

311001

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B. Tech. III Sem. (Main) Exam., Dec. - 2019
Aeronautical Engineering
3ME2-01 Advanced Engineering Mathematics-I
AE, AG, CR, CE, EC, EIC, ME, MH

Time: 3 Hours

Maximum Marks: 120

Instructions to Candidates:

Part – A: Short answer questions (up to 25 words) 10×2 marks = 20 marks. All ten questions are compulsory.

Part – B: Analytical/Problem Solving questions 5×8 marks = 40 marks. Candidates have to answer five questions out of seven.

Part – C: Descriptive/Analytical/Problem Solving questions 4×15 marks = 60 marks. Candidates have to answer four questions out of five.

Schematic diagrams must be shown wherever necessary. Any data you feel missing may suitably be assumed and stated clearly. Units of quantities used/calculated must be stated clearly.

Use of following supporting materials is permitted during examination. (Mentioned in form No. 205)

1. NIL

2. NIL

PART - A

✓ Q.1 Prove that : $\Delta [\log f(x)] = \log \left[1 + \frac{\Delta f(x)}{f(x)} \right]$.

✓ Q.2 State the fundamental theorem of finite differences and hence find the value of

$$\Delta^6 (ax - 1)(bx^2 - 1)(cx^3 - 1)$$

✓ Q.3 Write the Stirling's central interpolation formula.

✓ Q.4 If function $f(x)$ is a continuous function in the interval $(-\infty, \infty)$ and $\tilde{f}(s)$ is the Fourier transform of $f(x)$, then prove that $F\{f'(x)\} = -is\tilde{f}(s)$.

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Q.5 Write modified Euler's method to solve the ordinary differential equation.

Q.6 Find the Laplace transform of $F(t) = te^t \sin t$.

Q.7 State & prove the change of scale property for Laplace transform.

Q.8 Find $L^{-1} \left[\frac{1}{(s-1)(s+2)} \right]$.

Q.9 Find the Fourier sine transform of $f(x) = \begin{cases} 1 & ; 0 < x < a \\ 0 & ; x > a \end{cases}$

Q.10 Find the Z-transform of $u_n = e^n \cos h an, n \geq 0$.

PART - B

Q.1 Use Newton - Raphson method to find a real root of $(x) = x^3 - 3x - 5 = 0$.

Q.2 Using Lagrange's interpolation formula, find the value of $y(5)$ from the following table:

x :	1	2	3	4	7
y :	2	4	8	16	128

Q.3 Use Milne's Predictor - Corrector method to find $y(0.8)$, given that:

$$\frac{dy}{dx} = x - y^2 ; y(0) = 0, y(0.2) = 0.02, y(0.4) = 0.0795, y(0.6) = 0.1762$$

Q.4 Prove that $L \{t F(t)\} = -\frac{d}{ds} f(s)$ and hence find $L^{-1} \left[\log \left(\frac{s+2}{s+1} \right) \right]$.

Q.5 Find the Laplace transform of $\sin \sqrt{t}$. Hence show that $L \left(\frac{\cos \sqrt{t}}{\sqrt{t}} \right) = \sqrt{\frac{\pi}{s}} e^{-\frac{1}{4s}}$.

Q.6 Find the Fourier sine transform of $f(x) = e^{-x}, x \geq 0$ and hence show that:

$$\int_0^{\infty} \frac{x \sin mx}{x^2+1} dx = \frac{\pi}{2} e^{-m} ; m > 0$$

Q.7 Find the inverse Z-transform of following function:

$$f(z) = \frac{1}{(z-1)(z-2)}, \text{ if ROC is}$$

(i) $|z| < 1$

(ii) $1 < |z| < 2$

(iii) $|z| > 2$

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PART - C

Q.1 (a) Use Simpson's $\frac{1}{3}$ and $\frac{3}{8}$ rule to evaluate the integral $\int_0^1 \frac{1}{1+x^2} dx$. Hence obtain the approximate value of π .

(b) Given the following data:

x	:	0.0	0.2	0.4	0.6	0.8
y	:	0.3989	0.3910	0.3683	0.3332	0.2897

Evaluate the value of $y(0.25)$ and $y(0.62)$.

Q.2 Use Runge - Kutta method of fourth order to find $y(1.2)$, given that:

$$\frac{dy}{dx} = x^2 + y^2 ; y(1) = 0.$$

Q.3 (a) Prove that $L\left(\frac{\sin t}{t}\right) = \tan^{-1}\left(\frac{1}{s}\right)$ and hence find $L\left(\frac{\sin at}{t}\right)$. Does $L\left(\frac{\cos at}{t}\right)$ exists?

(b) Solve the differential equation, using Laplace transform:

$$(D^2 + 3D + 2)y = 1 ; y(0) = 0, y'(0) = 0 ; D = \frac{d}{dt}.$$

Q.4 Find the Fourier transform of $f(x) = \begin{cases} 1-x^2 & ; |x| < 1 \\ 0 & ; |x| > 1 \end{cases}$.

Also evaluate $\int_0^{\pi} \frac{1 + \cos x \cdot \sin x}{x^2} \cos \frac{x}{2} dx$.

Q.5 (a) Use Convolution theorem to find $L^{-1} \left[\frac{s^2}{(s^2 + a^2)(s^2 + b^2)} \right]$.

(b) Using Z - transform solve the difference equation:

$$U_{n+2} + 5U_{n+1} + 6U_n = 0, \text{ given that } u_0 = 0, u_1 = 1$$