UNIVERSITI MALAYA
UNIVERSITY OF MALAYA

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

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

KIX1001 : Matematik Kejuruteraan 1
Engineering Mathematics 1

Jan 2018 Masa: 2 jam
Jan 2018 *Time: 2 hours*

ARAHAN KEPADA CALON:
INSTRUCTIONS TO CANDIDATES:

Calon dikehendaki menjawab semua soalan.
Answer all questions.

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

SOALAN 1
QUESTION 1

(a) Diberi fungsi $f(x) = \frac{2x+1}{x-2}$

Given function of $f(x) = \frac{2x+1}{x-2}$

(i) Cari $f'(x)$
Find $f'(x)$

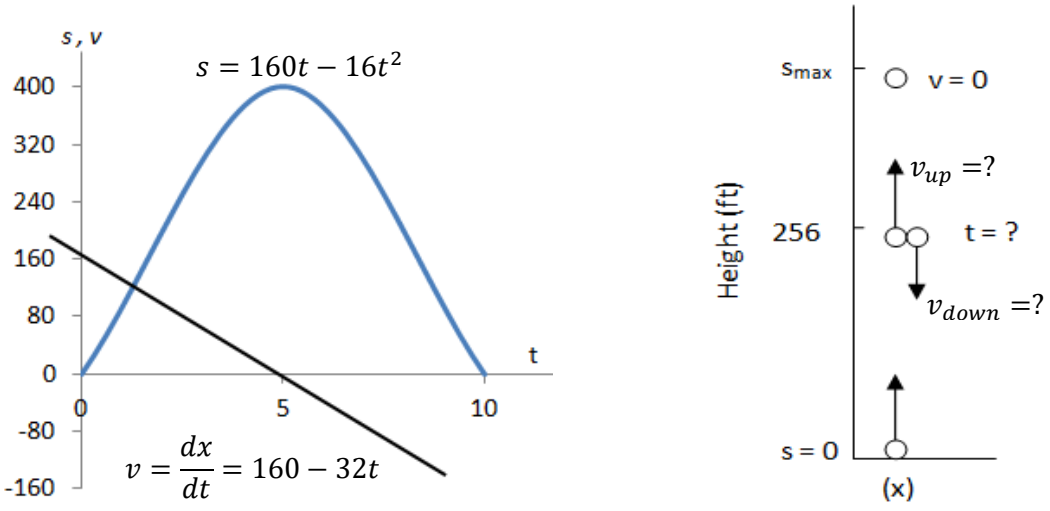
(2 markah/*marks*)

(ii) Kira $\lim_{x\to 3} f(x)$
Calculate $\lim_{x\to 3} f(x)$

(1 markah/*mark*)

(b) Satu lonjatan dinamik telah mengangkat batu ke atas dengan kelajuan 160 kaki/saat seperti ditunjukkan dalam Rajah S1. Diberikan ketinggian batu tersebut adalah $s = -16t^2 + 160t$. Nota: Graf *s* dan *v* adalah dalam fungsi masa; *s* mempunya nilai terbesar apabila $v = ds/dt = 0$.

A dynamite blast blows a heavy rock straight up with a launch velocity of 160 ft/sec as shown in Figure Q1. Its height is given by $s = -16t^2 + 160t$. *Note: The graphs of s and v as functions of time; s is largest when* $v = ds/dt = 0$.



Rajah S1
Figure Q1

(i) Sejauh manakah batu itu terangkat?
How high does the rock go?

(3 markah/*marks*)

(ii) Apakah kelajuan apabila batu tersebut berada pada 256 kaki di atas tanah pada kedudukan di atas dan pada kedudukan di bawah?
What are the velocities when the rock is 256 ft. above the ground on the way up and on the way down?

(3 markah/*marks*)

(iii) Apakah pecutan batu tersebut pada ketinggian 256 kaki?
What is the acceleration of the rock at 256 ft?

(3 markah/*marks*)

(iv) Bilakah batu itu akan jatuh ke tanah? Apakah kelajuannya?
When does the rock hit the ground? At what velocity?

(3 markah/*marks*)

SOALAN 2
QUESTION 2

(a) Tentukan derivatif separa pertama dan kedua bagi fungsi $2x^4\sin 10y$.
Determine the first and second order partial derivatives of the function $2x^4 sin10y$.

(10 markah/*marks*)

(b) Cari satah tangen dan garis normal ke sfera $x^2 + y^2 + z^2 = 36$ di titik (2, -2, 4).
Find the tangent plane and normal line to the sphere $x^2 + y^2 + z^2 = 36$ at point (2,-2, 4).

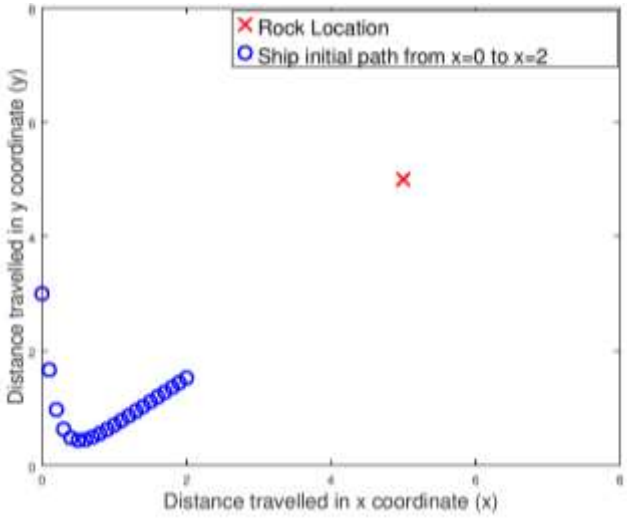
(5 markah/*marks*)

SOALAN 3
QUESTION 3

(a) Laluan perjalanan untuk sebuah kapal dengan system kawalan automatik tertakluk kepada persamaan berikut: $\frac{dy}{dx} + 6y = 5x$, di mana pemboleh ubah y dan x adalah jarak pergerakan di paksi y dan paksi x masing-masing.
Movement path of an autopilot ship is governed by the following equation: $\frac{dy}{dx} + 6y = 5x$, *where the* y *and* x *variables are the distances travelled in* y *-axis and* x*-axis respectively.*

(i) Diberikan kedudukan awal kapal tersebut berada pada kordinat $(x, y) = (0,3)$, tentukan penyelesaian tentu untuk masalah tersebut, $y(x)$.
Given the initial position of the ship is at (x, y) *coordinate = (0,3), determine the particular solution of the problem,* $y(x)$. (5 markah/*marks*)

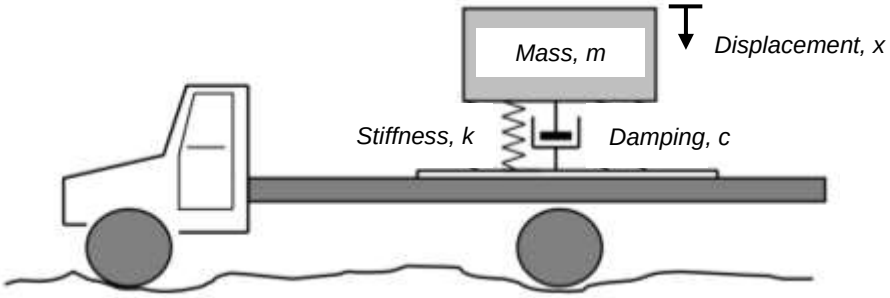
(ii) Ramalkan sama ada kapal itu akan melanggar batu yang terletak pada kordinat $(x, y) = (5,5)$ apabila ia kembara dari $x=2$ ke $x=5$, seperti yang ditunjukkan dalam Rajah S3(a).
Predict if the ship will hit with the rock located at (x, y) *coordinate = (5,5) when it continue to travel from* $x=2$ *to* $x=5$ *as shown in the Figure Q3(a).* (2 markah/*marks*)



Rajah S3(a)
Figure Q3(a)

(b) Trak membawa barang dengan jisim, $m = 25kg$ seperti ditunjukkan dalam Rajah S3(b). Sistem pengurangan getaran dengan kekakuan, $k = 40000N/m$ dan pekali redaman, $c = 2000Ns/m$ telah dipasangkan untuk mengurangkan kerosakan barang akibat getaran. Diberikan persamaan: $m\ddot{x} + c\dot{x} + kx = F(t)$ di mana $F(t)$ adalah fungsi daya dan x, $\dot{x}$ & $\ddot{x}$ adalah anjakan, halaju dan pecutan masing-masing. Tentukan penyelesaian am (iaitu jumlah penyelesaian pelengkap dan tentu) untuk persamaan berikut: $25\ddot{x} + 2000\dot{x} + 40000x = 5sin\,(10t)$. Petunjuk: Formula Euler: $e^{\pm ix} = cosx \pm i(sinx)$.

A truck is carrying goods with mass, $m = 25kg$ as shown in Figure Q3(b). A vibration suppression system with stiffness, $k = 40000N/m$ and damping coefficient, $c = 2000Ns/m$ has been installed to minimize the damage on the goods due to vibration. Given the governing equation: $m\ddot{x} + c\dot{x} + kx = F(t)$ where $F(t)$ is the forcing function and x, $\dot{x}$ & $\ddot{x}$ are the displacement, velocity and acceleration of the mass respectively. Determine the general solution (i.e. total complementary and particular solutions) of this equation: $25\ddot{x} + 2000\dot{x} + 40000x = 5sin\,(10t)$. Hint: Euler's Formula: $e^{\pm ix} = cosx \pm i(sinx)$.



Rajah S3(b)
Figure Q3(b)

(8 markah/*marks*)

SOALAN 4
QUESTION 4

(a) Selesaikan persamaan pembezaan berikut dengan Siri Kuasa:
Solve the following differential equation using Power Series:

$$y'' - 3y' + 2y = 0$$

(10 markah/*marks*)

(b) Tentukan titik atau titik-titik singular bagi persamaan pembezaan berikut dan tentukan samada ia atau mereka adalah regular atau tidak regular. Seterusnya, carikan punca-punca indeks persamaan pembezaan tersebut.
Determine the singular point(s) of the given differential equation and classify it/them as regular or irregular. Subsequently, find the indicial roots for the differential equation.

$$xy'' + 2y' + 4xy = 0$$

(5 markah/*marks*)

Lampiran/ *Appendix*

11 Table of Derivatives of Inverse Trigonometric Functions

$$\frac{d}{dx}(\sin^{-1}x) = \frac{1}{\sqrt{1-x^2}} \qquad \frac{d}{dx}(\csc^{-1}x) = -\frac{1}{x\sqrt{x^2-1}}$$

$$\frac{d}{dx}(\cos^{-1}x) = -\frac{1}{\sqrt{1-x^2}} \qquad \frac{d}{dx}(\sec^{-1}x) = \frac{1}{x\sqrt{x^2-1}}$$

$$\frac{d}{dx}(\tan^{-1}x) = \frac{1}{1+x^2} \qquad \frac{d}{dx}(\cot^{-1}x) = -\frac{1}{1+x^2}$$

1 Derivatives of Hyperbolic Functions

$$\frac{d}{dx}(\sinh x) = \cosh x \qquad \frac{d}{dx}(\operatorname{csch} x) = -\operatorname{csch} x \coth x$$

$$\frac{d}{dx}(\cosh x) = \sinh x \qquad \frac{d}{dx}(\operatorname{sech} x) = -\operatorname{sech} x \tanh x$$

$$\frac{d}{dx}(\tanh x) = \operatorname{sech}^2 x \qquad \frac{d}{dx}(\coth x) = -\operatorname{csch}^2 x$$

6 Derivatives of Inverse Hyperbolic Functions

$$\frac{d}{dx}(\sinh^{-1}x) = \frac{1}{\sqrt{1+x^2}} \qquad \frac{d}{dx}(\operatorname{csch}^{-1}x) = -\frac{1}{|x|\sqrt{x^2+1}}$$

$$\frac{d}{dx}(\cosh^{-1}x) = \frac{1}{\sqrt{x^2-1}} \qquad \frac{d}{dx}(\operatorname{sech}^{-1}x) = -\frac{1}{x\sqrt{1-x^2}}$$

$$\frac{d}{dx}(\tanh^{-1}x) = \frac{1}{1-x^2} \qquad \frac{d}{dx}(\coth^{-1}x) = \frac{1}{1-x^2}$$

~~~~~~~ **TAMAT / *END*** ~~~~~~
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