

# ARYA COLLEGE OF ENGINEERING (ACE)

## GUESS PAPER

(B.Tech II<sup>ND</sup> YEAR. III<sup>RD</sup> 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)  $\nabla = (1 - E^{-1})$  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)  $\int_2^{10} \frac{dx}{1+x}$  by dividing the range into eight parts.(INTEGRATION 1/3and3/8)

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

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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	60	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 4<sup>th</sup> 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)

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 BL-3

Q. 2 Using Euler's modified method; obtain a solution of  $\frac{dy}{dx} = x + \sqrt{y}$ ,  $y(0) = 1$  for the range  $0 \leq x \leq 0.4$  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  $x=0$  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:  $f(t) = \begin{cases} \sin(t - \frac{\pi}{3}), & t > \pi/3 \\ 0, & t < \pi/3 \end{cases}$  **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  $\left(\frac{\sin t}{t}\right) = \tan^{-1}\left(\frac{1}{s}\right)$ . Hence find Laplace transform of  $\frac{\sin at}{t}$ . Does  $\cos \frac{at}{t}$  exists? Also prove

$$\text{that } \int_0^\infty \frac{\sin^2 t}{t} dt = \frac{\pi}{2} \quad \text{CO-3 BL-2}$$

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

**Q. 4** Find  $L^{-1}\left[\frac{s}{s^4 + 4a^4}\right]$ . **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 solve the following equations (Only for ECE & ME)

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

### Unit 4:

Short Answers: (2 Marks Each)

**Q. 1** Find the Fourier sine transform of the function  $f(x) = e^{-x}$  and  $f(x) = \frac{1}{x}$ . **CO-4 BL-2**

**Q. 2** Find the Fourier transform of the following functions: **CO-4 BL-4**

# ARYA COLLEGE OF ENGINEERING (ACE)

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

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

**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  $\bar{f}(s)$  is the Fourier transform of  $f(x)$ , then the Fourier transform of  $f(x - a)$  is  $e^{isx}\bar{f}(s)$ . **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**

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

**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**

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

**Q. 5** Express the function  $f(x) = \begin{cases} \frac{2}{\pi} \sin x, & 0 \leq x \leq \pi \\ 0, & x > \pi \end{cases}$  as a Fourier sine integral and hence evaluate  $\int_0^\infty \frac{\sin \pi \lambda \sin x \lambda}{1 - \lambda^2} d\lambda$ .  
**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  $\theta = k \frac{\partial \theta}{\partial x^2}$  using Fourier transform. **CO-4 BL-4**

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

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

### 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 find  $Z\left(\frac{1}{(n+1)!}\right)$

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

Q. 2 If  $Z(u_n) = \bar{u}(z), n \geq 0$  then show that  $\lim_{z \rightarrow \infty} \bar{u}(z) = u_0$ . 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  $Z(n^p) = -z \frac{d}{dz} Z(n^{p-1}); n \geq 0$  CO-5 BL-2

Q. 5 If  $Z(u_n) = \bar{u}(z), n \geq 0$ , then  $\lim_{z \rightarrow \infty} \bar{u}(z) = u_0$ . 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-  $U(k) = \begin{cases} 0, & k < 0 \\ 1, & k \geq 0 \end{cases}$  CO-5 BL-2

Descriptive Answers: (5 to 20 Marks)

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

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

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

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

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

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

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

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### 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  $f(z) = \frac{x^2 y^2 (x+iy)}{x^4 + y^{10}}$ ,  $z \neq 0$ ,  $f(0) = 0$  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  $(\frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2}) |f(z)|^2 = 4|f'(z)|^2$  **CO-2 BL-2**