**UNIVERSITI MALAYSIA PERLIS**

Peperiksaan Akhir Semester Pertama
Sidang Akademik 2025/2026

Januari - Februari 2026

**SMQ11203 – Mathematics for Engineering Technology II**
***[Matematik untuk Teknologi Kejuruteraan II]***

Masa: 3 jam

Please make sure that this question paper has **TEN (10)** printed pages including this front page before you start the examination.
*[Sila pastikan kertas soalan ini mengandungi **SEPULUH (10)** muka surat yang bercetak termasuk muka hadapan sebelum anda memulakan peperiksaan ini.]*

This question paper has **FOUR (4)** questions. Answer **ALL** the questions.
*[Kertas soalan ini mengandungi **EMPAT (4)** soalan. Jawab **SEMUA** soalan.]*

*Dicetak oleh Unit Peperiksaan & Pengijazahan, Bahagian Pengurusan Akademik, Pusat Pengurusan Akademik UniMAP*

**(CO1, PO1, C3)**

**Question 1**
***[Soalan 1]***

(a) Determine whether the following statement is **TRUE** or **FALSE**.
*[Tentukan sama ada pernyataan berikut adalah **BETUL** atau **SALAH**.]*

(i) The characteristic equation for $y''-4y'+4y=0$ is $m^2-4m+4=0$.
*[Persamaan cirian bagi $y''-4y'+4y=0$ adalah $m^2-4m+4=0$.]*

(1 Mark/ *Markah)*

(ii) The roots of the equation $y''+25y=0$ is $m=\pm 25i$.
*[Punca-punca bagi persamaan $y''+25y=0$ adalah $m=\pm 25i$.]*

(1 Mark/ *Markah)*

(b) Find the general solution for the following second order homogeneous differential equation.
*[Dapatkan penyelesaian am bagi persamaan pembezaan homogen peringkat kedua berikut.]*

(i) $-2y''-7y'-6y=0$

(3 Marks/ *Markah)*

(ii) $16y''+40y'+25y=0$

(3 Marks/ *Markah)*

(c) Given the second order homogeneous differential equation as follows,
*[Diberi persamaan pembezaan homogen peringkat kedua seperti berikut,]*

$$y''-2y'-15y=0.$$

(i) Show that the general solution is $y=Ae^{5x}+Be^{-3x}$.
*[Tunjukkan bahawa penyelesaian am adalah $y=Ae^{5x}+Be^{-3x}$.]*

(3 Marks/ *Markah)*

(ii) From question 1(c)(i), find the particular solution when $y(0)=2$ and $y'(0)=-2$.
*[Daripada soalan 1(c)(i), dapatkan penyelesaian khusus apabila $y(0)=2$ dan $y'(0)=-2$.]*

(9 Marks/ *Markah)*

**(CO1, PO1, C3)**

**Question 2**
***[Soalan 2]***

(a) Determine the possible particular solution, $y_p$ for the following homogeneous solution, $y_h$ and function $f(x)$.

*[Tentukan penyelesaian khusus, $y_p$ yang mungkin bagi penyelesaian homogen, $y_h$ dan fungsi $f(x)$ yang berikut.]*

(i) $y_h = Ae^{-5x} + B \; ; \; f(x) = 4x$

(3 Marks/ *Markah)*

(ii) $y_h = Ae^{2x} + Be^{3x} \; ; \; f(x) = -3e^{3x}$

(3 Marks/ *Markah)*

(iii) $y_h = (A + Bx)e^{4x} \; ; \; f(x) = 2\sin(3x)$

(3 Marks/ *Markah)*

(b) By using the method of undetermined coefficient, solve the following second order non-homogeneous differential equation

*[Dengan menggunakan kaedah pekali tak tentu, selesaikan persamaan pembezaan peringkat kedua takhomogen berikut]*

$$\frac{d^2y}{dx^2} - 6\frac{dy}{dx} + 9y = 9e^{-3x}.$$

(i) Find the homogeneous solution, $y_h$.

*[Dapatkan penyelesaian homogen, $y_h$.]*

(3 Marks/ *Markah)*

(ii) Find the particular solution, $y_p$.

*[Dapatkan penyelesaian khusus, $y_p$.]*

(7 Marks/ *Markah)*

(iii) Find the general solution, $y = y_h + y_p$.

*[Dapatkan penyelesaian umum, $y = y_h + y_p$.]*

(1 Marks/ *Markah)*

**(CO2, PO1, C4)**

**Question 3**
***[Soalan 3]***

(a) Find the inverse Laplace transform for the following functions.
*[Dapatkan jelmaan Laplace songsang bagi fungsi-fungsi berikut.]*

(i) $F(s)=\dfrac{1}{s+7}$

(1 Mark/ *Markah)*

(ii) $F(s)=\dfrac{s}{s^2-64}$

(1 Mark/ *Markah)*

(iii) $F(s)=\dfrac{3}{s+9}$

(1 Mark/ *Markah)*

(iv) $F(s)=\dfrac{s}{s^2+16}$

(1 Mark/ *Markah)*

(b) By using appropriate properties, find the inverse Laplace transform for
*[Dengan menggunakan sifat-sifat yang bersesuaian, dapatkan jelmaan Laplace songsang bagi]*

(i) $F(s)=\dfrac{2s-10}{s^2+16}$.

(5 Marks/ *Markah)*

(ii) $F(s)=\dfrac{(s+4)+6}{(s+4)^2+9}$.

(6 Marks/ *Markah)*

(c) Given the differential equation
*[Diberikan persamaan pembezaan]*

$$y'' + 2y' - 3y = 5e^{2t}; \quad y(0) = 0,\ y'(0) = 0.$$

(i) By using Laplace transform, show that
*[Dengan menggunakan jelmaan Laplace, tunjukkan bahawa]*

$$Y(s) = \frac{5}{(s-2)(s^2+2s-3)}.$$

(5 Marks/ *Markah)*

(ii) Solve $Y(s)$ in question 3(c)(i).
*[Selesaikan $Y(s)$ pada soalan 3(c)(i).]*

(10 Marks/ *Markah)*

**(CO3, PO1, C4)**

**Question 4**
***[Soalan 4]***

(a) Determine whether the following function is odd, even or neither.
*[Tentukan sama ada fungsi berikut adalah fungsi ganjil, genap atau bukan kedua-duanya.]*

(i) $f(x) = 3x^2 + 7\cos(x)$

(3 Marks/ *Markah)*

(ii) $f(x) = x^3 + \sin(x)$

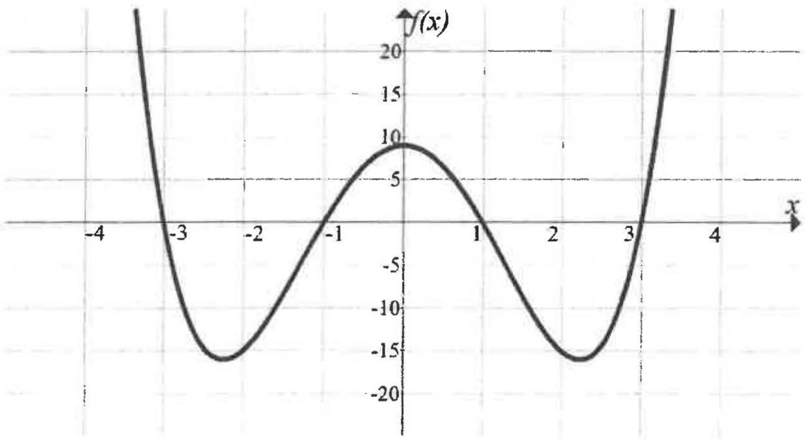
(3 Marks/ *Markah)*

(iii) $f(x) = (\cos(x))(2x^2 + 4x)$

(3 Marks/ *Markah)*

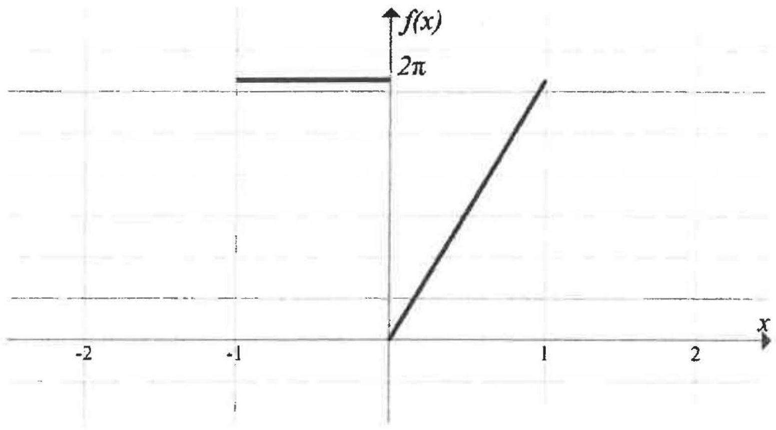
(b) Identify whether the following graph is odd, even or neither. Justify your reason.
*[Kenal pasti sama ada graf berikut adalah fungsi ganjil, genap atau bukan kedua-duanya. Nyatakan alasan anda.]*

(i)



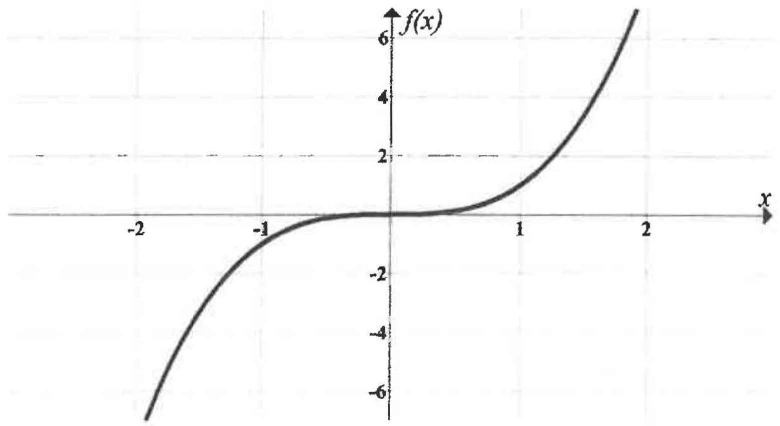

(2 Marks/ *Markah)*

(ii)




(2 Marks/ *Markah)*

(iii)




(2 Marks/ *Markah)*

(c) A periodic function is defined as
*[Suatu fungsi berkala ditakrifkan sebagai]*

$$f(x)=\begin{cases}0, & -\pi<x\leq 0,\\ 2, & 0\leq x\leq \pi,\\ f(x+2\pi). & \end{cases}$$

Find Fourier coefficients $a_0$, $a_n$ and $b_n$. Then, form the Fourier series $f(x)$.
*[Dapatkan pekali Fourier $a_0$, $a_n$ dan $b_n$. Seterusnya, bentukkan siri Fourier $f(x)$.]*

(15 Marks/ *Markah)*

**Appendix**
***[Lampiran]***

**Homogeneous Equation Formula**

| Types of root | $m$ | Solution |
|---|---|---|
| Real and Different | $m_1 \neq m_2$ | $y = Ae^{m_1 x} + Be^{m_2 x}$ |
| Real and Equal | $m_1 = m_2$ | $y = (A + Bx)e^{mx}$ |
| Complex Number | $m = \alpha \pm \beta i$ | $y = e^{\alpha x}\left[A\cos(\beta x) + B\sin(\beta x)\right]$ |

**Table of Laplace Transform**

| $f(t)$ | $\mathcal{L}\{f(t)\} = F(s)$ | $f(t)$ | $\mathcal{L}\{f(t)\} = F(s)$ |
|---|---|---|---|
| $a$ | $\frac{a}{s}$ | $e^{at}\sin(bt)$ | $\frac{b}{(s-a)^2 + b^2}$ |
| $t^n,\ n = 1,2,3,..$ | $\frac{n!}{s^{n+1}}$ | $e^{at}\cos(bt)$ | $\frac{s-a}{(s-a)^2 + b^2}$ |
| $e^{at}$ | $\frac{1}{s-a}$ | $t^n e^{at}$ | $\frac{n!}{(s-a)^{n+1}}$ |
| $\sin(at)$ | $\frac{a}{s^2 + a^2}$ | $t^n f(t)$ | $(-1)^n \frac{d^n}{ds^n}\left[F(s)\right]$ |
| $\cos(at)$ | $\frac{s}{s^2 + a^2}$ | $e^{at} f(t)$ | $F(s-a)$ |
| $\sinh(at)$ | $\frac{a}{s^2 - a^2}$ | $y'(t)$ | $sY(s) - y(0)$ |
| $\cosh(at)$ | $\frac{s}{s^2 - a^2}$ | $y''(t)$ | $s^2Y(s) - sy(0) - y'(0)$ |

**Differentiation and Integration**

| Derivative Formula | Integral Formula |
|---|---|
| $\frac{d}{dx}[x]=1$ | $\int 1dx = x+C$ |
| $\frac{d}{dx}\left[x^n\right]=nx^{n-1}$ where $n$ is any real number. | $\int x^n dx = \frac{x^{n+1}}{n+1}+C$ where $n$ is any real number. |
| $\frac{d}{dx}\left[e^{kx}\right]=ke^{kx}$ where $k$ is a constant. | $\int e^{kx}dx=\frac{1}{k}e^{kx}+C$ where $k$ is a constant. |
| $\frac{d}{dx}\left[\sin(kx)\right]=k\cos(kx)$ where $k$ is a constant. | $\int \sin(kx)\ dx=-\frac{1}{k}\cos(kx)+C$ where $k$ is a constant. |
| $\frac{d}{dx}\left[\cos(kx)\right]=-k\sin(kx)$ where $k$ is a constant. | $\int \cos(kx)\ dx=\frac{1}{k}\sin(kx)+C$ where $k$ is a constant. |

**Fourier Series Formula**

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

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

$$a_n=\frac{1}{L}\int_{-L}^{L}f(x)\cos\left(\frac{n\pi x}{L}\right)dx$$

$$b_n=\frac{1}{L}\int_{-L}^{L}f(x)\sin\left(\frac{n\pi x}{L}\right)dx$$

**Trigonometry Formula**

$$\sin(n\pi)=\sin(-n\pi)=0$$

$$\cos(n\pi)=\cos(-n\pi)=(-1)^n$$

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