



**FINAL EXAMINATION / PEPERIKSAAN AKHIR
SEMESTER I – SESSION 2020 / 2021
PROGRAM KERJASAMA**

COURSE CODE : DDWS 2033
KOD KURSUS

COURSE NAME : ENGINEERING MATHEMATICS 3
NAMA KURSUS MATEMATIK KEJURUTERAAN 3

YEAR / PROGRAMME : 2 DIPLOMA IN ENGINEERING
TAHUN / PROGRAM 2 DIPLOMA KEJURUTERAAN

DURATION : 3 HOURS (INCLUDING SUBMISSION HOUR)
TEMPOH 3 JAM (TERMASUK MASA PENGHANTARAN)

DATE : NOVEMBER 2020
TARIKH

INSTRUCTION / ARAHAN:

1. Answer **ALL** questions and write your answers on the answer sheet.
*Jawab **SEMUA** soalan dan tulis jawapan anda pada kertas jawapan.*
 2. Write your name, matric no., identity card no., course code, course name, section no. and lecturer's name on the first page (in the upper left corner) and every page thereafter on the answer sheet.
Tulis nama anda, no. matrik, no. kad pengenalan, kod kursus, nama kursus, no. seksyen dan nama pensyarah pada muka surat pertama (penjuru kiri atas) kertas jawapan dan pada setiap muka surat jawapan.
 3. Each answer sheet must have a page number written at the bottom right corner.
Setiap helai kertas jawapan mesti ditulis nombor muka surat pada bahagian bawah penjuru kanan.
 4. Answers should be handwritten, neat and clear.
Jawapan hendaklah ditulis tangan, kemas dan jelas menggunakan huruf cerai.
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WARNING / AMARAN

Students caught copying / cheating during the examination will be liable for disciplinary actions and the faculty may recommend the student to be expelled from sitting for exam.
Pelajar yang ditangkap meniru / menipu semasa peperiksaan akan dikenakan tindakan disiplin dan pihak fakulti boleh mengesyorkan pelajar diusir dari menduduki peperiksaan.

This examination paper consists of **7** pages including the cover.
*Kertas soalan ini mengandungi **7** muka surat termasuk kulit hadapan.*

ONLINE EXAMINATION RULES AND REGULATIONS
PERATURAN PEPERIKSAAN SECARA DALAM TALIAN

1. Student must carefully listen and follow instructions provided by invigilator.
Pelajar mesti mendengar dan mengikuti arahan yang diberikan oleh pengawas peperiksaan dengan teliti.
2. Student is allowed to start examination only after confirmation of invigilator if all needed conditions are implemented.
Pelajar dibenarkan memulakan peperiksaan hanya setelah pengesahan pengawas peperiksaan sekiranya semua syarat yang diperlukan telah dilaksanakan.
3. During all examination session student has to ensure, that he is alone in the room.
Semasa semua sesi peperiksaan pelajar harus memastikan bahawa dia bersendirian di dalam bilik.
4. During all examination session student is not allowed to use any other devices, applications except other sites permitted by course lecturer.
Sepanjang sesi peperiksaan pelajar tidak dibenarkan menggunakan peranti dan aplikasi lain kecuali yang dibenarkan oleh pensyarah kursus.
5. After completing the exam student must inform invigilator via the set communication platform (eg. WhatsApp etc.) about completion of exam and after invigilator's confirmation leave examination session.
Selepas peperiksaan selesai, pelajar mesti memaklumkan kepada pengawas peperiksaan melalui platform komunikasi yang ditetapkan (contoh: Whatsapp dan lain-lain) mengenai peperiksaan yang telah selesai dan meninggalkan sesi peperiksaan selepas mendapat pengesahan daripada pengawas peperiksaan.
6. Any technical issues in submitting answers online have to be informed to respective lecturer within the given 30 minutes. Request for re-examination or appeal will not be entertained if complains are not made by students to their lecturers within the given 30 minutes.
Sebarang masalah teknikal dalam menghantar jawapan secara dalam talian perlu dimaklumkan kepada pensyarah masing-masing dalam masa 30 minit yang diberikan. Permintaan untuk pemeriksaan semula atau rayuan tidak akan dilayan sekiranya aduan tidak dibuat oleh pelajar kepada pensyarah mereka dalam masa 30 minit yang diberikan.
7. During online examination, the integrity and honesty of the student is also tested. At any circumstances student is not allowed to cheat during examination session. If any kind of cheating behaviour is observed, UTM have a right to follow related terms and provisions stated in the respective Academic Regulations and apply needed measures.
Semasa peperiksaan dalam talian, integriti dan kejujuran pelajar juga diuji. Walau apa pun keadaan pelajar tidak dibenarkan menipu semasa sesi peperiksaan. Sekiranya terdapat sebarang salah laku, UTM berhak untuk mengikuti terma yang dinyatakan dalam Peraturan Akademik.

1. (a) **Use the separation of variables method to solve the equation:**

Guna kaedah pemisahan pembolehubah untuk menyelesaikan persamaan:

$$\frac{dy}{dx} = \frac{y}{x-3}, \quad y(4) = 1$$

(5M)

- (b) **Find the integrating factor and hence solve the equation:**

Dapatkan faktor pengamir persamaan dan seterusnya selesaikan persamaan tersebut:

$$x \frac{dy}{dx} - 2y = 6x^2 \quad (5M)$$

2. (a) **Use the method of undetermined coefficients to solve the nonhomogeneous equation:**

Guna kaedah pekali tak ditentukan untuk menyelesaikan persamaan tak homogen:

$$y'' + 6y' + 9y = 3x \quad (6M)$$

- (b) **Evaluate the following:**

Nilaikan yang berikut:

(i) $\mathcal{L} \{t^2 e^{-3t} - \sinh t\}$

(ii) $\mathcal{L}^{-1} \left\{ \frac{s}{s^2 - 6s - 5} \right\}$

(6M)

- (c) **Use the method of Laplace transforms to solve the initial value problem:**

Guna kaedah jelmaan Laplace untuk menyelesaikan masalah nilai awal:

$$y'' + 3y' = 4e^{-x} \quad y(0) = 1, \quad y'(0) = -1$$

(6M)

3. (a) **Find the partial derivatives f_x , f_y , f_{xx} and f_{yx} :**

Dapatkan terbitan separa f_x , f_y , f_{xx} dan f_{yx} :

$$f(x, y) = e^{2xy} + \cos xy$$

(4M)

- (b) **If $z = 3y^2 - 2x^3$, $x = e^t$ and $y = 4t$. Use the chain rule to find $\frac{dz}{dt}$.**
 Jika $z = 3y^2 - 2x^3$, $x = e^t$ dan $y = 4t$. Guna aturan rantai untuk mendapat $\frac{dz}{dt}$. (6M)

- (c) **Find and classify all the critical points of the function:**
 Dapatkan dan kelaskan semua titik-titik genting bagi fungsi:

$$f(x, y) = x^3 + 3y^2 - 3xy \quad (6M)$$

4. (a) **Evaluate the double integral:**

Nilaikan kamiran ganda dua:

$$\int_1^5 \int_0^3 6x^2y \, dydx \quad (5M)$$

- (b) **Evaluate / Nilaikan:**

$$\iint_R 4x \, dA$$

where R is the region bounded by the curve $y = 2 - x^2$, lines $y = 3x$ and $x = 0$.

dengan R ialah rantau yang dibatasi oleh lengkung $y = 2 - x^2$, garis-garis $y = 3x$ dan $x = 0$.

(5M)

- (c) **Use polar coordinates to evaluate the integral**

Gunakan koordinat kutub untuk menilaikan kamiran

$$\iint_R (3x^2 + 3y^2 + xy) \, dA$$

where R is enclosed in upper half of the region $4 \leq x^2 + y^2 \leq 9$.

dengan R dalam kawasan separuh atas tertutup bagi $4 \leq x^2 + y^2 \leq 9$.

(6M)

END OF QUESTIONS / SOALAN TAMAT

APPENDIX

A. Formulae

Derivatives	Integrals
$\frac{d}{dx}(u^n) = nu^{n-1} \frac{du}{dx}$	$\int u^n du = \frac{1}{n+1} u^{n+1} + C; n \neq -1$
$\frac{d}{dx}(e^u) = e^u \frac{du}{dx}$	$\int e^u du = e^u + C$
$\frac{d}{dx}(\ln u) = \frac{1}{u} \frac{du}{dx}$	$\int \frac{1}{u} du = \ln u + C$
$\frac{d}{dx}(\sin u) = \cos u \frac{du}{dx}$	$\int \cos u du = \sin u + C$
$\frac{d}{dx}(\cos u) = -\sin u \frac{du}{dx}$	$\int \sin u du = -\cos u + C$
$\frac{d}{dx}(\tan u) = \sec^2 u \frac{du}{dx}$	$\int \sec^2 u du = \tan u + C$
$\frac{d}{dx}(\sec u) = \sec u \tan u \frac{du}{dx}$	$\int \cot u du = \ln \sin u + C$
$\frac{d}{dx}(\operatorname{cosec} u) = -\operatorname{cosec} u \cot u \frac{du}{dx}$	$\int \sec u du = \ln \sec u + \tan u + C$
$\frac{d}{dx}(\sin^{-1} u) = \frac{1}{\sqrt{1-u^2}} \frac{du}{dx}$	$\int \frac{1}{\sqrt{a^2 - u^2}} du = \sin^{-1}\left(\frac{u}{a}\right) + C$
$\frac{d}{dx}(\cos^{-1} u) = -\frac{1}{\sqrt{1-u^2}} \frac{du}{dx}$	$\int \frac{1}{\sqrt{a^2 - u^2}} du = -\cos^{-1}\left(\frac{u}{a}\right) + C$
$\frac{d}{dx}(\tan^{-1} u) = \frac{1}{1+u^2} \frac{du}{dx}$	$\int \frac{1}{a^2 + u^2} du = \frac{1}{a} \tan^{-1}\left(\frac{u}{a}\right) + C$

B. The method of undetermined coefficients

Solution of homogeneous equation: $ay'' + by' + cy = 0$

Auxiliary equation: $am^2 + bm + c = 0$

Roots of $am^2 + bm + c = 0$	General solution, y_h
1. real and unequal: m_1 and m_2	$y_h = Ae^{m_1x} + Be^{m_2x}$
2. real and equal: $m = m_1 = m_2$	$y_h = (A + Bx)e^{mx}$
3. complex numbers: $m_1 = \alpha + \beta i$; $m_2 = \alpha - \beta i$	$y_h = e^{\alpha x} (A \cos \beta x + B \sin \beta x)$

Particular integrals of nonhomogeneous equation: $ay'' + by' + cy = f(x)$

$f(x)$	Roots of auxiliary equation: m_1, m_2	y_p
$A_n x^n + A_{n-1} x^{n-1} + \dots + A_1 x + A_0$	$m_1 \neq 0$ and $m_2 \neq 0$ $m_1 = 0$ or $m_2 = 0$	$B_n x^n + B_{n-1} x^{n-1} + \dots + B_1 x + B_0$ $(B_n x^n + B_{n-1} x^{n-1} + \dots + B_1 x + B_0) x$
$Ke^{\alpha x}$	$m_1 \neq \alpha$ and $m_2 \neq \alpha$ $m_1 = \alpha$ or $m_2 = \alpha$ $m_1 = \alpha$ and $m_2 = \alpha$	$Ce^{\alpha x}$ $Cxe^{\alpha x}$ $Cx^2 e^{\alpha x}$
$K \cos \beta x$ or $K \sin \beta x$	$m_1 \neq i\beta$ and $m_2 \neq i\beta$ $m_1 = i\beta$ or $m_2 = i\beta$	$C_1 \cos \beta x + C_2 \sin \beta x$ $(C_1 \cos \beta x + C_2 \sin \beta x) x$

C. Table of Laplace Transforms $\mathcal{L}\{f(t)\} = F(s)$

$f(t)$	$F(s)$
a	$\frac{a}{s}$
e^{at}	$\frac{1}{s-a}$
$\sin at$	$\frac{a}{s^2 + a^2}$
$\cos at$	$\frac{s}{s^2 + a^2}$
$e^{at} f(t)$	$F(s-a)$
$e^{at} \sin bt$	$\frac{b}{(s-a)^2 + b^2}$
$e^{at} \cos bt$	$\frac{(s-a)}{(s-a)^2 + b^2}$
$t^n, n = 1, 2, 3, \dots$	$\frac{n!}{s^{n+1}}$
$t^n e^{at}$	$\frac{n!}{(s-a)^{n+1}}$
$t^n f(t)$	$(-1)^n \frac{d^n F(s)}{ds^n}$
$y(t)$	$Y(s)$
$y'(t)$	$sY(s) - y(0)$
$y''(t)$	$s^2 Y(s) - sy(0) - y'(0)$