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ANNA UNIVERSITY (UNIVERSITY DEPARTMENTS)

B.E. /B.Tech / B. Arch (Full Time) - END SEMESTER EXAMINATIONS, APRIL/MAY 2025

Common to All Branches

MA5252 - ENGINEERING MATHEMATICS - II

(Regulation2019)

Time: 3hrs. Max.Marks: 100

CO1	Calculate grad, div and curl and use Gauss, Stokes and Greens theorems to simplify calculations of integrals.
CO2	Construct analytic functions and use their conformal mapping property in application problems.
CO3	Evaluate real and complex integrals using the Cauchy's integral formula and residue theorem.
CO4	Apply various methods of solving differential equation which arise in many application problems.
CO5	Apply Laplace transform methods for solving linear differential equations.

BL – Bloom's Taxonomy Levels

(L1-Remembering, L2-Understanding, L3-Applying, L4-Analysing, L5-Evaluating, L6-Creating)

PART- A (10x2=20 Marks)

Answer all the Questions:

Q.No	Questions	Marks	CO	BL
1	Find the directional derivative of $\varphi(x,y,z)=\left(x^2+y^2+z^2\right)^{-\frac{1}{2}}$ at (3, 1, 2) in the direction of $yz\vec{i}+zx\vec{j}+xy\vec{k}$.	**2**	1	L5
2	Determine the constants a so that $\vec{F}=(x+3y)\vec{i}+(y-3z)\vec{j}+(x-az)\vec{k}$ is a solenoidal vector.	**2**	1	L5
3	Prove that f(z) = sinz is an analytic function.	**2**	2	L6
4	Find the fixed points of the transformation $f(z)=\dfrac{z+4}{z+5}$.	**2**	2	L5
5	State Cauchy Integral Theorem.	**2**	3	L1
6	Evaluate $\int_C \dfrac{3z^2+z}{(z^2-1)}dz$, where C is the circle $\lvert z-1\rvert=1$.	**2**	3	L5
7	Find Complementary function of the equation $(x^4D^3+2x^3D^2-x^2D+x)\,y=1$.	**2**	4	L5
8	Write the particular integral of $(D^2-3D+2)y=x$.	**2**	4	L5
9	Obtain the Laplace transform of $f(t)=t^3e^{-3t}$.	**2**	5	L5
10	Find the Inverse Laplace Transform of $\dfrac{s+8}{s^2+4s+5}$.	**2**	5	L5

PART- B (5x13=65 Marks)

Q.No.	Questions	Marks	CO	BL
11 (a)	i. Verify Gauss divergence theorem for $\vec{F}=x^2\vec{i}+z\vec{j}+yz\vec{k}$ the surface taken over the cube bounded by the planes x = 0, x =1, y = 0 y =1, z = 0, z = 1.	**10**	1	L4
	ii. With the usual notation of $\vec{r}$, find grad r^n.	**3**	1	L5
	OR			
11 (b)	i).Verify Stoke's theorem for $\vec{F}=(x^2+y^2)\vec{i}-2xy\vec{j}$, taken round the	7	1	L4

	rectangle bounded by the lines $x = -a$, $x = a$, $y = 0$, $y = b$.			
	ii).Evaluate $\int_C (y-\sin x)dx + \cos x dy$, using Green's theorem where C is the closed curve formed by $y = 0$, $x = \pi/2$, $y = 2x/\pi$.	**6**	1	L5
12 (a)	i). If $z=x+iy$, then prove that $\left(\frac{\partial^2}{\partial x^2}+\frac{\partial^2}{\partial y^2}\right) = 4\frac{\partial^2}{\partial z \partial \bar{z}}$.	**6**	2	L6
	ii). If $v(x, y) = 3x^2y + x^2 - y^3 - y^2$, then find the analytic function.	**7**	2	L5
	OR			
12 (b)	i).Determine the region of the w – plane into which the region bounded $x=1$, $x=3$, $y=1$ and $y=2$ in the z plane is mapped by the transformation $w = z^2$.	**6**	2	L5
	ii). Find the bilinear transformation that maps the points $z = 0, -i, -1$ into the points $w = i, 1, 0$ respectively.	**7**	2	L5
13 (a)	i). Expand $\frac{1}{z(1-z)}$ in the regions i) $\|z+1\|<1$ ii) $1<\|z+1\|<2$ iii) $\|z+1\|>2$.	**8**	3	L5
	ii) Obtain the residues $\frac{z}{(z+1)(z-2)}$ at its poles inside $\|z\|=2$.	**5**	3	L5
	OR			
13 (b)	i).Apply Calculus of residues, find $\int_{-\infty}^{\infty} \frac{x^2 dx}{(x^2+a^2)^2}$, $a > 0$.	**10**	3	L5
	ii). Classify the singularity of $f(z) = \frac{1}{z}\sin z$.	**3**	3	L5
14 (a)	i). Solve $(D^2+a^2)y = \tan ax$, using method of variations of parameter.	**6**	4	L5
	ii). Solve $(D^4-1)y = \cos x \cosh x$.	**7**	4	L5
	OR			
14 (b)	i). Solve $(x^3D^3+2x^2D^2+2)y = 10\left(x+\frac{1}{x}\right)$.	**7**	4	L5
	ii). Solve $Dx+y = \sin t$, $Dy+x = \cos t$, $D = d/dt$, given $x(0) = 2$, $y(0) = 0$.	**6**	4	L5
15 (a)	i).Use Laplace transform, evaluate the integral $\int_0^{\infty} \frac{e^{-t}\sin^2 t}{t} dt$.	**6**	5	L5
	ii). Obtain the $L^{-1}\left\{\frac{1}{s^2(s+5)}\right\}$.	**7**	5	L5
	OR			
15 (b)	i. Using Laplace transform, solve $y'' - 3y' + 2y = 4t + e^{3t}$, with $y(0) = 1$, $y'(0) = -1$.	**10**	5	L5
	ii. Verify initial value theorem for $f(t) = t^2 \sin t$.	**3**	5	L6

PART- C(1x 15=15Marks)

(Q.No.16 is compulsory)

Q.No.	**Questions**	**Marks**	**CO**	**BL**
16.	i). Find the Laplace transform of $f(x) = \begin{cases} -k, 0 \le t \le a \\ k, a \le t \le 2a \end{cases}$ and $f(t+2a) = f(t)$ for all t.	**8**	5	L5
	ii).Find the image of the regions $x > c, c > 0$ and $y > c, c < 0$, under the transformation $w = \frac{1}{z}$.	**7**	2	L5