$.

(c) Find the root mean square (RMS) value of $y=\frac{1}{\sqrt{3t+1}}$ over the interval from $t=1$ to $t=3$.

(22 marks)

2. (a) By using an appropriate substitution, find $\int x^2\left(4+x^3\right)^{20}\,dx$.

(b) By using the substitution $u=1+e^x$, evaluate $\int_0^1\sqrt{e^{2x}\left(1+e^x\right)}\,dx$.

(18 marks)

3. Using integration by parts, find the following integrals:

(a) $\int x\cos 3x\,dx$

(b) $\int\left(3x-1\right)\ln\left(3x-1\right)dx$ (20 marks)

4. (a) Write down the partial fractions for $\frac{1}{x^2\left(x+1\right)\left(x^2+1\right)}$, **without evaluating the coefficients**.

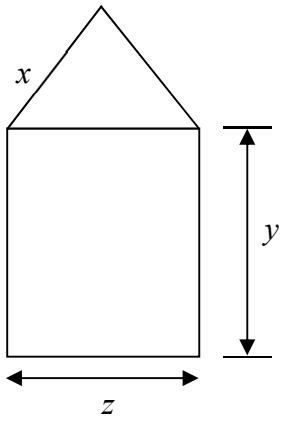
(b) Find $\int\frac{1}{\left(x+2\right)\left(x+1\right)^2}\,dx$

(c) By completing the square, find $\int\frac{1}{x^2+2x+5}\,dx$

Hence, find $\int\frac{1}{10x^2+20x+50}\,dx$

(20 marks)

5. A metal sheet (see figure) is in the form of a rectangle surmounted by an isosceles triangle. Suppose A (m^2) is the area of the metal sheet, x (m) is the equal side of the isosceles triangle, y (m) and z (m) are the height and width of the rectangular part respectively.



(a) Show that the area of the metal sheet can be expressed as $A = f(x, y, z) = \frac{1}{4} z\sqrt{4x^2 - z^2} + yz$.

(b) Find the partial derivatives $\frac{\partial A}{\partial x}$, $\frac{\partial A}{\partial y}$ and $\frac{\partial A}{\partial z}$.

(c) If $\frac{dx}{dt} = 0.015$ m/s, $\frac{dy}{dt} = 0.01$ m/s, $\frac{dz}{dt} = 0.01$ m/s, use partial differentiation to find the rate of change in A when $x = 2$m, $y = 5$m, and $z = 3$m.

(20 marks)

- End of Paper -