UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2012/2013

COURSE NAME	:	ENGINEERING MATHEMATICS II
COURSE CODE	:	DAS 20603
PROGRAMME	:	3 DAE
EXAMINATION DATE	:	MARCH 2013
DURATION	:	3 HOURS
INSTRUCTIONS	:	ANSWER **ALL** QUESTIONS IN **PART A** AND **THREE (3)** QUESTIONS IN **PART B**

THIS QUESTION PAPER CONSISTS OF SIX (6) PAGES

PART A

Q1 Show that the following differential equations is either separable, homogeneous, or exact . Then solve the equations in the form of y.

(a) $\dfrac{dy}{dx}=\dfrac{e^{2x}+7}{y}$

(10 marks)

(b) $\dfrac{dy}{dx}=\dfrac{y^2+x^2}{2xy}$

(10 marks)

Q2 Given the ordinary differential equation $\dfrac{d^2y}{dx^2}+2\dfrac{dy}{dx}+5y=16e^x+\sin 2x$.

(a) Solve the homogeneous equation $\dfrac{d^2y}{dx^2}+2\dfrac{dy}{dx}+5y=0$.

(6 marks)

(b) Solve the homogeneous equation $\dfrac{d^2y}{dt^2}+2\dfrac{dy}{dt}+5y=16e^x$.

(7 marks)

(c) Hence find the solution of the ordinary differential equation $\dfrac{d^2y}{dx^2}+2\dfrac{dy}{dx}+5y=16e^x+\sin 2x$.

(7 marks)

PART B

Q3 As part of your part-time job at a restaurant, you learned to cook up a big pot of soup late at night, just before closing time, so that there would be plenty of soup to feed customers the next day. You also found out that, while refrigeration was essential to preserve the soup overnight, the soup was too hot to be put directly into the fridge when it was ready. The soup had just boiled at 100 degrees C, and the fridge was not powerful enough to accommodate a big pot of soup if it was any warmer than 20 degrees C. You discovered that by cooling the pot in a sink full of cold water, (kept running, so that its temperature was roughly constant at 5 degrees (C) and stirring occasionally, you could bring the temperature of the soup to 60 degrees C in ten minutes.

(a) Find the rate of change of the temperature dT/dt in term of T and T_s, given the temperature of the soup $T(t)$ and the ambient temperature T_s

(4 marks)

(b) Show that $T - T_s = Ae^{-kt}$.

(4 marks)

(c) Using the observed initial temperatures of the soup, $T(0) = 100$, find the constant A. Hence find $T(t)$.

(4 marks)

(d) Using the observed temperatures of the soup, given $T(10) = 60$, find the constant k.

(4 marks)

(e) Hence, how long before closing time should the soup be ready so that you could put it in the fridge and leave on time?

(4 marks)

Q4 (a) Evaluate each integral.

(i) $\int (e^x - \cos x)\, dx$

(ii) $\int x^2\left(x - 3x^3\right) dx$

(iii) $\int \frac{x^7 + 4x^5 - 2x^2 - 7}{x^3} \, dx$

(10 marks)

(b) Evaluate the integral using the appropriate formula.

(i) $\int \frac{2x+6}{(x^2 + 6x + 3)^2} \, dx$

(ii) $\int \frac{6}{x^2 - 2x - 8} \, dx$

(10 marks)

Q5 (a) Find the area of the region bounded above by $y = x + 6$, bounded below by $y = x^2$, and bounded on the sides by the lines $x = -1$ and $x = 3$.

(8 marks)

(b) Find the volume of the solid generated when the region R in the first quadrant enclosed between $y = 2x$ and $y = x^2$ is revolved about the y – axis.

(12marks)

Q6 Show that the following differential equations is either separable, homogeneous, or exact . Then solve the equations in the form of y.

(a) $\frac{dy}{dx} = \frac{x^2 + 2}{y}$

(10 marks)

(b) $(y^2 - 2x)dx + (2xy)dy = 0$

(10 marks)

Q7 Show that the following differential equations is either separable, homogeneous, or exact . Then solve the equations in the form of y.

(a) $\dfrac{dy}{dx} = 3y - xy$

(6 marks)

(b) $\dfrac{dy}{dx} = \dfrac{x+y}{x-y}$

(7 marks)

(c) $2xydx + (x^2 - y^2)dy = 0$

(7 marks)

- END OF QUESTION -

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Formula

Table 1 : Laplace transform.

$\mathcal{L}\{f(t)\}=\int_0^\infty f(t)e^{-st}\,dt=F(s)$

$f(t)$	$F(s)$
k	$\frac{k}{s}$
$t^n,\ n=1,2,..$	$\frac{n!}{s^{n+1}}$
e^{at}	$\frac{1}{s-a}$
$\sin at$	$\frac{a}{s^2+a^2}$
$\cos at$	$\frac{s}{s^2+a^2}$
$\sinh at$	$\frac{a}{s^2-a^2}$
$\cosh at$	$\frac{s}{s^2-a^2}$
$e^{at}f(t)$	$F(s-a)$
$t^n f(t),\ n=1,2,..$	$(-1)^n\frac{d^nF(s)}{ds^n}$

Table 2 : Indefinite differentiation

$\frac{d}{dx}\ln u=\frac{1}{u}\cdot\frac{du}{dx}$
$\frac{d}{dx}e^u=e^u\cdot\frac{du}{dx}$
$\frac{d}{dx}\sin u=\cos u\cdot\frac{du}{dx}$
$\frac{d}{dx}\tan u=\sec^2 u\cdot\frac{du}{dx}$
$\frac{d}{dx}\cos u=-\sin u\cdot\frac{du}{dx}$

Table 3 : Indefinite integral

$\int \sec^2 x\,dx=\tan x+c$

$\int \operatorname{cosec}^2 x\,dx=-\cot x+c$

$\int \sec x\tan x\,dx=\sec x+c$

Table 4 : Application of Integration

$A=\int_a^b[f(x)-g(x)]\,dx$ or $A=\int_c^d[u(y)-v(y)]\,dy$

$V=\int_a^b 2\pi x f(x)\,dx$ or $V=\int_c^d 2\pi y g(y)\,dy$

Table 5 : Solution of particular solution $ay''+by'+cy=f(x)$

$f(x)$	$y_k(x)$
$P_n(x)=A_n x^n+A_{n-1}x^{n-1}+..+A_1x+A_0$	$x^r(B_n x^n+B_{n-1}x^{n-1}+..+B_1x+B_0)$
$Ce^{\alpha x}$	$x^r(Pe^{\alpha x})$
$C\cos\beta x$ atau $C\sin\beta x$	$x^r(p\ \mathrm{kos}\ \beta x+q\sin\beta x)$

Notes : r is the smallest non negative integers to ensure no alike terms between $y_k(x)$ and $y_h(x)$.