SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)

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COIMBATORE-641 035, TAMIL NADU

DEPARTMENT OF MATHEMATICS

CourseCode:	**23MAT102**
CourseName:	**COMPLEX ANALYSIS AND LAPLACE TRANSFORMS**
Year/Sem:	**I/II**

QUESTION BANK
UNIT-I VECTOR CALCULUS

Unit-I /Part-A/2Marks				
S.No	**Questions**	**Mark Splitup**	**K – Level**	**CO**
1.	Find $\nabla(r^n)$.	2	K2	CO1
2.	Find $\nabla(\log r)$.	2	K2	CO1
3.	Find $grad\phi$ if $\phi=3x^2y-y^3z^2$ at the point $(1,-2,-1)$.	2	K2	CO1
4.	Find the unit normal to the surface $x^2+y^2-z^2=1$ at $(1,1,1)$.	2	K2	CO1
5.	Find the directional derivative of $\phi=x^2yz+4xz^2$ at the Point $(1,-2,-1)$ in the direction of $2\vec{i}-\vec{j}-2\vec{k}$.	2	K2	CO1
6.	Prove that $div\vec{r}=3$ and $curl\vec{r}=\vec{0}$.	2	K1	CO1
7.	Show that $\vec{F}=(x+2y)\vec{i}+(y+3z)\vec{j}+(x^2-2z)\vec{k}$ is solenoidal.	2	K1	CO1
8.	Find a such that $\vec{F}=(3x-2y+z)\vec{i}+(4x+ay-z)\vec{j}+(x-y+2z)\vec{k}$ is solenoidal.	2	K2	CO1
9.	Prove that $\vec{F}=yz\vec{i}+zx\vec{j}+xy\vec{k}$ is irrotational.	2	K2	CO1
10.	Find the values of a,b,c so that the vector $\vec{F}=(x+y+az)\vec{i}+(bx+2y-z)\vec{j}+(-x+cy+2z)\vec{k}$ is irrotational.	2	K2	CO1
11.	Find the values of a,b,c so that the vector $\vec{F}=(x+2y+az)\vec{i}+(bx-3y-z)\vec{j}+(4x+cy+2z)\vec{k}$ is irrotational.	2	K2	CO1
12.	If $\vec{A}$ and $\vec{B}$ are irrotational, then prove that $\vec{A}\times\vec{B}$ is solenoidal.	2	K2	CO1
13.	Prove that curl(gradϕ)$=\vec{0}$.	2	K2	CO1
14.	If $\vec{F}=x^3\vec{i}+y^3\vec{j}+z^3\vec{k}$, then find $div(curl\vec{F})$.	2	K1	CO1
15.	State Green's theorem.	2	K1	CO1
16.	Find area of a circle of radius a using Green's theorem	2	K2	CO1
17	State Gauss divergence theorem.	2	K1	CO1
18	State Stoke'stheorem.	2	K1	CO1

Unit - I / Part - B/ 16, 8 Marks				
S.No	**Questions**	**Marks Splitup**	**K - Level**	**CO**
1.	Find the angle between the surfaces $x \log z = y^2 - 1$ and $x^2y = 2 - z$ at the point $(1, 1, 1)$.	8	K2	CO1
2.	Find a and b so that the surfaces $ax^3 - by^2z - (a+3)x^2 = 0$ And $4x^2y - z^3 - 11 = 0$ cut orthogonally at the point $(2, -1, -3)$.	8	K2	CO1
3.	Find a and b so that the surfaces $ax^2 - byz = (a+2)x$ and $4x^2y + z^3 = 4$ cut orthogonally at the point $(1, -1, 2)$.	8	K2	CO1
4.	Show that $\vec{F} = (6xy + z^3)\vec{i} + (3x^2 - z)\vec{j} + (3xz^2 - y)\vec{k}$ is irrotational vector and find the scalar potential φ such that $\vec{F} = \nabla\varphi$	8	K2	CO1
5.	Prove that $\vec{F} = (y^2 \cos x + z^3)\vec{i} + (2y \sin x - 4)\vec{j} + 3xz^2\vec{k}$ is irrotational and find its scalar potential.	8	K2	CO1
6.	If $\vec{r}$ is the position vector of the point (x, y, z), Prove that $\nabla^2 r^n = n(n+1)r^{n-2}$. Hence find the value of $\nabla^2\left(\frac{1}{r}\right)$.	8	K2	CO1
7.	If $\vec{A} = (3x^2 + 6y)\vec{i} + 14yz\vec{j} + 20xz^2\vec{k}$, evaluate $\int_C \vec{A} \cdot d\vec{r}$ $(0, 0, 0)$ to $(1, 1, 1)$ over the curve $x = t, y = t^2, z = t^3$ and $\vec{r}$ is the position vector.	8	K3	CO1
8.	Find the work done by the force $\vec{F} = (x^2 - y^2 + x)\vec{i} - (2xy + y)\vec{j}$ which moves a particle in xy plane from $(0, 0)$ to $(1, 1)$ along the parabola $y^2 = x$.	8	K3	CO1
9.	Verify Green's theorem for $\int_C [(xy + y^2)\, dx + x^2\, dy]$ where C is the boundary of the common area between $y = x^2$ and $y = x$.	16	K3	CO1
10.	Verify Green's theorem in a plane for $\int_C [(3x^2 - 8y^2)dx + (4y - 6xy)dy]$, where C is the boundary of the region defined by $x = y^2$, $y = x^2$.	16	K3	CO1
11.	Verify Green's theorem in a plane for $\int_C [3x - 8y^2)dx + (4y - 6xy)dy]$, where C is the boundary of the region defined by the lines $x = 0$, $y = 0$ and $x + y = 1$.	16	K3	CO1
12.	Verify Gauss Divergence theorem for $\vec{F} = 4xz\,\vec{i} - y^2\,\vec{j} + yz\,\vec{k}$ over the cube bounded by $x = 0, x = 1, y = 0, y = 1, z = 0, z = 1$.	16	K3	CO1
13.	Verify Gauss Divergence theorem for $\vec{F} = (x^2 - yz)\vec{i} + (y^2 - zx)\vec{j} + (z^2 - xy)\vec{k}$ taken over the rectangular parallelopiped bounded by $x = 0, y = 0, z = 0$ and $x = a, y = b, z = c$.	16	K3	CO1

14.	Verify Gauss Divergence theorem for the vector function $\vec{F} = (x^3 - yz)\vec{i} - 2x^2y\vec{j} + 2\vec{k}$ over the cube bounded by $x = 0, y = 0, z = 0$ and $x = a, y = a, z = a$.	16	K3	CO1
15.	Verify Stoke's theorem for $\overline{F} = (x^2 + y^2)\,\vec{i} - 2\,xy\,\vec{j}$ taken round the rectangle bounded by the lines $x = \pm a, y = 0, y = b$	16	K3	CO1
16.	Verify Stoke's theorem for $\overline{F} = (y - z + 2)\,\vec{i} + (yz + 4)\,\vec{j} - xz\,\vec{k}$ over the cube bounded by $x = 0, y = 0, z = 0$ and $x = 1, y = 1, z = 1$.	16	K3	CO1
17.	Verify Stoke's theorem for $\overline{F} = (x^2 - y^2)\,\vec{i} + 2\,xy\,\vec{j}$ taken round the rectangle bounded by the lines $x = 0,\ x = a,\ y = 0,\ y = b$.	16	K3	CO1

UNIT - II

Unit - II / Part - A / 2 Marks				
S.No	**Questions**	**Mark Splitup**	**K – Level**	**CO**
1.	Solve $(D^2 + 5D + 4) = 0$.	2	K2	CO2
2.	Solve $\frac{d^2y}{dx^2} + 2\frac{dy}{dx} - 2y = 0$.	2	K2	CO2
3.	Solve $\frac{d^4y}{dx^4} = 16y$.	2	K2	CO2
4.	Solve $(D^4 - 2D^3 + D^2)y = 0$.	2	K2	CO2
5.	Solve $(D^4 - 2D^2 + 1)y = 0$.	2	K2	CO2
6.	Solve $y''' + 2y'' + y' = 0$.	2	K2	CO2
7.	Solve $(D^3 + 1)y = 0$	2	K2	CO2
8.	Solve $(D^2 + 1)y = e^{-x}$.	2	K2	CO2
9.	Find the particular integral of $\left(D^2 - 4\right)y = e^{2x}$.	2	K2	CO2
10.	Find the particular integral of $(D^3 + 8)y = e^{-2x}$	2	K2	CO2
11.	Find the particular integral of $(D^2 - a^2)y = e^{ax}$.	2	K2	CO2
12.	Find the particular integral of $(D - m)^2 y = e^{mx}$	2	K2	CO2
13.	Find the complementary function of $(D^2 + 4)^2 = \cos x$	2	K2	CO2
14.	Find the particular integral of $(D^4 + D^2)y = \sin x$	2	K2	CO2
15.	Find the particular integral of $(D - 1)^2 = \sinh 2x$	2	K2	CO2
16.	Find the particular integral of $(D - 1)^2\, y = \cosh 2x$	2	K2	CO2
17.	Find the particular integral of $\frac{d^2y}{dx^2} + 4y = \sin 2x$.	2	K2	CO2

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18.	Find the particular integral of $(D^4+D^2)y = \sin x$	2	K2	CO2
19	Find the particular integral of $(D^2+2)y = x^2$.	2	K2	CO2
20.	Find the particular integral of $(D+1)^2 y = e^{-x}\cos x$.	2	K2	CO2
21.	Find the particular integral of $(D^2-2D+5)y = e^x \sin 2x$	2	K2	CO2
22.	Find the particular integral of $(D^2-2D+5)y = e^x \sin 2x$	2	K2	CO2
23.	Reduce the equation $x^2\frac{d^2y}{dx^2} - x\frac{dy}{dx} + y = 0$ to homogeneous differential equation with constant coefficients.	2	K2	CO2
24.	Solve $(x^2D^2 + xD)y = 0$.	2	K2	CO2
25.	Solve $x^2y'' - 2xy' + 2y = 0$.	2	K2	CO2
26.	Transform $(x+2)^2\frac{d^2y}{dx^2} - (x+2)\frac{dy}{dx} + y = 3x + y$ in to differential equation with constant coefficients.	2	K2	CO2
27.	Eliminate x and find the equation in y from $\frac{dx}{dt} + 5x - 2y = t$; $\frac{dy}{dt} + 2x + y + = 0$.	2	K2	CO2

Unit - II / Part - B / 16, 8 Marks				
S.No	**Questions**	**Marks Splitup**	**K - Level**	**CO**
1.	Solve $(D^2+4D+3)y = e^{-x}\sin x + xe^{3x}$.	8	K2	CO2
2.	Solve $(4D^2-4D+1)y = 4$.	8	K2	CO2
3.	Solve $(D^2-4D+13)y = e^{2x}\sin 3x$.	8	K2	CO2
4.	Solve $(D^2+5D+4)y = 4e^{-x} + x$.	8	K2	CO2
5.	Solve $(D^2+4)y = x^2\cos 2x$.	8	K2	CO2
6.	Solve $(D^2+16)y = \cos^3 x$.	8	K2	CO2
7.	Solve $y^{11} - 2y^1 + y = xe^x \sin x$..	8	K2	CO2
8.	Solve $(D^2 + 4D + 5)y = e^x + x^3 + cos2x + 1$	8	K2	CO2
9.	Solve $(D^2+a^2)y = \tan ax$ by the method of variation of parameters.	8	K2	CO2
10.	Solve $(D^2+4)y = \sec 2x$ by the method of variation of parameters.	8	K2	CO2
11.	Solve $(D^2-4D+4)y = e^{2x}$ by the method of variation of parameters.	8	K2	CO2
12.	Solve $y^{11} + 9y = \cot 3x$. by the method of variation of parameters.	8	K2	CO2

13.	Solve $(D^2+1)y = x\sin x$ by the method of variation of parameters.	8	K2	CO2
14.	Solve $(D^2+1)y = cosecx$ by the method of variation of parameters.	8	K2	CO2
15.	Solve $x^2\frac{d^2y}{dx^2} - 3x\frac{dy}{dx} + 4y = x^2 + \cos(\log x)$.	8	K3	CO2
16.	Solve $(x^2D^2 - xD + 1)y = \left(\frac{\log x}{x}\right)^2$.	8	K3	CO2
17.	Solve $(x^2D^2 - 3xD + 5)y = x^2\sin(\log x)$.	8	K3	CO2
18.	Solve $x^2\frac{d^2y}{dx^2} + x\frac{dy}{dx} + y = \log x\sin(\log x)$	8	K3	CO2
19.	Solve $(3x+2)^2\frac{d^2y}{dx^2} + 3(3x+2)\frac{dy}{dx} - 36y = 3x^2 + 4x + 1$.	8	K3	CO2
20.	Solve $((1+x)^2D^2 + (1+x)D + 1)y = 4\,cos[log(1+x)]$	8	K3	CO2
21.	Solve $\left((1+x)^2D^2 + (1+x)D + 1\right)y = 2\sin\log(1+x)$.	8	K3	CO2
22.	Solve $(x+2)^2\frac{d^2y}{dx^2} - (x+2)\frac{dy}{dx} + y = 3x + 4$.	8	K3	CO2
23.	Solve the simultaneous equations $\frac{dx}{dt} + 2x - 3y = 5t; \frac{dy}{dt} - 3x + 2y = 0$ *given that* $x(0) = 0$ & $y(0) = -1$.	8	K3	CO2
24.	Solve the simultaneous equations $\frac{dx}{dt} + 2y + sint = 0$; $\frac{dy}{dt} - 2x - cost = 0$ given that $x = 0$ and $y = 1$ at $t = 0$.	8	K3	CO2
25.	Solve the simultaneous equations $\frac{dx}{dt} + 2y = 5e^t$; $\frac{dy}{dt} - 2x = 5e^t$ given that $x = -1$ and $y = 3$ at $t = 0$.	8	K3	CO2
26.	Solve the following simultaneous differential equations $\frac{dx}{dt} + 2y = \sin 2t$; $\frac{dy}{dt} - 2x = \cos 2t$.	8	K3	CO2
27.	Solve the following simultaneous differential equations $Dx + y = \sin 2t$; $-x + Dy = \cos 2t$.	8	K3	CO2
28.	Solve the following simultaneous differential equations $\frac{dx}{dt} - \frac{dy}{dt} + 2y = cos2t, \frac{dx}{dt} + \frac{dy}{dt} - 2x = sin2t$	8	K3	CO2

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UNIT - III

Unit - II / Part - A / 2 Marks				
S.No	Questions	Mark Splitup	K – Level	CO
1.	Define analytic function of a complex variable.	2	K2	CO3
2.	Write the necessary condition for $f(z)$ to be analytic	2	K2	CO3
3.	Check whether $w = \bar{z}$ is analytic everywhere.	2	K2	CO3
4.	Test the analyticity of the function $w = \sin z$.	2	K2	CO3
5.	Determine whether the function $2xy + i\,(x^2 - y^2)$ is analytic or not.	2	K1	CO3
6.	For what values of a, b and c the function $f(z) = x + ay - i\,(bx + cy)$ is analytic.	2	K3	CO3
7.	Verify the function $u = log\sqrt{x^2 + y^2}$ is harmonic or not?	2	K3	CO3
8.	Show that $u = 2x\,(1 - y)$ is harmonic.	2	K1	CO3
9.	Find the value of m if $u = 2x^2 - my^2 + 3x$ is harmonic.	2	K1	CO3
10.	Prove that an analytic function whose real part is constant must itself be a constant.	2	K1	CO3
11.	Prove that an analytic function with constant imaginary part is constant.	2	K1	CO3
12.	Construct the analytic function $f(z)$ for which the real part is $e^x cosy$.	2	K1	CO3
13.	Define conformal mapping.	2	K1	CO3
14.	Find the image of the circle $\|z\| = 3$ under the transformation $w = 2z$.	2	K1	CO3
15.	Find the critical points of the transformation $w^2 = (z - \alpha)(z - \beta)$.	2	K1	CO3
16.	Find the invariant points of the bilinear transformation $w = \frac{1+z}{1-z}$.	2	K1	CO3
17.	Find the fixed points of the transformation $w = \frac{6z-9}{z}$.	2	K2	CO3
18.	Define bilinear transformation.	2	K2	CO3

Unit - III / Part - B / 16, 8 Marks				
S.No	Questions	Marks Splitup	K – Level	CO
1.	Prove that the real and imaginary parts of an analytic function are harmonic functions.	8	K2	CO3
2.	Show that an analytical function with constant modulus is constant.	8	K2	CO3
3.	If $w = u(x,y) + i\,v(x,y)$ is an analytic function the curves of the family $u(x,y) = a$ and the curves of the family $v(x,y) = b$ cut orthogonally, where a and b are varying constants.	8	K2	CO3

4.	If $f(z)$ is a regular function of z, then prove that $\nabla^2 \lvert f(z)\rvert^2 = 4\,\lvert f'(z)\rvert^2$.	8	K2	CO3
5.	If $f(z)$ is an analytic (regular) function of z, then prove that $\nabla^2 \log \lvert f(z)\rvert = 0$.	8	K2	CO3
6.	Determine the analytic function where real part is $u = x^3 - 3xy^2 + 3x^2 - 3y^2 + 1$.	8	K2	CO3
7.	Find an analytic function $u = e^x(x\cos y - y\sin y)$ also find conjugate harmonic function	8	K2	CO3
8.	Show that the function $u = \frac{1}{2}\log(x^2 + y^2)$ is harmonic and determine its conjugate. Also find $f(z)$.	8	K2	CO3
9.	Determine the analytic function whose real part is $\frac{\sin 2x}{\cosh 2y - \cos 2x}$.	8	K2	CO3
10.	Find the analytic function $f(z) = u + iv$ given that $2u + 3v = e^x(\cos y - \sin y)$.	8	K2	CO3
11.	Show that $v = e^{-x}(x\cos y + y\sin y)$ is harmonic function. Hence find the analytic function $f(z)$.	8	K2	CO3
12.	Find the analytic function $f(z) = u + iv$ given that $u - v = e^x(\cos y - \sin y)$.	8	K2	CO3
13	Find the analytic function $f(z) = u + iv$, if $u + v = \frac{\sin 2x}{\cosh 2y - \cos 2x}$	8	K2	CO3
14.	Find the image of the circle $\lvert z - 2i\rvert = 2$ under the transformation $w = \frac{1}{z}$.	8	K3	CO3
15.	Find the image of the circle $\lvert z - 1\rvert = 1$ under the transformation $w = \frac{1}{z}$.	8	K3	CO3
16.	Find the image of the infinite strips $(i)\ \frac{1}{4} < y < \frac{1}{2}$ $(ii)\ 0 < y < \frac{1}{2}$ under the transformation $w = \frac{1}{z}$.	8	K3	CO3
17.	Find the image of the half plane $x > c$, when $c > 0$ under the transformation $w = \frac{1}{z}$. Show the regions graphically.	8	K3	CO3
18.	Find the image of infinite strip $1 < x < 2$ under the transformation $w = \frac{1}{z}$.	8	K3	CO3
19.	Find the bilinear transformation that maps the points $z = 0, -1, i$ into the points $w = i, 0, \infty$ respectively.	8	K3	CO3
20.	Find the bilinear transformation that maps the points $z = -2, 0, 2$ into the points $w = 0, i, -i$ respectively	8	K3	CO3
21.	Find the bilinear mapping which maps points $z = 0, 1, \infty$ into $w = i, 1, -i$ respectively.	8	K3	CO3
22.	Find the bilinear transformation that transforms the points $z = 1, i, -1$ into the points $w = 2, i, -2$ respectively.	8	K3	CO3
23.	Find 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.	8	K3	CO3
24.	Find the bilinear transformation that transforms the points $z = 1, i, -1$ into the points $w = 2, i, -2$ respectively. Also	8	K3	CO3

	find its fixed(Invariant) points.			
25.	Find the bilinear transformation which maps the points $1, i, -1$ onto points $0, 1, \infty$, show that the transformation maps the interior of the circle of the z- plane onto the upper half of the w plane.	8	K3	CO3
26.	Find the bilinear transformation that transforms $-1, 0, 1$ of the z- plane onto $-1, -i, 1$ of the w- plane. Show that under this transformation the upper half of the z-plane maps on to the interior of the unit circle $\lvert w \rvert = 1$.	8	K3	CO3

UNIT - IV

Unit - IV / Part - A / 2 Marks				
S.No	Questions	Mark Splitup	K - Level	CO
1.	State Cauchy's Integral Theorem	2	K1	CO4
2.	Write Cauchy's Integral formula and its derivatives.	2	K1	CO4
3.	Define Taylor's Series	2	K1	CO4
4.	Expand $\frac{1}{z-2}$ at $z = 1$ in Taylor's series.	2	K2	CO4
5.	Define Laurent's Series Expansion.	2	K1	CO4
6.	Define pole and give an example.	2	K1	CO4
7.	Define an isolated singularity and give an example.	2	K1	CO4
8.	Define Essential singularity and give an example.	2	K1	CO4
9.	Define Removable singularity and give an example.	2	K1	CO4
10.	Define Residue.	2	K1	CO4
11.	Discuss the nature of the singularity of the function $\frac{\sin z - z}{z^3}$	2	K2	CO4
12.	Discuss the nature of the singularity of the function $\frac{e^{\frac{1}{z}}}{(z-a)^2}$	2	K2	CO4
13.	Discuss the nature of the singularity of the function $\frac{e^z}{z^2+4}$	2	K2	CO4
14.	Discuss the nature of the singularity of the function $\frac{\cot(\pi z)}{(z-a)^2}$	2	K2	CO4
15.	State Cauchy's Residue Theorem	2	K2	CO4
16.	Find the residue of $\frac{1-e^{2z}}{z^4}$ at $z = 0$	2	K2	CO4
17.	Evaluate $\int_C \frac{dz}{z+4}$, where C is the circle $\lvert z \rvert = 2$.	2	K2	CO4
18.	Find the residue of the function $f(z) = \frac{4}{z^3(z-2)}$.	2	K1	CO4

Unit - IV / Part - B/ 16, 8 Marks				
S.No	**Questions**	**Marks Splitup**	**K - Level**	**CO**
1.	Evaluate $\int_C \frac{\sin \pi z^2+\cos \pi z^2}{(z-1)(z-2)} dz$, Where $C: \|z\| = 3$ by using Cauchy's integral formula.	8	K2	CO4
2.	Evaluate $\int_C \frac{\cos \pi z^2}{(z-1)(z-2)} dz$, where $C: \|z\| = \frac{3}{2}$	8	K2	CO4
3.	Evaluate $\int_C \frac{z}{(z-2)^2 (z-1)} dz$, where C is the circle $\|z-2\| = \frac{1}{2}$ by using Cauchy's integral formula.	8	K2	CO4
4.	Using Cauchy's integral formula, evaluate $\int_C \frac{(z+4)}{(z^2+2z+5)} dz$, where C is the circle $\|z+1+i\| = 2$.	8	K2	CO4
5.	If $f(a) = \int_C \frac{3z^2+7z+1}{z-a} dz$, where $C: \|Z\| = 2$, find $f(3), f(1), f'(1-i)$ & $f''(1-i)$	8	K2	CO4
6.	Evaluate $\int_C \frac{dz}{(z+1)^2(z-2)}$, where $C$is the circle $\|z\| = \frac{3}{2}$.	8	K2	CO4
7.	Find the Taylor's Series to represent the function $\frac{z^2-1}{z^2+5z+6}$ in the region $(i)\ 2 < \|z\| < 3$ and $(ii)\ \|z\| < 2$	8	K2	CO4
8.	Expand $\frac{1}{z^2-3z+2}$ in the region $(i)\ 1 < \|z\| < 2$ $(ii)\ \|z-1\| < 1$ and $(iii) \|z\| > 2$.	8	K2	CO4
9.	Expand $f(z) = \frac{1}{(z+1)(z+3)}$ as a Laurent's Series if $1 < \|z\| < 3$ and $\|z\| > 3$	8	K2	CO4
10.	Find the Laurent's series expansion of $f(z) = \frac{7z-2}{z(z-2)(z+1)}$ in $1 < \|z+1\| < 3$	8	K2	CO4
11.	Expand $f(z) = \frac{z}{(z+1)(z+2)}$ as Laurent's series valid in the following $(i)\ 1 < \|z\| < 2$. $(ii)\ \|z-1\| < 1$ and $(iii)\ \|z\| > 2$	8	K2	CO4
12.	Evaluate $\int_C \frac{z^2}{(z-1)^2(z+2)} dz$, where C is the circle $\|z\| = 3$, using Cauchy's Residue Theorem.	8	K2	CO4
13.	Evaluate $\int_C \frac{z-1}{(z+1)^2(z-2)} dz$, where $C: \|z-i\| = 2$, using Cauchy's Residue Theorem.	8	K2	CO4

14.	Evaluate $\int_C \frac{dz}{(z^2+4)^2}$, where C is the circle $\lvert z-i\rvert = 2$, using Cauchy's Residue Theorem.	8	K2	CO4
15.	Evaluate $\int_C \frac{z}{(z^2+1)^2} dz$, where C is the circle $\lvert z-i\rvert = 1$, using Cauchy's Residue Theorem.	8	K2	CO4
16.	Using Cauchy's Residue Theorem to evaluate $\int_C \frac{3z^2+z+1}{(z^2-1)(z-3)} dz$, where C is the circle $\lvert z\rvert = 2$	8	K2	CO4
17.	Evaluate $\int_0^{2\pi} \frac{d\theta}{a+b\cos\theta}$ by using contour integration.	8	K3	CO4
18.	Evaluate $\int_0^{2\pi} \frac{d\theta}{a+b\sin\theta}$ by using contour integration.	8	K3	CO4
19.	Evaluate $\int_0^{2\pi} \frac{d\theta}{2+\cos\theta}$ by using contour integration	8	K3	CO4
20.	Evaluate $\int_0^{2\pi} \frac{d\theta}{13+5\cos\theta}$ by using contour integration	8	K3	CO4
21.	Evaluate $\int_0^{2\pi} \frac{d\theta}{13+5\sin\theta}$ by using contour integration.	8	K3	CO4
22.	Evaluate $\int_0^{2\pi} \frac{d\theta}{5-4\sin\theta}$ by using contour integration	8	K3	CO4
23.	Evaluate $\int_0^{2\pi} \frac{\cos m\theta}{a+b\cos\theta} d\theta$ by using contour integration	8	K3	CO4
24.	Evaluate $\int_0^{2\pi} \frac{\cos 3\theta}{5-4\cos\theta} d\theta$ by using contour integration	8	K3	CO4
25.	Evaluate $\int_0^{\infty} \frac{x^2 dx}{(x^2+a^2)(x^2+b^2)}$, $a > 0, b > 0$ using contour integration.	8	K3	CO4
26.	Evaluate $\int_0^{\infty} \frac{dx}{(x^2+a^2)(x^2+b^2)}$, $a > 0, b > 0$ using contour integration.	8	K3	CO4
27.	Evaluate $\int_0^{\infty} \frac{x^2 dx}{(x^2+4)(x^2+9)}$, $a > 0, b > 0$ using contour integration.	8	K3	CO4
28.	Evaluate $\int_0^{\infty} \frac{dx}{(1+x^2)^2}$ using contour Integration.	8	K3	CO4
29.	Evaluate $\int_{-\infty}^{\infty} \frac{x^2 dx}{(x^2+1)(x^2+4)}$ using contour integration	8	K3	CO4
30.	Evaluate $\int_0^{\infty} \frac{\cos ax}{x^2+1} dx$, $a > 0$	8	K3	CO4
31.	Evaluate $\int_0^{\infty} \frac{x \sin mx}{x^2+a^2} dx$, $a > 0, m > 0$	8	K3	CO4

UNIT - V

Unit - V / Part - A / 2 Marks				
S.No	**Questions**	**Mark Splitup**	**K - Level**	**CO**
1.	Define Laplace Transform of $f(t)$.	2	K1	CO5
2.	Change of scale of Laplace Transform. (or) If $L[f(t)] = F(s)$, then $L[f(at)] = \frac{1}{a} F\left(\frac{s}{a}\right), a > 0$.	2	K1	CO5
3.	State and prove First Shifting property.	2	K1	CO5
4.	Find $L[t \ \sin at]$	2	K1	CO5
5.	Find $L[t^2 e^{-3t}]$	2	K1	CO5
6.	$L[sin^2 2t]$	2	K1	CO5
7.	Find $L[\sin 5t \cos 2t]$	2	K1	CO5
8.	Find $L\left[\frac{\sin at}{t}\right]$. Hence, show that $\int_0^{\infty} \frac{\sin t}{t}\, dt = \frac{\pi}{2}$	2	K1	CO5
9.	Find $L[te^{-t} \sin t]$	2	K1	CO5
10.	Find $L[t \sin 3t \cos 2t]$	2	K1	CO5
11.	Find the inverse Laplace Transforms of $\frac{s-3}{s^2+4s+13}$	2	K1	CO5
12.	State Initial and Final value theorems.	2	K1	CO5
13.	Find the Laplace Transform of Unit step function.	2	K1	CO5
14.	Verify the Initial value theorem for the function $f(t) = ae^{-bt}$.	2	K1	CO5
15.	State Convolution Theorem in Laplace Transform.	2	K1	CO5

Unit - V / Part - B / 16, 8 Marks				
S.No	**Questions**	**Marks Splitup**	**K - Level**	**CO**
1.	Find $L\left[\frac{\cos at - \cos bt}{t}\right]$	8	K2	CO5
2.	Find $L\left[\frac{1-e^t}{t}\right]$	8	K2	CO5
3.	Verify the initial and final value theorem for the function $f(t) = 1 + e^{-t}(sint + cost)$.	4	K2	CO5
4.	Verify the initial and final value theorem for the function $f(t) = 3e^{-2t}$.	4	K2	CO5
5.	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 $f(t+2a) = f(t)$.	8	K2	CO5
6.	Find the Laplace transform of the periodic function $f(t) = \begin{cases} t & 0 \le t \le 1 \\ 2 - t, & 1 < t \le 2 \end{cases}$ and $f(t+2) = f(t)$.	8	K2	CO5

7.	Find the Laplace transform of the square wave given by $f(t)=\begin{cases} E, & 0<t<\frac{T}{2} \\ -E, & \frac{T}{2}\le t\le T \end{cases}$ and $f(t+T)=f(t)$.	8	K2	CO5
8.	Find the Laplace transform of the square wave given by $f(t)=\begin{cases} 1, & 0<t<\frac{a}{2} \\ -1, & \frac{a}{2}\le t\le a \end{cases}$ and $f(t+a)=f(t)$.	8	K2	CO5
9.	Find the Laplace transform of the half wave rectifier $f(t)=\begin{cases} \sin\omega t, & 0<t\le\frac{\pi}{\omega} \\ 0, & \frac{\pi}{\omega}<t<\frac{2\pi}{\omega} \end{cases}$, and $f\left(t+\frac{2\pi}{\omega}\right)=f(t)$.	8	K2	CO5
10.	Using convolution theorem find $L^{-1}\left[\frac{s^2}{(s^2+a^2)(s^2+b^2)}\right]$	8	K2	CO5
11.	Using convolution theorem find $L^{-1}\left[\frac{s^2}{(s^2+4)(s^2+9)}\right]$	8	K2	CO5
12.	Using convolution theorem find $L^{-1}\left[\frac{s}{(s^2+a^2)^2}\right]$	8	K2	CO5
13.	Using convolution theorem find $L^{-1}\left[\frac{1}{(s+1)\,(s^2+1)}\right]$	8	K2	CO5
14.	Using convolution theorem find $L^{-1}\left[\frac{s^2}{(s^2+a^2)^2}\right]$	8	K2	CO5
15.	Using convolution theorem find $L^{-1}\left[\frac{1}{(s^2+a^2)^2}\right]$	8	K2	CO5
16.	Solve the difference equation $\frac{d^2y}{dt^2}-3\frac{dy}{dt}+2y=e^{-t}$ with $y(0)=1$ and $y'(0)=0$, using Laplace transform.	8	K2	CO5
17.	Using Laplace transform, solve $\frac{d^2y}{dt^2}+9y=\cos 2t$ given $y(0)=1$, $y\left(\frac{\pi}{2}\right)=-1$.	8	K2	CO5
18.	Solve $y''+5y'+6y=2$, $y(0)=0$, $y'(0)=0$ using Laplace transform.	8	K2	CO5
19.	Using Laplace transforms, solve $y''+y'=t^2+2t$, $y(0)=4$, $y'(0)=-2$.	8	K2	CO5
20.	Using Laplace transform, solve $(D^2-3D+2)y=e^{-3t}$ given $y(0)=1$ and $y'(0)=-1$	8	K2	CO5
21.	Solve $\frac{d^2x}{dt^2}-3\frac{dx}{dt}+2x=2$, given $x=0$ and $\frac{dx}{dt}=5$ for $t=0$, using Laplace transform method.	8	K2	CO5