UNIVERSITI MALAYA
UNIVERSITY OF MALAYA

PEPERIKSAAN IJAZAH SARJANA MUDA KEJURUTERAAN
EXAMINATION FOR THE DEGREE OF BACHELOR OF ENGINEERING

SESI AKADEMIK 2018/2019 : SEMESTER I
ACADEMIC SESSION 2017/2018 : SEMESTER I

KIX1002 : Matematik Kejuruteraan 2
Engineering Mathematics 2

Januari 2019
January 2019

Masa : 2 jam
Time : 2 hours

ARAHAN KEPADA CALON :
INSTRUCTIONS TO CANDIDATES :

Jawab semua soalan.
Answer all questions.

(Kertas soalan ini mengandungi 4 soalan dalam 7 halaman yang dicetak)
(This question paper consists of 4 questions on 7 printed pages)

Soalan 1
Question 1

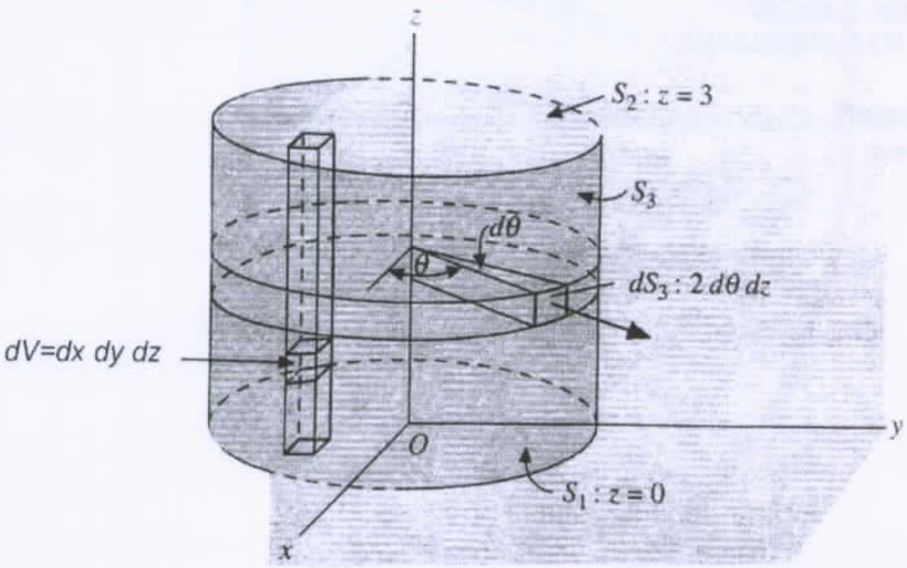
(a) Cari medan vektor fluks $\boldsymbol{F}\,(x,y,z) = -y\boldsymbol{i} + x\boldsymbol{j} - z\boldsymbol{k}$ yang melalui sfera unit $x^2 + y^2 + z^2 = 1$ yang mempunyai orientasi ke bawah.

Find the flux of vector field $\boldsymbol{F}\,(x,y,z) = -y\boldsymbol{i} + x\boldsymbol{j} - z\boldsymbol{k}$ through the unit sphere $x^2 + y^2 + z^2 = 1$ that has downward orientation.

(7 markah / *marks*)

(b) Sahkan teorem penyelewengan untuk $\boldsymbol{A} = 4x\boldsymbol{i} - 2y^2\boldsymbol{j} + z^2\boldsymbol{k}$ diambil alih rantau yang dibatasi oleh $x^2 + y^2 = 4$, z=0 and z=3.

Verify the divergence theorem for $\boldsymbol{A} = 4x\boldsymbol{i} - 2y^2\boldsymbol{j} + z^2\boldsymbol{k}$ taken over the region bounded by $x^2 + y^2 = 4$, z=0 and z=3.



Rajah S1
Figure S1

(8 markah / *marks*)

Soalan 2
Question 2

(a) Cari isipadu dibawah $z = \sqrt{4 - r^2}$ di atas bulatan suku di dalam $x^2 + y^2 = 4$ di dalam kuadran pertama.

Find the volume under $z = \sqrt{4 - r^2}$ above the quarter circle inside $x^2 + y^2 = 4$ in the first quadrant.

(7 markah / *marks*)

(b) Cari $\iiint_E 16z\,dV$ di mana E ialah bahagian atas sfera $x^2 + y^2 + z^2 = 1$

Find $\iiint_E 16z\,dV$ where E is the upper half of the sphere $x^2 + y^2 + z^2 = 1$

(8 markah / *marks*)

Soalan 3
Question 3

(a) Persamaan pembezaan berikut mempunyai satu titik tunggal di x = 0, dapatkan persamaan hubungan perulangan.

The following differential equation has a singular point at x = 0, find its recurrence relation.

$$x^2y'' + xy' + x^2y = 0$$

(8 markah / *marks*)

(b) Selesaikan persamaan di bawah dengan menggunakan transformasi Laplace.

Solve the following equation using Laplace transform.

$$y(t) - \int_0^t y(\tau)\cosh(t-\tau)d\tau = e^t$$

(7 markah / *marks*)

Soalan 4
Question 4

Diberikan suatu persamaan gelombang

Given a wave equation

$$\frac{\partial^2 u}{\partial x^2} = \frac{\partial^2 u}{\partial t^2}, \qquad 0 \le x \le 4, \qquad t > 0$$

dengan syarat-syarat sempadan

with boundary conditions

$$u(0,t) = 0, \quad u(4,t) = 0, \qquad t > 0$$

dan syarat-syarat awal

and initial conditions

$$u(x,0) = f(x) = \sin\tfrac{\pi x}{4}, \qquad 0 \le x \le 4$$

$$\left.\frac{\partial u}{\partial t}\right|_{t=0} = g(x) = \begin{cases} 0, & 0 \le x \le 1 \\ a, & 1 \le x \le 3 \\ 0, & 3 \le x \le 4 \end{cases}$$

(a) Dengan menggunakan kaedah pemisahan pembolehubah, dapatkan dua persamaan perbezaan biasa (ODE). Nyatakan andaian yang dibuat dan gunakan $-\lambda$ sebagai pemalar pemisahan.

Using separation of variables method, obtain two ordinary differential equations (ODEs). State the assumption made and use $-\lambda$ as the separation constant.

(3 markah / *marks*)

(b) Dengan mempertimbangkan tiga kes: $\lambda = 0$, $\lambda = -\alpha^2 < 0$ dan $\lambda = \alpha^2 > 0$, selesaikan persamaan perbezaan tersebut. Kemudian pertimbangkan satu kes untuk mendapatkan nilai eigen dan fungsi eigen.

By considering three cases: $\lambda = 0$, $\lambda = -\alpha^2 < 0$, and $\lambda = \alpha^2 > 0$, solve the differential equations. Then, consider one case to obtain the eigenvalue and eigenfunction.

(7 markah / *marks*)

(c) Selesaikan masalah nilai sempadan dengan mempertimbangkan syarat-syarat awal dan menggunakan siri Fourier.

Solve the boundary value problem by considering the initial conditions and using Fourier series.

(5 markah / *marks*)

TAMAT

END

Lampiran A / *Appendix A*

Koordinat Cartesian ke Sfera
Cartesian to Spherical coordinates

$$x = r \sin\theta \cos\emptyset$$
$$y = r \sin\theta \sin\emptyset$$
$$z = r \cos\theta$$
$$dS = r^2 \sin\theta \, d\theta d\emptyset$$
$$dV = r^2 \sin\theta \, d\theta d\emptyset dz$$

Koordinat Cartesian ke Silinder
Cartesian to Cylindrical coordinates

$$x = r \cos\theta$$
$$y = r \sin\theta$$
$$z = z$$
$$dV = r dr d\theta dz$$

Jadual Jelmaan Laplace
Laplace Transform Table

$f(t)$	$F(s)$	$f(t)$	$F(s)$
1	$\frac{1}{s}$	$af(t) + bg(t)$	$aF(s) + bG(s)$
$\delta(t)$	1	$u(t-a)$	$\frac{e^{-as}}{s}$
t	$\frac{1}{s^2}$	$\delta(t-a)$	e^{-as}
$t^n,\ n = 1,2,3, \ldots$	$\frac{n!}{s^{n+1}}$	$f(t-a)u(t-a)$	$e^{-as}F(s)$
e^{at}	$\frac{1}{s-a}$	$e^{at}f(t)$	$F(s-a)$
te^{at}	$\frac{1}{(s-a)^2}$	$\frac{df}{dt}$	$sF(s) - f(0)$
$t^n e^{at},\ n = 1,2,3, \ldots$	$\frac{n!}{(s-a)^{n+1}}$	$\frac{d^2f}{dt^2}$	$s^2F(s) - sf(0) - f'(0)$
$\sin\omega t$	$\frac{\omega}{s^2+\omega^2}$	$\frac{d^nf}{dt^n}$	$s^nF(s) - s^{n-1}f(0) - \cdots - f^{(n-1)}(0)$
$\cos\omega t$	$\frac{s}{s^2+\omega^2}$	$\int_0^t f(\tau)\, d\tau$	$\frac{1}{s}F(s)$

$e^{at}\sin\omega t$	$\dfrac{\omega}{(s-a)^2+\omega^2}$	$tf(t)$	$-\dfrac{d}{ds}F(s)$
$e^{at}\cos\omega t$	$\dfrac{s-a}{(s-a)^2+\omega^2}$	$\dfrac{f(t)}{t}$	$\int_s^\infty F(s)ds$
$\sinh\omega t$	$\dfrac{\omega}{s^2-\omega^2}$	$f(t)*g(t)$	$F(s)G(s)$
$\cosh\omega t$	$\dfrac{s}{s^2-\omega^2}$		

Lampiran B / *Appendix B*

The Fourier series of a function f defin-ed on the interval $(-p, p)$ is given by

$$f(x)=\frac{a_0}{2}+\sum_{n=1}^{\infty}\left(a_n\cos\frac{n\pi}{p}x+b_n\sin\frac{n\pi}{p}x\right)$$

where

$$a_0=\frac{1}{p}\int_{-p}^{p}f(x)dx$$

$$a_n=\frac{1}{p}\int_{-p}^{p}f(x)\cos\frac{n\pi}{p}x\,dx$$

$$b_n=\frac{1}{p}\int_{-p}^{p}f(x)\sin\frac{n\pi}{p}x\,dx$$

The Fourier Cosine series of an even function on the interval $(-p, p)$ is

$$f(x)=\frac{a_0}{2}+\sum_{n=1}^{\infty}a_n\cos\frac{n\pi}{p}x$$

where

$$a_0=\frac{2}{p}\int_{0}^{p}f(x)dx$$

$$a_n=\frac{2}{p}\int_{0}^{p}f(x)\cos\frac{n\pi}{p}x\,dx$$

The Fourier Sine series of an odd function on the interval $(-p, p)$ is

$$f(x)=\sum_{n=1}^{\infty}b_n\sin\frac{n\pi}{p}x$$

where

$$b_n=\frac{2}{p}\int_{0}^{p}f(x)\sin\frac{n\pi}{p}x\,dx$$

Trigonometric Identities

$$\sin x \sin y = \frac{1}{2}[\cos(x-y) - \cos(x+y)]$$

$$\cos x \cos y = \frac{1}{2}[\cos(x+y) + \cos(x-y)]$$

$$\sin x \cos y = \frac{1}{2}[\sin(x+y) + \sin(x-y)]$$

$$\cos^2 x = \frac{1}{2}[1 + \cos 2x]$$

$$\sin^2 x = \frac{1}{2}[1 - \cos 2x]$$

TAMAT
END