| Reg. No. | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

| Question Paper Code | 13681 |
|---|---|

**B.E. / B.Tech. - DEGREE EXAMINATIONS, APRIL / MAY 2025**

Second Semester

**Civil Engineering**

(Common to Electrical and Electronics Engineering, Electronics and Communication Engineering, Electronics and Instrumentation Engineering & Electronic Instrumentation and Control Engineering)

**24BSMA202 - DIFFERENTIAL EQUATIONS, COMPLEX VARIABLES AND TRANSFORMS**

Regulations - 2024

Duration: 3 Hours Max. Marks: 100

**PART - A (MCQ) (10 × 1 = 10 Marks)**

Answer ALL Questions

| | Question | Marks | K – Level | CO |
|---|---|---|---|---|
| 1. | Which one of the following is the Homogenous Linear Differential Equation<br>(a) $y'' + 3y' + 3y = x^2e^x$ (b) $x^2y'' + xy' + (x^2-4)y = 0$<br>(c) $3y'' + 2y' + 3y = \cos x$ (d) $y'' - y' + 20y = \sin x$ | 1 | K1 | CO1 |
| 2. | The Wronskian of the differential equation $\frac{d^2y}{dx^2} + y = Cosec\ x$ is<br>(a) 1 (b) -1 (c) 0 (d) 2 | 1 | K2 | CO1 |
| 3. | A function $u$ is said to be harmonic if and only if<br>(a) $u_x + u_y = 0$ (b) $u_{xx} + u_{yy} = 0$ (c) $u_{xx} - u_{yy} = 0$ (d) $u_{xy} + u_{yx} = 0$ | 1 | K1 | CO2 |
| 4. | If $f(z)$ is an analytic function whose real part is constant then $f(z)$ is<br>(a) function of $z$ (b) function of $x$ only (c) function of $y$ only (d) constant | 1 | K1 | CO2 |
| 5. | The value of the integral $\int_C \frac{z^2dz}{z-2}$, where C is the circle $\lvert z\rvert = 3$ is<br>(a) $2\pi i$ (b) $-\pi i$ (c) $4\pi i$ (d) $8\pi i$ | 1 | K2 | CO3 |
| 6. | Find the simple poles for $\int_C \frac{z^2+1}{z^2-2z}dz$<br>(a) The simple poles are z = 1,2 (b) The simple poles are z = 0,2<br>(c) The simple poles are z = 0,1 (d) The simple poles are z = 0, −1 | 1 | K2 | CO3 |
| 7. | The Laplace transform of $\cos at$ is<br>(a) $\frac{s}{s^2-a^2}$ (b) $\frac{s}{s^2+a^2}$ (c) $\frac{a}{s^2+a^2}$ (d) $\frac{a}{s^2-a^2}$ | 1 | K1 | CO4 |
| 8. | A function $f(t)$ is said to be Periodic if<br>(a) $f(t-p) = f(t)$ (b) $f(t-p) = f(p)$ (c) $f(t+p) = f(p)$ (d) $f(t+p) = f(t)$ | 1 | K1 | CO4 |
| 9. | If $F[f(x)] = F(s)$ then $F\left[e^{iax}f(x)\right]$ is<br>(a) $F(s+a)$ (b) $F(s-a)$<br>(c) $\frac{1}{a}[F(s+a) + F(s-a)]$ (d) $\frac{1}{2}[F(s+a) + F(s-a)]$ | 1 | K1 | CO5 |
| 10. | The $Z$ transform of the function $(-2)^k$ is<br>(a) $\frac{z}{z+1}$ (b) $\frac{z}{z+k}$ (c) $\frac{z}{z+2}$ (d) $\frac{z}{z-1}$ | 1 | K2 | CO6 |

**PART - B (12 × 2 = 24 Marks)**

Answer ALL Questions

| | Question | Marks | K – Level | CO |
|---|---|---|---|---|
| 11. | Solve $(D^4 - 2D^3 + D^2)y = 0$. | 2 | K2 | CO1 |
| 12. | Find the equation in $y$ from $\frac{dx}{dt} + 5x - 2y = t$ ; $\frac{dy}{dt} + 2x + y + = 0$. by eliminating $x$. | 2 | K2 | CO1 |
| 13. | Construct the analytic function $f(z)$ for which the real part is $e^x cosy$. | 2 | K2 | CO2 |
| 14. | Define Conformal mapping. | 2 | K1 | CO2 |
| 15. | Define Essential singularity. | 2 | K1 | CO3 |

| | | | | |
|---|---|---|---|---|
| 16. | Classify the nature of the singularity of the function $\frac{\cot(\pi z)}{(z-a)^3}$. | 2 | K2 | CO3 |
| 17. | State First Shifting property in Laplace Transform. | 2 | K1 | CO4 |
| 18. | Find $L[t \sin 3t \cos 2t]$. | 2 | K1 | CO4 |
| 19. | Find the Fourier sine transform of $f(x) = e^{-3x}$. | 2 | K2 | CO5 |
| 20. | Define Fourier cosine transform and its inversion formula. | 2 | K1 | CO5 |
| 21. | Find $Z[2 \cdot 3^n + 5(-2)^n]$. | 2 | K2 | CO6 |
| 22. | Form the difference equation of second order by eliminating the arbitrary constants A and B from $y_n = A(-2)^n + Bn$. | 2 | K2 | CO6 |

**PART - C (6 × 11 = 66 Marks)**

Answer ALL Questions

| | | | | | |
|---|---|---|---|---|---|
| 23. | a) | Solve $(D^2+4)y = \sec 2x$ by the method of variation of parameters. | 11 | K3 | CO1 |
| | | **OR** | | | |
| | b) | Solve $x^2\frac{d^2y}{dx^2} - 3x\frac{dy}{dx} + 4y = x^2 + \cos(\log x)$. | 11 | K3 | CO1 |
| 24. | a) | Solve the analytic function whose real part is $\frac{\sin 2x}{\cosh 2y - \cos 2x}$. | 11 | K3 | CO2 |
| | | **OR** | | | |
| | b) | Construct the bilinear transformation that maps the points $z = 0, 1, \infty$ of the z- plane into the points $w = -5, -1, 3$ of the w- plane. Also find its fixed (Invariant) points. | 11 | K3 | CO2 |
| 25. | a) | Expand the Laurent's series expansion of $f(z) = \frac{z}{(z+1)(z+2)}$ in the region $(i)\ 1 < \lvert z\rvert < 2$ $(ii) \lvert z-1\rvert < 1$ and $(iii) \lvert z\rvert > 2$. | 11 | K3 | CO3 |
| | | **OR** | | | |
| | b) | Apply Cauchy's Residue theorem to find the value of $\int_C \frac{z-1}{(z+1)^2(z-2)}dz$, where $C: \lvert z-i\rvert = 2$. | 11 | K3 | CO3 |
| 26. | a) | Find the Laplace transform of the periodic function $f(t) = \begin{cases} t & 0 \le t \le a \\ 2a-t, & a < t \le 2a \end{cases}$ and $f(t+2a) = f(t)$. | 11 | K3 | CO4 |
| | | **OR** | | | |
| | b) | Apply convolution theorem to find $L^{-1}\left[\frac{s^2}{(s^2+a^2)^2}\right]$. | 11 | K3 | CO4 |
| 27. | a) | Determine the Fourier transform of $f(x)$ given by $f(x) = \begin{cases} a^2 - x^2; & \lvert x\rvert < a \\ 0; & \lvert x\rvert > a > 0 \end{cases}$. Hence prove that $\int_0^\infty \frac{\sin x - x\cos x}{x^3}dx = \frac{\pi}{4}$. | 11 | K3 | CO5 |
| | | **OR** | | | |
| | b) | Apply Fourier transforms to find the value $\int_0^\infty \frac{dx}{(x^2+a^2)(x^2+b^2)}$. | 11 | K3 | CO5 |
| 28. | a) | Apply convolution theorem to find the inverse Z-transform of $\frac{8z^2}{(2z-1)(4z-1)}$. | 11 | K3 | CO6 |
| | | **OR** | | | |
| | b) | Solve: $u_{n+2} + 4u_{n+1} + 3u_n = 3^n$ given that $u_0 = 0, u_1 = 1$. | 11 | K3 | CO6 |