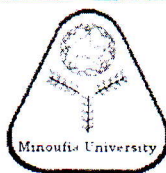


Menofia University
 Faculty of Engineering, Shebin El-Kom
 Dep. Mechanical Power Engineering
 Second Semester Examination 2017-2018
 Date of Exam: 3/06/2018



Subject: Engineering Mathematics (2)
 Code: BES112
 Year : 1st year
 Time Allowed : 3 hours
 Total Marks: 100 marks

Answer the following questions:

عدد الاسئلة (ثلاثة أسئلة) (الأمتحان في صفحتين)

Question 1

25 marks

(A) Find the general solution of the differential equations:-

- (i) $(e^x + 1) y dy = (y + 1) e^x dx$ (ii) $\frac{dy}{dx} = \frac{x+3y-5}{2x-y-3}$
 (iii) $x \frac{dy}{dx} + y = y^2 \ln x$ (iv) $\frac{dy}{dx} + y \sec x = \cos^2 x$
 (v) $\frac{dy}{dx} - 5y = -\frac{5}{2} x y^3$

(B) Find the general solution of the differential equations :-

- (i) $\left(\frac{dy}{dx}\right)^2 - 2x \frac{dy}{dx} + y = 0$
 (ii) $(D^2 + 9) y = \cos 2x + \sin 2x$ (iii) $(x^2 D^2 + 3x D - 3) y = x$

(C) Solve the following system of simultaneous linear D. Eqs.:

- (i) $D y_1 - y_2 = 0, \quad -y_1 + D y_2 = 0$ (ii) $\frac{dx}{dt} = y, \quad \frac{dy}{dt} = x$

(D) Prove that any separable differential equation is an exact differential equation.

Question 2

25 marks

(A) Find the orthogonal trajectories of the curves:

- (i) $y = c x^2$ (ii) $x^2 + y^2 = c^2$

(B) Find the area of the region R that enclosed by the parabola $y = x^2$ and the line $y = x + 2$.

(C) Find the mass and the center of mass (gravity) of a thin plate bounded by the parabola $y = 6x - x^2$ and the straight line $y = x$, given that it has a mass density $\rho(x, y) = 1$.

(D) Evaluate the following integral: $\int_0^4 \int_{\sqrt{y}}^2 y \cos x^5 dx dy$

Question 3

50 marks

(A) Test the following sequences are convergence and monotonic (and/or) bounded:

(i) $\left\{1 + \frac{1}{n}\right\}$	(ii) $\left\{\frac{n}{n+1}\right\}_{n=1}^{\infty}$	(iii) $\{(-1)^{n+1}\}_{n=1}^{\infty}$
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(B) Test the convergence of the following series:

(i) $\sum_{n=1}^{\infty} \frac{(-4)^{3n}}{5^{n-1}}$ and find its sum	(ii) $\sum \frac{1}{(n+1) \ln(n+1)}$
(iii) $\sum_{n=1}^{\infty} \frac{3}{\sqrt{n^2+n+1}}$ (by limit comparison test)	(iv) $\sum_{n=1}^{\infty} \left(1 - \frac{3}{n}\right)^n$

(C) Determine whether the following series is absolutely convergent, conditionally convergent, or divergent:

(i) $\sum_{n=1}^{\infty} (-1)^{n-1} \frac{n^2+4}{2^n}$	(ii) $\sum_{n=1}^{\infty} (-1)^{n-1} (0.3)^n$	(iii) $\sum_{n=1}^{\infty} (-1)^{n-1} \frac{n+1}{n^2}$
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(D) Find the radius and the interval of convergence of the following power series:

(i) $\sum_{n=1}^{\infty} \frac{(x-3)^n}{n}$	(ii) $\sum_{n=1}^{\infty} \frac{x^n}{\sqrt{n}}$
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(E) Find the Fourier series of the function: $f(x) = x, \quad -\pi < x \leq \pi$

(i) In the form: $f(x) = 2 \left[\sin x - \frac{1}{2} \sin 2x + \frac{1}{3} \sin 3x - \dots \right]$

(ii) By giving an appropriate value to (x) , show that: $\frac{\pi}{4} = 1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \dots$

(F) Find Laplace transform of the following functions:

(i) $e^{-3t} \sin(4t)$ (ii) $G(t) = \begin{cases} 0 & t < 2 \\ (t-2)^2 & t > 2 \end{cases}$

(iii) $\int_0^t \frac{\sin(t)}{t}$ (iv) $e^{-2t} t^2$ (v) $\frac{1-\cos(t)}{t}$

(G) Find Inverse Laplace transform of the following function:

(i) $F(S) = \frac{1}{S^2-3S+2}$ (ii) $F(S) = \ln \frac{S-1}{S+2}$ (iii) $F(S) = \frac{S e^{-\frac{2\pi}{3}S}}{S^2+1}$

(iv) $F(S) = \tan^{-1}(S+1)$ (v) $F(S) = \frac{1}{S^2+2S+5}$

(H) Solve the differential equation $y'' - 3y' + 2y = 6e^{2t}$ using the Laplace transform method with initial conditions $y(0) = -3, y'(0) = 5$.

This exam measures the following ILOs

Question Number	Q4-a	Q2-a	Q4-b	Q1-b	Q3-b	Q4-b	Q3-c		Q1-b	Q3-a	Q4-a
Skills	Q2-b				Q2-a	Q3-b			Q3-a		
	Knowledge & understanding skills				Intellectual Skills			Professional Skills			

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