



# SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)

Approved by AICTE, New Delhi, Affiliated to Anna University, Chennai

Accredited by NAAC-UGC with 'A++' Grade (Cycle III) &

Accredited by NBA (B.E - CSE, EEE, ECE, Mech & B.Tech.IT)

COIMBATORE-641 035, TAMIL NADU



## DEPARTMENT OF MATHEMATICS

<b>CourseCode:</b>	<b>23MAT102</b>
<b>CourseName:</b>	<b>COMPLEX ANALYSIS AND LAPLACE TRANSFORMS</b>
<b>Year/Sem:</b>	<b>I/II</b>

## 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 $\text{grad}\phi$ 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 $\text{div}\vec{r}=3$ and $\text{curl}\vec{r}=0$ .	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 $\vec{F}=yzi\vec{j}+zxj\vec{i}+xyk\vec{i}$ 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 $\text{curl}(\text{grad}\phi)=0$ .	2	K2	CO1
14.	If $\vec{F}=x^3\vec{i}+y^3\vec{j}+z^3\vec{k}$ , then find $\text{div}(\text{curl}\vec{F})$ .	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's theorem.	2	K1	CO1



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## DEPARTMENT OF MATHEMATICS

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 $\phi$ such that $\vec{F} = \nabla\phi$	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 parallelepiped bounded by $x = 0, y = 0, z = 0$ and $x = a, y = b, z = c$ .	16	K3	CO1



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14.	Verify Gauss Divergence theorem for the vector function $\vec{F} = (x^3 - yz)\vec{i} - 2x^2y\vec{j} + 2z\vec{k}$ 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 $\vec{F} = (x^2 + y^2)\vec{i} - 2xy\vec{j}$ taken round the rectangle bounded by the lines $x = \pm a, y = 0, y = b$	16	K3	CO1
16.	Verify Stoke's theorem for $\vec{F} = (y - z + 2)\vec{i} + (yz + 4)\vec{j} - xz\vec{k}$ 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 $\vec{F} = (x^2 - y^2)\vec{i} + 2xy\vec{j}$ 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 $(D^2 + 5D + 4)y = 0$ .	2	K2	CO2
2.	Solve $\frac{d^2y}{dx^2} + 2\frac{dy}{dx} - 2y = 0$ .	2	K2	CO2
3.	Solve $\frac{d^4y}{dx^4} - 16y = 0$ .	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 $(D^3 - 4)y = e^{2x}$ .	2	K2	CO2
10.	Find the particular integral of $(D^3 + 8)y = e^{-2x}$ .	2	K2	CO2
11.	Find the particular integral of $(D^3 - a^3)y = e^{ax}$ .	2	K2	CO2
12.	Find the particular integral of $(D - m)^2 y = e^{mx}$ .	2	K2	CO2
13.	Find the complementary function of $(D^2 + 4)^2 y = \cos x$ .	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 $(D - 1)^2 y = \sinh 2x$ .	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 $x^2 \frac{d^2 y}{dx^2} - x \frac{dy}{dx} + y = 0$ to homogeneous differential equation with constant coefficients.	2	K2	CO2
24.	Solve $(x^2 D^2 + xD)y = 0$ .	2	K2	CO2
25.	Solve $x^2 y'' - 2xy' + 2y = 0$ .	2	K2	CO2
26.	Transform $(x+2)^2 \frac{d^2 y}{dx^2} - (x+2) \frac{dy}{dx} + y = 3x + y$ 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 $y^{(4)} - 2y'' + y = xe^x \sin x$ .	8	K2	CO2
8.	Solve $(D^2 + 4D + 5)y = e^x + x^3 + \cos 2x + 1$	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 $y^{(4)} + 9y = \cot 3x$ by the method of variation of parameters.	8	K2	CO2



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13.	Solve $(D^2 + 1)y = x \sin x$ by the method of variation of parameters.	8	K2	C02
14.	Solve $(D^2 + 1)y = \operatorname{cosec} x$ by the method of variation of parameters.	8	K2	C02
15.	Solve $x^3 \frac{d^2 y}{dx^2} - 3x \frac{dy}{dx} + 4y = x^2 + \cos(\log x)$ .	8	K3	C02
16.	Solve $(x^2 D^2 - xD + 1)y = \left(\frac{\log x}{x}\right)^2$ .	8	K3	C02
17.	Solve $(x^2 D^2 - 3xD + 5)y = x^2 \sin(\log x)$ .	8	K3	C02
18.	Solve $x^2 \frac{d^2 y}{dx^2} + x \frac{dy}{dx} + y = \log x \sin(\log x)$	8	K3	C02
19.	Solve $(3x + 2)^2 \frac{d^2 y}{dx^2} + 3(3x + 2) \frac{dy}{dx} - 36y = 3x^2 + 4x + 1$ .	8	K3	C02
20.	Solve $((1 + x)^2 D^2 + (1 + x)D + 1)y = 4 \cos[\log(1 + x)]$	8	K3	C02
21.	Solve $((1 + x)^2 D^2 + (1 + x)D + 1)y = 2 \sin \log(1 + x)$ .	8	K3	C02
22.	Solve $(x + 2)^2 \frac{d^2 y}{dx^2} - (x + 2) \frac{dy}{dx} + y = 3x + 4$ .	8	K3	C02
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	C02
24.	Solve the simultaneous equations $\frac{dx}{dt} + 2y + \sin t = 0$ ; $\frac{dy}{dt} - 2x - \cos t = 0$ given that $x = 0$ and $y = 1$ at $t = 0$ .	8	K3	C02
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	C02
26.	Solve the following simultaneous differential equations $\frac{dx}{dt} + 2y = \sin 2t$ ; $\frac{dy}{dt} - 2x = \cos 2t$ .	8	K3	C02
27.	Solve the following simultaneous differential equations $Dx + y = \sin 2t$ ; $-x + Dy = \cos 2t$ .	8	K3	C02
28.	Solve the following simultaneous differential equations $\frac{dx}{dt} - \frac{dy}{dt} + 2y = \cos 2t$ , $\frac{dx}{dt} + \frac{dy}{dt} - 2x = \sin 2t$	8	K3	C02



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## DEPARTMENT OF MATHEMATICS

### 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	C03
2.	Write the necessary condition for $f(z)$ to be analytic	2	K2	C03
3.	Check whether $w = z$ is analytic everywhere.	2	K2	C03
4.	Test the analyticity of the function $w = \sin z$ .	2	K2	C03
5.	Determine whether the function $2xy + i(x^2 - y^2)$ is analytic or not.	2	K1	C03
6.	For what values of a, b and c the function $f(z) = x + ay - i(bx + cy)$ is analytic.	2	K3	C03
7.	Verify the function $u = \log \sqrt{x^2 + y^2}$ is harmonic or not?	2	K3	C03
8.	Show that $u = 2x(1 - y)$ is harmonic.	2	K1	C03
9.	Find the value of $m$ if $u = 2x^2 - my^2 + 3x$ is harmonic.	2	K1	C03
10.	Prove that an analytic function whose real part is constant must itself be a constant.	2	K1	C03
11.	Prove that an analytic function with constant imaginary part is constant.	2	K1	C03
12.	Construct the analytic function $f(z)$ for which the real part is $e^x \cos y$ .	2	K1	C03
13.	Define conformal mapping.	2	K1	C03
14.	Find the image of the circle $ z  = 3$ under the transformation $w = 2z$ .	2	K1	C03
15.	Find the critical points of the transformation $w^2 = (z - \alpha)(z - \beta)$ .	2	K1	C03
16.	Find the invariant points of the bilinear transformation $w = \frac{1+z}{1-z}$ .	2	K1	C03
17.	Find the fixed points of the transformation $w = \frac{5z-9}{z}$ .	2	K2	C03
18.	Define bilinear transformation.	2	K2	C03

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	C03
2.	Show that an analytical function with constant modulus is constant.	8	K2	C03
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	C03



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4.	If $f(z)$ is a regular function of $z$ , then prove that $\nabla^2  f(z) ^2 = 4  f'(z) ^2$ .	8	K2	CO3
5.	If $f(z)$ is an analytic (regular) function of $z$ , then prove that $\nabla^2 \log  f(z)  = 0$ .	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 $ z - 2i  = 2$ under the transformation $w = \frac{1}{z}$ .	8	K3	CO3
15.	Find the image of the circle $ z - 1  = 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



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	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 $ w  = 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 $\frac{1}{e^z}$	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 $\frac{1-e^{2z}}{z^3}$ at $z = 0$	2	K2	CO4
17.	Evaluate $\int_C \frac{dz}{z^2+4}$ , where $C$ is the circle $ z  = 2$ .	2	K2	CO4
18.	Find the residue of the function $f(z) = \frac{4}{z^2(z-2)^2}$	2	K1	CO4





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## DEPARTMENT OF MATHEMATICS

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 $f(z) = \int_C \frac{3z^2+7z+1}{z-a} dz$ , 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



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14.	Evaluate $\int_C \frac{dx}{(x^2+4)^2}$ , where $C$ is the circle $ z - i  = 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 $ z - i  = 1$ , using Cauchy's Residue Theorem.	8	K2	CO4
16.	Using Cauchy's Residue Theorem to evaluate $\int_C \frac{3x^2+x+1}{(x^2-1)(x-3)} dz$ , where $C$ is the circle $ z  = 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



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## DEPARTMENT OF MATHEMATICS

### 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 $f(t) = 1 + e^{-t} (\sin t + \cos t)$ .	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 $f(t) = \begin{cases} t & 0 \leq t \leq a \\ 2a - t, & a < t \leq 2a \end{cases}$ and $f(t + 2a) = f(t)$ .	8	K2	CO5
6.	Find the Laplace transform of the periodic function $f(t) = \begin{cases} t & 0 \leq t \leq 1 \\ 2 - t, & 1 < t \leq 2 \end{cases}$ and $f(t + 2) = f(t)$ .	8	K2	CO5



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7.	Find the Laplace transform of the square wave given by $f(t) = \begin{cases} E, & 0 < t < \frac{T}{2} \\ -E, & \frac{T}{2} \leq t \leq T \end{cases}$ and $f(t + T) = f(t)$ .	8	K2	C05
8.	Find the Laplace transform of the square wave given by $f(t) = \begin{cases} 1, & 0 < t < \frac{a}{2} \\ -1, & \frac{a}{2} \leq t \leq a \end{cases}$ and $f(t + a) = f(t)$ .	8	K2	C05
9.	Find the Laplace transform of the half wave rectifier $f(t) = \begin{cases} \sin \omega t, & 0 < t \leq \frac{\pi}{\omega} \\ 0, & \frac{\pi}{\omega} < t < \frac{2\pi}{\omega} \end{cases}$ and $f\left(t + \frac{2\pi}{\omega}\right) = f(t)$ .	8	K2	C05
10.	Using convolution theorem find $L^{-1} \left[ \frac{x^2}{(x^2+a^2)(x^2+b^2)} \right]$	8	K2	C05
11.	Using convolution theorem find $L^{-1} \left[ \frac{x^2}{(x^2+4)(x^2+9)} \right]$	8	K2	C05
12.	Using convolution theorem find $L^{-1} \left[ \frac{x}{(x^2+a^2)^2} \right]$	8	K2	C05
13.	Using convolution theorem find $L^{-1} \left[ \frac{1}{(x+1)(x^2+1)} \right]$	8	K2	C05
14.	Using convolution theorem find $L^{-1} \left[ \frac{x^2}{(x^2+a^2)^2} \right]$	8	K2	C05
15.	Using convolution theorem find $L^{-1} \left[ \frac{1}{(x^2+a^2)^2} \right]$	8	K2	C05
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	C05
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	C05
18.	Solve $y'' + 5y' + 6y = 2$ , $y(0) = 0$ , $y'(0) = 0$ using Laplace transform.	8	K2	C05
19.	Using Laplace transforms, solve $y'' + y' = t^2 + 2t$ , $y(0) = 4$ , $y'(0) = -2$ .	8	K2	C05
20.	Using Laplace transform, solve $(D^2 - 3D + 2)y = e^{-3t}$ given $y(0) = 1$ and $y'(0) = -1$	8	K2	C05
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	C05