ARYA COLLEGE OF ENGINEERING

(ACE)

GUESS PAPER

(B.Tech II YEAR. III^{RD} Semester 2025-2026)

3EE2-01, 3ME2-01 and 3CE2-01_AEM-I

Unit 1:

Short Answers: (2 Marks Each)

Q. 1 Relation between Different operators

1) $\Delta = E - 1$ **2)** $\boldsymbol{\nabla = (1 - E^{-1})}$ **CO-1 BL-3**

Q. 2 If $f(x) = x^3 - 3x^2 + 5x + 7$, find $\Delta^2 f(x)$ when x=1. **CO-1 BL-2**

Q. 3 Write striling, differential forward and backward formula . **CO-1 BL-2**

Q. 4 Prove that $\Delta^6(ax-1)(bx^2-1)(cx^3-1);\ h = 1$. **CO-1 BL-3**

Q. 5 Find the missing term of the following data **CO-1 BL-3 Use Lagrange's Formula**

X	0	1	2	3	4
Y	1	8	-	64	125

Descriptive Answers: (5 to 20 Marks)

Q. 1 A body moving with velocity v at any time t satisfies the data **CO-2 BL-2**

T	0	1	3	4
V	21	15	12	10

Obtain the distance travelled in 4 seconds and acceleration at the end of 4 seconds

Q. 2 Use stirling formula to find y_{28}, given $y_{20} = 49225$, $y_{25} = 48316$, $y_{30} = 47236$, $y_{35} = 45926$, $y_{40} = 44306$. **CO-1 BL-2**

Q. 3 Use Lagrange Formula; Interpolate the value of y at x = 10.

X	5	6	9	11	
Y	12	13	14	16	

CO-1 BL-2

Q. 4 Use newton divided difference formula to find the values of f(2), f(8) and f(15) from the following table .

X	**4**	**5**	**7**	**10**	**11**	**13**
F(x)	48	**100**	**294**	**900**	**1210**	**2028**

CO-1 BL-2

Q. 5 Calculate (upto 3 places of decimal) $\int_2^{10} \frac{dx}{1}$ by dividing the range into eight parts.(INTEGRATION

CO-1 BL-2

Q. 6 From the given data given below, find the number of students whose weight is between 60 and 70.: **CO-1 BL-2**

Weight	No. of Candidates
0-40	250
40-60	120
60-80	100
80-100	70
100-120	50

Q.7 Given the following data

x	10	20	30	40	50	690	70	80
y	0.9848	0.9397	0.8660	0.7660	0.6428	0.500	0.3420	0.1737

Evaluate (i) y(25), (ii) y(32) (iii) y(73) CO-1 BL-2

Unit 2(Q.1 to 4 Only for ECE & ME)

Short Answers: (2 Marks Each)

Q. 1 Given the $y(x)$ is the solution to $\frac{dy}{dx} = y^3 + 2$, $y(0) = 3$, find the value of $y(0.2)$ from a second order Taylor polynomial around $x = 0$. **CO-2 BL-2**

Q. 2 Solve $\frac{dy}{dx} = xy$, with the help of Euler's method, given that y (0) = 1, and find y when x=0.2; the step size being 0.1. **CO-2 BL-2**

Q. 3 Write Runge-Kutta 4th order formula. **CO-2 BL-2**

Q. 4 Write Milne's and Adam's predictor-corrector method formula. **CO-2 BL-2**

Q. 5 Using Newton-Rapson's method, find the real root of $x^4 - 12x + 7 = 0$, which is near to x=2, correct to three places of decimal. **CO-2 BL-2**

Q. 6 Write Regula-False method formula. **CO-2 BL-2**

Descriptive Answers: (5 to 20 Marks)

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Q. 1 Use Taylor's series method to solve the equation $\frac{dy}{dx} = x + y, x = 1, y = 0$ up to $x = 1.2$ with $h = 0.1$. **CO-2 B**

Q. 2 Using Euler's modified method; obtain a solution of $\frac{dy}{dx} = x + |\sqrt{y}|, y(0) = 1$ for the range $0 \le x \le 0.4$ in steps of 0.2. **CO-2 BL-2**

Q. 3 Given that $\frac{dy}{dx} = x^2(1 + y)$ and $y(1) = 1, y(1.1) = 1.233, y(1.2) = 1.548, y(1.3) = 1.979$. Evaluate y (1.4) by Milne method. **CO-2 BL-3**

Q. 4 If $\frac{dy}{dx} = x + y$, use Runge - Kutta method to find an approximate value of y for x=0.2, given that y=1 when and taking h=0.1. **CO-2 BL-2**

Q. 5 Using Halving method or Bisection method, find the approximate root of the equation $x^4 + 2x^3 - x - 1 = 0$ lying in the interval [0, 1]. **CO-2 BL-3**

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Q. 6 Perform four iterations of the Newton-Raphson method to obtain approximate value of $(17)^{1/2}$ starting with the initial approximation $x_0 = 2$. **CO-2 BL-2**

Unit 3:

Short Answers: (2 Marks Each)

Q. 1 If $L\{f(t)\} = F(s)$, then prove that $L\{tf(t)\} = -\frac{d}{ds}F(s)$. And hence find the Laplace transform of $e^t t^2 \sin 4t$. **CO-3 BL-2**

Q. 2 Obtain the Laplace transform of $\frac{\cosh at}{\sqrt{t}}$. **CO-3 BL-3**

Q. 3 Find the Laplace transform of $e^{2t} + 4t^3 - 5\sin 3t + 7\cos 2t$. **CO-3 BL-2**

Q. 4 Find the inverse Laplace transform of $\log\left(\frac{s+3}{s+2}\right)$ **CO-3 BL-3**

Q. 5 Find the Laplace transform of Dirac delta function. **CO-3 BL-2**

Q. 6 Compute L.T. of the following: $f(t) = \begin{cases} \sin\left(t - \frac{\pi}{3}\right), & t > \pi/3 \\ 0, & t < \pi/3 \end{cases}$ **CO-3 BL-4**

Q.7 Define the Unit step function and find Laplace transform of unit step function (Heaviside Unit step function) **CO-3 BL-2**

Descriptive Answers: (5 to 20 Marks)

Q. 1 Find the Laplace transform of $\sin\sqrt{t}$. Hence show that $L\left(\frac{\cos\sqrt{t}}{\sqrt{t}}\right) = \left(\frac{\pi}{s}\right)^{1/2} e^{-1/4s}$. **CO-3 BL-4**

Q. 2 Prove that $L\left(\frac{\sin t}{t}\right) = \tan^{-1}\left(\frac{1}{s}\right)$. Hence find Laplace transform of $\frac{\sin at}{t}$. Dose $\frac{\cos at}{t}$ exists? Also prove that $\int_0^\infty \frac{\sin 2t}{t}\,dt = \frac{\pi}{2}$. **CO-3 BL-2**

Q. 3 show that. **CO-3 BL-3**

Q. 4 Find $L^{-1}\left[\frac{s}{s^4+s^2+1}\right]$. **CO-3 BL-2**

Q. 5 Apply the convolution theorem to evaluate $L^{-1}\left(\frac{s}{(s^2+a^2)(s^2+b^2)}\right)$ **CO-3 BL-2**

Q. 6 State and proof of convolution theorem for Laplace transform. **CO-3 BL-2**

Q. 7 Use Laplace transform technique to solv the following equations **(Only for ECE & ME)**

$(D^2 + 9)y = \cos 2t,\ y(0) = 1,\ y\left(\frac{\pi}{2}\right) = -1$. **CO-3 BL-2**

Unit 4:

Short Answers: (2 Marks Each)

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$f(x) = \begin{cases} 1 - x^2, & |x| < 1 \\ 0, & |x| > 1 \end{cases}$

Q. 3 Find the Fourier sine and cosine transform of the functions: $f(x) = x$ **CO-4 BL-2**

Q. 4 Find the relation between Fourier and Laplace transforms. **CO-4 BL-2**

Q. 5 Find f(x) if its Fourier Sine transform is e^{-as}. **CO-4 BL-3**

Q. 6 If $F(s)$ is the Fourier transform of $f(x)$, then the Fourier transform of $f(x-a)$ is $e^{isx}F(s)$. **CO-4 BL-3**

Q.7 State the Fourier integral theorem. **CO-4 BL-2**

Descriptive Answers: (5 to 20 Marks)

Q. 1 Find the Fourier transform of **CO-4 BL-4**

$f(x) = \begin{cases} 1 - x^2, & |x| < a \\ 0, & |x| > a \end{cases}$. Hence prove that: $\int_0^\infty \left(\frac{x\cos x - \sin x}{x^3}\right)\cos\frac{x}{2}\,dx = -\frac{3\pi}{16}$

Q. 2 Find the Fourier sine transform of the following function: **CO-4 BL-3**

$$f(x) = \begin{cases} x, & 0 < x < 1 \\ 2 - x, & 1 < x < 2 \\ 0, & x > 2 \end{cases}$$

Q. 3 Find the Fourier cosine transform of e^{-x^2}. **CO-4 BL-4**

Q. 4 Solve the following integral equation: **CO-4 BL-4**

$\int_0^\infty f(x)\cos sx\,dx = \begin{cases} 1 - s, & \text{when } 0 \le s \le 1 \\ 0, & \text{when } s > 1 \end{cases}$. Hence deduce that $\int_0^\infty \frac{\sin^2 x}{x^2}\,dx = \frac{\pi}{2}$

Q. 5 Express the function $f(x) = \begin{cases} \sin x, & 0 < x < \pi \\ 0, & x > \pi \end{cases}$ as a Fourier sine integral and hence evaluate $\int_0^\infty \frac{\sin x\lambda \sin \pi\lambda}{1-\lambda^2}\,d\lambda$

CO-4 BL-4

Q. 6 Find the f(x) if its Fourier sine transform is $\frac{s}{1+s^2}$. **CO-4 BL-3**

Q. 7 Solve the boundary value problem for $\frac{\partial \theta}{\partial t} = k\frac{\partial^2 \theta}{\partial x^2}$, using Fourier transform. **CO-4 BL-4**

Given that $\theta(0,t) = \theta_0, t > 0$; $\theta(x,0) = 0, x > 0$ and $\frac{\partial \theta}{\partial x} \to 0$ and as $x \to \infty, \theta \to 0$. **(Only for ECE & ME)**

Unit 5:

Short Answers: (2 Marks Each)

Q. 1 Find the Z-transform of the following function **CO-5 BL-2**

i) $\frac{1}{n!}$ and hence $\frac{1}{(n+1)!}$

ii) $\{u_n\} = \{8, 6, 3, -1, 0, 1, 4, 5\}, -5 \le n \le 2.$

Q. 2 If $Z(u_n) = \bar{u}(z), n \ge 0$ then show that $\lim_{z\to\infty} \bar{u}(z) = u_0$. **CO-5 BL-2**

Q. 3 If $Z(u_n) = \bar{u}(z)$, then show that $Z(u_{n-k}) = z^k\bar{u}(z)$ **CO-5 BL-2**

Q. 4 Prove that $Z(n^p) = -z \frac{d}{dz} Z(n^{p-1}); n \ge 0$ **CO-5 BL-2**

Q. 5 If $Z(u_n) = \bar{u}(z), n \ge 0$, then $\lim_{z\to\infty} \bar{u}(z) = u_0$. **CO-5 BL-2**

Q. 6 Find the inverse z-transform of $\log\left(\frac{z}{z+1}\right)$. Also, find inverse Z-transform of $\left[\frac{z}{(z-1)(z-2)}\right]; |z| > 2$ **CO-5 BL-2**

Q. 7 Find the inverse Z-transform of discrete unit step function- $U(k) = \begin{cases} 0, & k < 0 \\ 1, & k \ge 0 \end{cases}$ **CO-5 BL-2**

Descriptive Answers: (5 to 20 Marks)

Q. 1 Find the Z-transform of $n^2; n \ge 0$. Hence find the $Z[(n-1)^2]$. **CO-5 BL-2**

Q. 2 Find the Z-transform of ${}^{m+n}C_m, n \ge 0$ and also find the Z-transform of $a^n \sinh n\theta, n \ge 0$ **CO-5 BL-2**

Q. 3 If $Z(u_n) = \bar{u}(z), n \ge 0$, then $\lim_{n\to\infty} (u_n) = \lim_{z\to 1}(z-1)\bar{u}(z) = u_\infty$. **CO-5 BL-2**

Q. 4 State and prove the convolution theorem for Z-transform $(n \ge 0)$. **CO-5 BL-2**

Q. 5 Find the $Z^{-1}\left[\frac{9z^2}{(3z-1)^2(z-2)}\right]$ by residue method. **CO-5 BL-2**

Q. 6 Using convolution theorem, find $Z^{-1}\left[\frac{z^2}{(z-3)(z-4)}\right]; n \ge 0$. **CO-5 BL-2**

Q. 7 Solve $u_{n+2} - 6u_{n+1} + 8u_n = 2^n + 6n$. **CO-5 BL-2**

Unit 6: Only for 3EE2-01

Short Answers: (2 Marks Each)

Q. 1 Prove that the function $e^x(\cos y + i \sin y)$ is analytic and find its derivative. **CO-2 BL-2**

Q. 2 Define Mobius transform. **CO-2 BL-2**

Q. 3 Test the analyticity of the function $w = \sin z$ and hence derive that $\frac{d}{dz}(\sin z) = \cos z$. **CO-2 BL-2**

Q. 4 Consider the transformation $w = 2z$, and determine the region R' in w-plane into which the triangular region R enclosed by the lines $x = 0, y = 0$ and $x + y = 1$ in z-plane is mapped under this transformation. **CO-2 BL-2**

Q. 5 For the conformal transformation at $w = z^2$, show that the coefficient of magnification at $z = 1 + i$ is $2\sqrt{2}$. **CO-2 BL-2**

Q. 6 For the conformal transformation $w = z^2$, show that the angle of rotation at $z = 2 + i$ is $\tan^{-1}(0.5)$. **CO-2 BL-2**

Q. 7 Show that the transformation $w = \frac{2z+3}{z-4}$ maps the circle $x^2 + y^2 - 4x = 0$ into straight line $4u + 3 = 0$. **CO-2 BL-2**

Descriptive Answers: (5 to 20 Marks)

Q. 1 If $f(z) = u + iv$ is an analytic function of $z = x + iy$, and $u - v = e^x(\cos y - \sin y)$, find $f(z)$ in terms of z.
CO-2 BL-2

Q. 2 Determine the analytic function, whose real part is $x^3 - 3xy^2 + 3x^2 - 3y^2 + 2x + 1$. Also prove that the given function satisfies Laplace equation. **CO-2 BL-2**

Q. 3 Define the analytic function and derive C-R conditions for analytic function and examine the nature of the function $f(z) = \frac{x^2 y^5 (x+iy)}{x^4+y^{10}}$, $z \neq 0$, $f(0) = 0$ in the region including the origin. **CO-2 BL-2**

Q. 4 Determine the region in the w-plane into which the rectangular region bounded by the lines $x = 0$, $y = 0$, $x = 1$, $y = 2$ in the z-plane is mapped under the transformation. $w = (1 + i)z + (2 - i)$. Discuss also magnification, rotation and translation. **CO-2 BL-2**

Q. 5 Find the bilinear transform which maps the points $z - 1, i, -1$ respectively on to the points $w = i, 0, -i$.
CO-2 BL-2

Q. 6 State and prove of Cauchy-Riemann equation. **CO-2 BL-2**

Q.7 If $f(z)$ is a regular function of z, prove that $\left(\frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2}\right) |f(z)|^2 = 4|f'(z)|^2$ **CO-2 BL-2**