SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

S.R.M. Nagar, Kattankulathur - 603203

DEPARTMENT OF MATHEMATICS

QUESTION BANK

II SEMESTER

(COMMON TO ALL BRANCHES)

1918202-ENGINEERING MATHEMATICS –II

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SUBJECT : 1918202 – ENGINEERINGMATHEMATICS-II

SEM / YEAR: II SEMESTER / I YEAR (COMMON TO ALL BRANCHES)

UNIT I ORDINARY DIFFERENTIAL EQUATIONS

First order linear Differential equations- Exact differential equations- Second order linear differential equations with constant coefficients – Method of variation of parameters – Homogenous equation of Euler's and Legendre's type

Q.No	Question	BT Level	Competence
1	Find the order and degree of the following equation $\frac{dy}{dx}+y=x^2$.	BTL-1	Remembering
2	Form the Differential Equation by eliminating arbitrary constants for the equation $y^2=4ax$.	BTL-1	Remembering
3	Solve $(D^2+1)y=0$.	BTL-1	Remembering
4	Solve $(D-1)^2y=0$	BTL-1	Remembering
5	Solve $(D^4-1)y=0$.	BTL-1	Remembering
6	Solve $(D^2+a^2)y=0$.	BTL-1	Remembering
7	Solve $(D^2+5D+6)y=0$.	BTL-3	Applying
8	Solve $(D^4+D^3+D^2)y=0$	BTL-4	Analyzing
9	Solve $(D^4+D^3+D^2)y=0$	BTL-4	Analyzing
10	Find the complementary function of $(D^2+4)y=sin2x$.	BTL-2	Understanding
11	Find the complementary function of $y''-4y'+4y=0$.	BTL-2	Understanding
12	Estimate the P.I of $(D^3+3D^2+3D+1)y=e^{-x}$.	BTL-4	Analyzing
13	Find the particular Integral for $(D^2-2D+1)y=2e^x$.	BTL-2	Understanding
14	Estimate the P.I of $(D^2-4D+4)y=e^{2x}$	BTL-3	Applying
15	Find the P.I of $(D^2+2)y=x^2$	BTL-3	Applying
16	Estimate the P.I of $(D^2+5D+4)y=sin2x$.	BTL-3	Applying
17	Find the P.I of $(D^2+1)y=cos2x$	BTL-4	Analyzing
18	Find the P.I of $(D^2+4D+5)y=e^{-2x}$	BTL-4	Analyzing
19	Find the P.I. of $(D-a)^2y=e^{ax}\,sinx$	BTL-2	Understanding
20.	Rewrite the equation $(x^2D^2-2xD+4)y=0$ into the linear equation with constant coefficients	BTL-2	Understanding
21.	Transform the equation $xy''+y'+1=0$ into a linear equation with constant coefficients.	BTL-4	Analyzing
22.	Rewrite the equation $(x^2D^2+xD+1)y=logx$ into the linear equation with constant coefficients	BTL-2	Understanding
23.	Solve the equation $x^2y''-xy'+y=0$	BTL-2	Understanding
24.	Rewrite the equation $((2x+5)^2D^2-6(2x+5)D+8)y=6x$ into the linear equation with constant coefficients.	BTL-3	Applying

25.	Reduce the differential equation given by $x^2\frac{d^2y}{dx^2}+x\frac{dy}{dx}+y=logx\sin(logx)$	BTL-3	Applying
	PART B		
1(a)	Evaluating the following equation $\frac{dx}{dy}+\frac{x}{1+y^2}=\frac{tan^{-1}y}{1+y^2}$	BTL-5	Evaluating
1(b)	Solve the differential equation $y''+y=tanx$ by method of variation of parameters	BTL-1	Remembering
2(a)	Find the solution of $(D^3-1)y=e^{2x}$.	BTL-2	Understanding
2(b)	Solve $\frac{dy}{dx}+y\,cotx=2\,cosx$	BTL-1	Remembering
3(a)	Solve $(2D^3-D^2+4D-2)y=e^x$	BTL-4	Analyzing
3(b)	Using the method of variation of parameters for the following $(D^2+a^2)y=tanax$	BTL-5	Evaluating
4(a)	Solve $(D^3-6D^2+11D-6)y=e^{-2x}+e^{-3x}$	BTL-2	Understanding
4(b)	Solve $y''+y=cotx$ by method of variation of parameters	BTL-5	Evaluating
5(a)	Solve $(D^2+3D+2)y=sin3x$	BTL-4	Analyzing
5(b)	Solve $(D^2+a^2)y=secax$ by method of variation of parameters	BTL-4	Analyzing
6(a)	Solve $(D^2+4)\,y=cos2x..0000000$	BTL-4	Analyzing
6(b)	Solve the differential equation $y''-2y'+2y=e^xtanx$ by method of variation of parameters	BTL-1	Remembering
7(a)	Solve $(D^2+2D+2)y=e^{-2x}+cos2x$	BTL-4	Analyzing
7(b)	Identify the solution of $(D^2-7D-6)y=(1+x)e^{2x}$	BTL-1	Remembering
8(a)	Solve $(D^2+4)y=sin3x+\cos 2x$.	BTL-2	Understanding
8(b)	Evaluate the general solution of(x^2D^2-xD+1) y = $\left(\frac{logx}{x}\right)^2$	BTL-5	Evaluating
9(a)	Solve $(D^2+1)y=sinx\,\sin 2x$.	BTL-1	Remembering
9(b)	Solve the equation $(D^2+4D+3)y=e^{-x}sinx$	BTL-2	Understanding
10(a)	Solve $(D^2+4)y=x^2\cos 2x$.	BTL-1	Remembering
10(b)	Solve $[(x+1)^2D^2+(x+1)D+1]y=4\cos[log(x+1)]$.	BTL-4	Analyzing
11(a)	Formulate the ODE and hence solve$(x^2D^2+4xD+2)y=logx$	BTL-5	Evaluating
11(b)	Find the solution $(D^2+2D+1)y=e^{-x}x^2$.	BTL-5	Evaluating
12(a)	Solve the homogeneous differential equation $(x^2D^2-xD+1)y=x^2$	BTL-2	Understanding
12(b)	Solve $(D^2+1)y=xcosx$		
13.	Solve $(D^2-6D+9)y=2x^2-x+3$	BTL-5	Evaluating
14.	Solve $(D^2-2D+5)y=e^x\,cos2x$	BTL-4	Analyzing
15.	Find the solution $(D^2+4D-12)y=(x-1)e^{2x}$.	BTL-4	Analyzing
16.	Using the method of variation of parameters find the solution of $(D^2+2D+1)y=\frac{e^{-x}}{x^2}$	BTL-4	Analyzing
17.	Find the solution of$((2x+3)^2D^2-2(2x+3)D-12)y=6x$	BTL-1	Remembering
18.	Solve the differential equation $(x^2D^2-3xD+4)y=x^2\cos(logx)$	BTL-4	Analyzing
	PART C		

1.	Solve $(1-x^2)\frac{dy}{dx}+2xy=x\sqrt{(1-x^2)}$	BTL-2	Understanding
2.	A drug is excreted in a patient's urine. The urine is monitored continuously using catheter. A patient is administered 10 mg of drug at time t=0, which is excreted at the Rate of $-3t^{\frac{1}{2}}$mg/h.(i)What is the general equation for the amount of drug in the patient at time $t>0$? (ii) When will the patient be drug free?	BTL-3	Applying
3.	Using the method of variation of parameter evaluate $(D^2-6D+9)\,y\ =\frac{e^{3x}}{x^2}$	BTL-5	Evaluating
4.	Formulate the ODE and hence solve$(x^2D^2-2xD+4)y=x^2+2logx$	BTL- 6	Creating
5.0	Solve the differential equation $(x^2D^2-3xD+5)y=x^2\sin(logx)$	BTL-3	Applying
UNIT II- VECTORCALCULUS Gradient and directional derivative – Divergence and curl– Irrotational and Solenoidal vector fields –Green's theorem-Gauss divergence theorem and Strokes' theorems – Verification and application in evaluating line, surface and volume integrals			
	PART A		
1.	If $\varphi=x^2+y^2+z^2$ then find $grad\ \varphi$ at (2, 0, 2).	BTL-1	Remembering
2.	If $\varphi=x^2+yz$ then find $grad\ \varphi$.		
3.	Find the maximum directional derivative of $\varphi=xyz^2$ at (1, 0, 3).	BTL-1	Remembering
4.	If $\varphi=3xy-yz$, Find $grad\varphi$ at (1, 1, 1).	BTL-2	Understanding
5.	Find the Directional derivative of $\varphi=4xz^2+x^2yz$ at (1,-2,1) in the direction $2\vec{i}+3\vec{j}+4\vec{k}$.	BTL-1	Remembering
6.	Show that$\nabla(r^n)=nr^{n-2}\vec{r}$.	BTL-1	Remembering
7.	Give the unit normal vector to the surface $xyz=2$ at (2, 1, 1).	BTL-2	Understanding
8.	Give the unit normal vector to the surface $x^2+y^2+z^2=1$ at (1, 1, 1).		
9.	Find the unit normal to the surface $x^2+y^2-z=10$ at (1,1,1)	BTL-5	Evaluating
10.	Find the unit normal to the surface $xy^3z^2=4$ at (-1,-1,2)		
11.	What is the value of a, b, c if the vector $\vec{F}=(x+y+az)\vec{i}+(by+2y-z)\vec{j}+(-x+cy+2z)\vec{k}$ may be irrotational	BTL-1	Remembering
12.	Show that the vector $\vec{F}=3y^4z^2\vec{i}+4x^3z^2\vec{j}-3x^2y^2\vec{k}$ is solenoidal.	BTL-6	Creating
13.	Show that the vector $\vec{F}=(x+3y)\vec{i}+(y-3z)\vec{j}+(x-2z)\vec{k}$ is solenoidal.	BTL-4	Analyzing
14.	Is the position vector $\vec{r}=x\vec{i}+y\vec{j}+z\vec{k}$ irrotational? Justify.		
15.	If $\vec{r}$ is the position vector, Find $div\vec{r}$.	BTL-2	Understanding
16.	What is the value of *m* if the vector $\vec{F}=(x+3y)\vec{i}+(y-2z)\vec{j}+(x+mz)\vec{k}$ is solenoidal		
17.	Show that the vector $\vec{F}=(y^2-z^2+3yz-2x)\vec{i}+(3xz+2xy)\vec{j}+(3xy-2xz+2z)\vec{k}$ is solenoidal.	BTL-3	Applying
18.	Show that $curl(grad\varphi)=0$.	BTL-3	Applying
19.	If $\vec{F}=3xy\vec{i}-y^2\vec{j}$, Evaluate$\int\vec{F}.d\vec{r}$, where C is the arc of the parabola $y=2x^2$ from the point (0, 0) to the point (1, 2).	BTL-4	Analyzing
20.	If $\vec{F}=(x^2)\vec{i}+(xy^2)\vec{j}$, evaluate $\int\vec{F}.d\vec{r}$ from (0,0) to (1,1) along the path	BTL-3	Applying

	$y = x$.		
21.	Using Green's theorem evaluate $\int_C [(2x^2 - y^2)dx + (x^2 + y^2)\,dy$ where C is the boundary of the square enclosed by the lines $x = 0, y = 0, x = 2, y = 3$.	BTL-6	Creating
22.	State Gauss Divergence theorem.	BTL-5	Evaluating
23.	Evaluate using Gauss Divergence theorem for $\vec{F} = 4xz\vec{i} - y^2\vec{j} + +yz\vec{k}$ taken over the cube $x = 0, y = 0, z = 0, x = 1, y = 1, z = 1$.	BTL-5	Evaluating
24.	State Stokes theorem.	BTL-6	Creating
25.	State Greens theorem	BTL-6	Creating
	PART B		
1(a)	Find the Directional Derivative of $\varphi = 3x^2yz + 4xz^2 + xyz$ at (1, 2, 3) in the direction of $2\vec{i} + \vec{j} - \vec{k}$.	BTL-1	Remembering
1(b)	Find the constants a and b, so that the surfaces $5x^2 - 2yz - 9x = 0$and $ax^2y + bz^3 = 4$ may cut orthogonally at the point (1,-1,2).	BTL-2	Understanding
2(a)	Find the angle between the surfaces $x^2 - y^2 - z^2 = 11$ and $xy + yz - zx = 18$ at the point (6,4,3).	BTL-1	Remembering
2(b)	Find the unit normal to the surface $x^2y + 2xz^2 = 8$ at the point (1, 0, 2).	BTL-2	Understanding
3(a)	Calculate the angle between the normal to the surface$xy = z^2$ at the points (4, 1, 2) and (3, 3, -3).	BTL-1	Remembering
3(b)	Find the work done when a force $\vec{F} = (x^2 - y^2 + x)\vec{i} - (2xy + y)\vec{j}$ moves a particle in the XY pane from(0,0,0) to (1,1,1) along the parabola $x = y^2$.	BTL-3	Applying
4(a)	Find the angle between the surface $x^2 + y^2 + z^2 = 9$ and $x^2 + y^2 - 3 = z$ at the points (2,-1, 2).	BTL-2	Understanding
4(b)	Find the work done by the force $\vec{F} = (2xy + z^3)\vec{i} + (x^2)\vec{j} + 3xz^2\vec{k}$ when it moves a particle from (1,-2, 1) to (3, 1, 4) along any path?	BTL-4	Analyzing
5(a)	Find the values of a and b so that the surfaces $ax^2 - byz = (a+2)x$ and $4x^2y + z^3 = 4$ may cut orthogonally at (1,-1, 2).	BTL-3	Applying
5(b)	Find the scalar potential, if the vector field $\vec{F} = (x^2 + xy^2)\vec{i} + (y^2 + x^2y)\vec{j}$ is irrotational	BTL-5	Evaluating
6(a)	Find the value of *a, b, c* so that the vector $\vec{F} = (x + y + az)\vec{i} + (bx - 2y - z)\vec{j} + (-x + cy + 2z)\vec{k}$ may be irrotational. Also find its scalar potential	BTL-1	Remembering
6(b)	Find the work done by the force $\vec{F} = 3xy\vec{i} - y^2\vec{j}$ where C is the arc of the parabola $y = 2x^2$ from (0,0) to (1,2).	BTL-2	Understanding
7(a)	Prove that the area bounded by a simple closed curve is given by $\frac{1}{2}\int_C (xdy - ydx)$.Hence find the area of the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$	BTL-1	Remembering
7(b)	Find the Directional Derivative of $\varphi = xyz$ at P(1, 1, 3) in the direction of the outward drawn normal to the sphere $x^2 + y^2 + z^2 = 11$ through the point P.	BTL-3	Applying
8(a)	Find the angle between the surface $x\,logz = y^2 - 1$ and $x^2y = 2 - z$ at the point (1,1, 1).	BTL-1	Remembering
8(b)	Find the Directional Derivative of $\varphi = xy^2\,\vec{i} + zy^2\vec{j} + xz^2\,\vec{k}$ at (2, 0, 3) in the direction of the outward normal to the sphere$x^2 + y^2 + z^2$ at the point(3,2,1)	BTL-2	Understanding
9.	Verify Green's theorem in the plane for $\int_c [(3x^2 - 8y^2)dx + (4y - 6xy)dy]$	BTL-5	Evaluating

	where C is the boundary of the region bounded by $x = 0, y = 0,$ $x + y = 1.$		
10(a)	Verify Stokes' theorem for $\vec{F} = (xy + y^2)\vec{\imath} + x^2\vec{\jmath}$ in the XOY plane bounded by $x = y$ *and* $y = x^2$	BTL-6	Creating
10(b)	Show that the field $\vec{F} = (x^2 - y^2 + x)\vec{\imath} - (2xy + y)\vec{\jmath}$ is irrotational and find its scalar potential.	BTL-2	Understanding
11	Verify Green's theorem in the plane for $\int_c [(xy + y^2)dx + (x^2)dy]$ where c is a closed of the region bounded by $x = y$ *and* $y = x^2$.	BTL-2	Understanding
12	Verify Gauss divergence theorem for $\vec{F} = (x^3)\vec{\imath} + (y^3)\vec{\jmath} + z^3\vec{k}$ where s is the surface of the cuboid formed by the planes $x = 0, x = a, y = 0,$ $y = a, z = 0, z = a.$	BTL-3	Applying
13	Show that Stokes theorem is verified for $\vec{F} = (y - z + 2)\vec{\imath} + (yz + 4)\vec{\jmath} - xz\vec{k}$ where S is the surface of the cube formed by $x = 0, x = 2, y = 0,$ $y = 2,$ *and* $z = 2$ above the *XY*- plane.	BTL-1	Remembering
14	Verify Gauss divergence theorem for $\vec{F} = (x^2)\vec{\imath} + (y^2)\vec{\jmath} + (z^2)\vec{k}$ where s is the surface of the cuboid formed by the planes $x = 0, x = a, y = 0,$ $y = b, z = 0, z = c.$	BTL-3	Applying
15	Verify Gauss divergence theorem for $\vec{F} = (x^3 - yz)\vec{\imath} - (2x^2y)\vec{\jmath} + 2\vec{k}$ where s is the surface of the cuboid formed by the planes $x = 0,$ $x = a, y = 0, y = a, z = 0, z = a.$	BTL-3	Applying
16	Verify the Stokes theorem is verified for $\vec{F} = (x^2)\vec{\imath} + xy\vec{\jmath}$ integrated round the square those sides formed $x = 0, x = a, y = 0, y = a$ *in the plane* $z = 0$	BTL-5	Evaluating
17	Verify Gauss divergence theorem for $\vec{F} = (x^2)\vec{\imath} + z\vec{\jmath} + yz\vec{k}$ taken over the cube bounded by $x = 0, x = 1, y = 0, y = 1, z = 0, z = 1.$	BTL-6	Creating
18	Verify the Stokes theorem is verified for $\vec{F} = (y - z)\vec{\imath} + (yz)\vec{\jmath} - xz\vec{k}$ where S is the surface of the cube formed by $x = 0, x = 1, y = 0,$ $y = 1, z = 0$ *and* $z = 1$ above the *XY*- plane.	BTL-3	Applying
PART C			
1	Verify Green's theorem to evaluate $\int_c (xy - x^2)dx + x^2y\,dy$ along the closed curve C formed by $y = 0, x = 1, y = x.$	BTL-2	Understanding
2	Verify Green's theorem in the plane for $\int_c [(3x^2 - 8y^2)dx + (4y - 6xy)dy]$ where C is the boundary of the region bounded by $y = x^2, x = y^2.$	BTL-4	Analyzing
3	Verify Gauss divergence theorem for $\vec{F} = (x^2 - yz)\vec{\imath} + (y^2 - zx)\vec{\jmath} + (z^2 - xy)\vec{k}$ taken over the rectangular parallelepiped $x = 0, x = 1, y = 0, y = 2, z = 0, z = 3.$	BTL-3	Applying
4	Verify Stoke's theorem for $\vec{F} = (x^2 - y^2)\vec{\imath} + 2xy\vec{\jmath}$ in the rectangular region in the xy plane bounded by the lines $x = 0, x = a, y = 0, y = b.$	BTL-5	Evaluating
5	Verify Gauss divergence theorem for $\vec{F} = 4xz\vec{\imath} - y^2\vec{\jmath} + yz\vec{k}$ where s is the surface of the cube formed by the planes $x = 0, x = 1, y = 0,$ $y = 1, z = 0, z = 1.$	BTL-1	Remembering

UNIT –III LAPLACE TRANSFORMS			
Existence conditions – Transforms of elementary functions – Transform of unit step function and unit impulse function – Basic properties – Shifting theorems -Transforms of derivatives and integrals – Inverse transforms – Convolution theorem – Transform of periodic functions – Application to solution of linear second order ordinary differential equations with constant coefficients			
	PART-A		
1	State the sufficient conditions for the existence of Laplace transform.	BTL-1	Remembering
2	State first and second shifting theorem.	BTL-1	Remembering
3	State and prove change of scale property	BTL-1	Remembering
4	Find L(e^{-3t})	BTL-1	Remembering
5	State Convolution theorem	BTL-1	Remembering
6	Tell whether $L\left[\frac{\cos t}{t}\right]$ exist? Justify.	BTL-1	Remembering
7	Find the inverse Laplace transform of F(s) = $\frac{1}{s(s-2)}$	BTL-2	Understanding
8	Estimate L[t cost]	BTL-2	Understanding
9	Estimate $L\left[\frac{\sin at}{t}\right]$	BTL-2	Understanding
10	Find L($(t-1)^2$)	BTL-2	Understanding
11	Find L(t e^{-t})	BTL-3	Applying
12	Find L(t cosh3t)	BTL-3	Applying
13	State the final value theorem of Laplace Transform	BTL-3	Applying
14	Find $L^{-1}\left[\cot^{-1} s\right]$	BTL-4	Analyzing
15	Find $L\left[\frac{e^{at}-e^{-bt}}{t}\right]$	BTL-4	Analyzing
16	Find $L^{-1}\left[\log\frac{s+1}{s-1}\right]$	BTL-4	Analyzing
17	Evaluate $L^{-1}\left[\frac{1}{(s+2)^4}\right]$	BTL-5	Evaluating
18	State the Initial value theorem of Laplace Transform	BTL-5	Evaluating
19	Formulate L[t sinh2t]	BTL- 6	Creating
20	Formulate $L^{-1}\left[\frac{1}{s(s-4)}\right]$	BTL- 6	Creating
21	Find L($e^{-t}\sin 2t$)	BTL-4	Analyzing
22	Verify Final value theorem for $f(t) = 3e^{-t}$	BTL-2	Understanding
23	Evaluate $L^{-1}\left[\frac{s}{(s+2)^2}\right]$	BTL-2	Understanding
24	Find the Laplace Transform of unit step function.	BTL-3	Applying
25	Find the Laplace Transform of $\frac{1-e^{-t}}{t}$	BTL-3	Applying
	PART-B		
1(a)	Find L[t cost sinh2t]	BTL-2	Understanding
1(b)	Identify the Laplace transform of the saw tooth wave function of period 1, $f(t) = kt, 0 < t < 1$	BTL-4	Analyzing

2(a)	Find the Laplace Transform of the function $\frac{1-\cos t}{t}$	BTL-2	Understanding
2(b)	Find the Laplace transform of f(t) if $f(t) = e^t, 0 < t < 2\pi$ and $f(t+2\pi) = f(t)$	BTL-2	Understanding
3(a)	Evaluate $L\left[\frac{\cos at - \cos bt}{t}\right]$	BTL-1	Remembering
3(b)	Identify the Laplace transform of the square - wave function of period a defined as $f(t) = \begin{cases} 1, when\ 0 < t < a/2 \\ -1, when\ a/2 < t < a \end{cases}$	BTL-4	Analyzing
4(a)	Evaluate $L(te^{-4t} sin3t)$	BTL-5	Evaluating
4(b)	Find the Laplace transform of the square- wave function of period 2 defined as f(t)= $\begin{cases} 1, when\ 0 < t < 1 \\ 0,\ when\ 1 < t < 2 \end{cases}$ and $f(t+2) = f(t)$ for all t.	BTL-5	Evaluating
5(a)	Identify the Laplace Transform of the function $t\ sin3t\ cos2t$	BTL-1	Remembering
5(b)	Identify the Laplace transform of the square- wave function of period $2a$ defined as $f(t) = \begin{cases} k, when\ 0 < t < a \\ -k,\ when\ a < t < 2a \end{cases}$ and $f(t+2a) = f(t)$), for all t.	BTL-5	Evaluating
6(a)	Analyze the Laplace transform of $tsin^2 3t$	BTL-4	Analyzing
6(b)	Find f(t), if $L(f(t))$=$\frac{s}{(s+2)^2}$	BTL-1	Remembering
7	Using convolution theorem, find $L^{-1}\left[\frac{s}{(s^2+4)(s^2+9)}\right]$	BTL-3	Applying
8	Apply convolution theorem, find $L^{-1}\left[\frac{s}{(s^2+a^2)^2}\right]$	BTL-2	Understanding
9	Using Convolution theorem evaluate the inverse Laplace transform of $L^{-1}\left[\frac{s^2}{(s^2+a^2)(s^2+b^2)}\right]$	BTL-5	Evaluating
10	Give the general solution of $y'' + 5y' + 6y = 2, y(0) = 0, y'(0) = 0$	BTL-2	Understanding
11	Solve $y'' - 3y' + 2y = e^{3t}$ when $y'(0) = -1$and $y(0) = 1$ using Laplace transforms.	BTL-5	Evaluating
12	Using Laplace transforms, solve $y'' - 3y' - 4y = 2e^{-t}$ when $y'(0) = 1$ and $y(0) = 1$.	BTL- 6	Creating
13	Using Laplace transforms, solve $y'' - 3y' + 2y = 1$ when $y(0) = 0$ and $y'(0) = 1$	BTL- 6	Creating
14	Using Laplace transforms, solve $y'' - 2y' + y = e^t$ when $y'(0) = -1$ and $y(0) = 2$.	BTL-1	Remembering
15(a)	Estimate $L[f(t)]$, if $f(t) = \begin{cases} t,\ 0 < t < 1 \\ 0, 1 < t < 2 \end{cases}$ and $f(t+2) = f(t)$, for all t.	BTL-3	Applying
15(b)	Verify initial and final value theorem for $f(t) = 1 + e^{-t}(\sin t + \cos t)$	BTL-5	Evaluating
16	Apply convolution theorem, find $L^{-1}\ [\frac{s^2}{(s^2+4)^2}]$	BTL-6	Creating
17	Apply convolution theorem, find $L^{-1}\ [\frac{1}{(s^2+1)(s+1)}]$	BTL-3	Applying
18	Solve $y'' - 3y' + 2y = 2$, given $y(0) = 0$ and $y'(0) = 5$.	BTL-3	Applying
	PART-C		

1	Estimate $L[f(t)]$, if f(t)=$\begin{cases} \sin\omega t, for 0 < t < \frac{\pi}{\omega} \\ 0, for \frac{\pi}{\omega} < t < \frac{2\pi}{\omega} \end{cases}$ and $f\left(t+\frac{2\pi}{\omega}\right)=f(t)$, for all t.	BTL- 6	Creating
2	Find L [f(t)], if f(t)=$\begin{cases} t, & for 0 \le t \le a \\ 2a-t, for a < t < 2a \end{cases}$ and $f(t+2a) = f(t)$), for all t.	BTL-5	Evaluating
3	Using Convolution theorem calculate the inverse Laplace transform of $L^{-1}\left[\frac{s}{(s^2+a^2)(s^2+b^2)}\right]$	BTL- 6	Creating
4	Using Laplace transform evaluate the differential equation $y''+y=t^2+2t, \quad y(0)=4, y'(0)=-2$	BTL-5	Evaluating
5	Solve $y''+y=\sin 2t$, $y(0)=0, y'(0)=0$ using Laplace Transform method.	BTL-1	Remembering

UNIT IV ANALYTIC FUNCTIONS

Analytic functions – Necessary and sufficient conditions for analyticity in Cartesian and polar coordinates - Properties– Harmonic conjugates – Construction of analytic function - Conformal mapping – Mapping by functions $w = z + C$, Cz, $1/z$, - Bilinear transformation.

	PART-A		
1	Examine if f (z) = z^3 analytic?	BTL-1	Remembering
2	Identify the constants a, b, c if $f(z)=x+ay+i(bx+cy)$ is analytic.	BTL-1	Remembering
3	Can $u=3x^2y-y^3$ be the real part of an analytic function? Justify your answer	BTL-1	Remembering
4	State necessary and sufficient condition for f (z) to be analytic.	BTL-1	Remembering
5	Show that $u=2x-x^3+3xy^2$ is harmonic	BTL-2	Understanding
6	If f(z) is an analytic function whose real part is constant, Point out f(z) is a constant function.	BTL-2	Understanding
7	Show that $\|z\|^2$ is not analytic at any point	BTL-2	Understanding
8	Examine whether the function xy^2 can be real part of analytic function	BTL-2	Understanding
9	Test the analyticity of the function $f(z)=e^{-z}$	BTL-3	Applying
10	Show that an analytic function in a region R with constant imaginary part is constant.	BTL-3	Applying
11	Define conformal mapping	BTL-3	Applying
12	Evaluate the image of the circle $\|z\|=3$ under the transformation w = 5z.	BTL-5	Evaluating
13	Under the transformation $w=\frac{1}{z}$, evaluate the image of the circle $\|z-1\|=1$in the complex plane.	BTL-5	Evaluating
14	Evaluate the image of hyperbola$x^2-y^2=1$ under the transformation $w=\frac{1}{z}$	BTL-1	Remembering
15	Formulate the critical points of the transformation $w=z+\frac{1}{z}$	BTL-4	Analyzing
16	Estimate the invariant points of the transformation $w=\frac{z-1}{z+1}$	BTL-2	Understanding
17	Estimate the invariant point of the bilinear transformation $w=\frac{z-1-i}{z+2}$	BTL-2	Understanding
18	Identify the invariant point of the bilinear transformation $w=\frac{2z+6}{z+7}$	BTL-2	Understanding
19	Explain that a bilinear transformation has at most 2 fixed points.	BTL-4	Analyzing
20	Formulate the bilinear transformation which maps $z = 0, -i, -1$ into	BTL-4	Analyzing

	$w = i, 1, 0$ respectively		
21	Verify whether the function $u = x^3 - 3xy^2 + 3x^2 - 3y^2 + 1$ is harmonic.	BTL-3	Applying
22	Estimate the invariant point of the bilinear transformation $w = \frac{z^3 + 7z}{7 - 6zi}$	BTL-4	Analyzing
23	Find the value of m if $u = 2x^2 - my^2 + 3x$ is harmonic	BTL-3	Applying
24	Find the map of the circle |z|=3 under the transformation $w = z + 1 + i$	BTL-6	Creating
25	Verify whether the function $w = \sin z$ is analytic. If so find its derivative.	BTL-5	Evaluating
	PART-B		
1	Given that $u = \frac{sin2x}{cosh2y - cos2x}$. Estimate the analytic function.	BTL-2	Understanding
2(a)	Estimate the analytic function $w = u + iv$ if $u = e^x(xcos2y - ysin2y)$.	BTL-2	Understanding
2(b)	Formulate the image of $\|z + 1\| = 1$ under the map $w = 1/z$.	BTL-6	Creating
3(a)	Show that the function $u(x, y) = 3x^2y + 2x^2 - y^3 - 2y^2$ is harmonic. Find also the conjugate harmonic function$v$.	BTL-2	Understanding
3(b)	Prove that an analytic function with constant modulus is constant.	BTL-1	Remembering
4	Estimate the analytic function $f(z) = u + iv$ given the imaginary part is $v = x^2 - y^2 + \frac{x}{x^2+y^2}$	BTL-3	Applying
5(a)	Estimate the analytic function $w = u + iv$ if $u - v = e^x(cosy - siny)$	BTL-2	Understanding
5(b)	Find the image of $\|z\| = 2$ under the transformation$w = z + 3 + 2i$	BTL-1	Remembering
6	Determine the analytic function $w = u + iv$ given that $3u + 2v = y^2 - x^2 + 16xy$	BTL-1	Remembering
7	Identify the image of the infinite strip (i) $0 \le y \le \frac{1}{2}$ (ii)$\frac{1}{4} \le y \le \frac{1}{2}$ under the transformation $w = 1/z$	BTL-2	Understanding
8	Point out the bilinear transformation that maps the point $z_1 = 1, z_2 = i, z_3$= -1 into the points $w_1 = i, w_2 = 0, w_3 = -i$ respectively.	BTL-3	Applying
9	Give the bilinear transformation which maps $z = 1, 0, -1$ into $w = 0, -1, \infty$ respectively. What are the invariant points of the transformation?	BTL-2	Understanding
10(a)	Solve the bilinear transformation that maps the point $z_1 = i., z_2 = -1, z_3 =$ 1into the points $w_1 = 0, w_2 = 1, w_3 = \infty$ respectively.	BTL-1	Remembering
10(b)	Under the transformation w = $\frac{1}{z}$, find the image of a region $x > c$ where $c > 0$	BTL-4	Analyzing
11	If $w = f(z)$ is analytic then show that $\left(\left(\frac{\partial^2}{\partial x^2}\right) + \left(\frac{\partial^2}{\partial y^2}\right)\right) \log(f(z)) = 0$	BTL-6	Creating
12	Determine the analytic function $f(z) = u + iv$ such that $2u + v = e^x(cosy - siny)$	BTL-1	Remembering
13(a)	If $w = u(x, y) + iv(x, y)$ is an analytic function, show that 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.	BTL-2	Understanding
13(b)	Solve the bilinear transformation that maps the point $z_1 = 0, z_2 = 1, z_3 = \infty$ into the points $w_1 = i, w_2 = 1, w_3 = -i$ respectively.	BTL-3	Analyzing

14	Solve the bilinear transformation that maps the point $z_1 = 0, z_2 = 1, z_3 = \infty$ into the points $w_1 = -5, w_2 = -1$, $w_3 = 3$ respectively. What are invariant points of transformation?	BTL-3	Analyzing
15	Prove that $u = e^x(x\cos y - y\sin y)$ is harmonic. Hence find the analytic function $= u + iv$.	BTL-5	Evaluating
16	Verify the families of curves $u = c_1$ and $v = c_2$ cut orthogonally , when $u + iv = z^3$.	BTL-6	Creating
17	Find the analytic function $u + iv$, if $u = (x - y)(x^2 + 4xy + y^2)$. Also find the conjugate harmonic function.	BTL-3	Applying
18	Find the image of the circle $\|z - 2i\| = 2$ under the transformation $w = 1/z$.	BTL-3	Applying
	PART-C		
1	Show that the transformation $w = \frac{1}{z}$ maps, in general, circles and straight lines into circles and straight lines. Point out the circles and straight lines are transformed into straight lines and circles respectively.	BTL-1	Remembering
2	If $u = x^2 - y^2, v = -\frac{y}{x^2+y^2}$, prove that u and v are harmonic functions but $u + iv$ is not an analytic function.	BTL-5	Evaluating
3	If f (z) is a regular function of z, Show that $\nabla^2\|f(z)\|^2 = 4\|f'(z)\|^2$.	BTL-3	Applying
4	Identify the bilinear mapping which maps $-1,0,1$ of the z-plane onto $-1, -i, 1$ of the w-plane. Show that under this mapping the upper half of z- plane maps onto the interior of unit circle $\|w\| = 1$.	BTL-1	Remembering
5	Find the bilinear mapping which maps $z = 1, i, -1$ onto $w = i, 0, -i$. Hence find the image of plane $\|z\|<1$.	BTL-3	Applying

UNIT V COMPLEX INTEGRATION

Complex integration – Cauchy's integral theorem – Cauchy's integral formula – Taylor's and Laurent's series – Singularities – Residues – Residue theorem – Application of residue theorem for evaluation of real integrals – Use of circular contour and semicircular contour

PART –A

1	State Cauchy's integral theorem.	BTL-1	Remembering
2	State Cauchy's integral formula.	BTL-1	Remembering
3	State Cauchy's residue theorem.	BTL-1	Remembering
4	Identify the value of $\int_C e^z\, dz$, where C is $\|z\| = 1$?	BTL-1	Remembering
5	Estimate the residue of the function $f(z) = \frac{4}{z^3(z-2)}$ at a simple pole.	BTL-2	Understanding
6	Give the Laurent's series of $f(z) = \frac{1}{z(1-z)}$ valid in the region $\|z + 1\| < 1$.	BTL-2	Understanding
7	Give the Laurent's series expansion of $f(z) = \frac{e^z}{(z-1)^2}$ about $z = 1$.	BTL-2	Understanding
8	Give the Taylor's series for $f(z) = \sin z$ about $z = \frac{\pi}{4}$	BTL-2	Understanding
9	Calculate the residue at $z = 0$ of $(z) = \frac{1-e^2}{z^3}$.	BTL-3	Applying
10	Calculate the residue of the function $\frac{z-3}{(z+1)(z+2)}$ at poles.	BTL-3	Applying
11	Determine the residues at poles of the function $f(z) = \frac{z+4}{(z-1)(z-2)}$.	BTL-3	Applying
12	Expand $\frac{1}{z-1}$ as Laurent's series about z = 0 in the annulus $0< \|z\| < 1$.	BTL-4	Analyzing

13	Obtain the expansion of $\log(1+z)$ where $\lvert z\rvert < 1$	BTL-4	Analyzing
14	Evaluate $\int_C \frac{z}{(z-2)} dz$ where C is (a)$\lvert z\rvert = 1$(b) $\lvert z\rvert = 3$.	BTL-4	Analyzing
15	Evaluate $\int_C \frac{z+2}{z} dz$ where C is the circle $\lvert z\rvert = 2$ in the z –plane.	BTL-5	Evaluating
16	Evaluate $\frac{1}{2\pi i}\int_C \frac{z^2+5}{z-3} dz$ where C is the circle $\lvert z\rvert = 4$ using Cauchy's integral formula.	BTL-5	Evaluating
17	Integrate$\int_C \frac{dz}{z+4}$ where C is the circle ∣Z∣=2.	BTL-6	Creating
18	Integrate$\int_C \frac{e^z}{z-1} dz\ if\ C\ is\ \lvert z\rvert = 2$.	BTL- 6	Creating
19	Expand $f(z) = \frac{1}{z^2}$ as Taylor's series about the point $z = 2$.	BTL-4	Analyzing
20	Find the residues of $f(z) = \frac{z+2}{(z-2)(z+1)^2}$ about each singularity.	BTL-5	Evaluating
21	Evaluate $\int_C \frac{dz}{(z-2)}$ where C is $\lvert z-2\rvert = 4$.	BTL-4	Analyzing
22	Evaluate $\int_C \log z\, dz$ where C is $\lvert z\rvert = 2$.	BTL-4	Analyzing
23	Give the Taylor's series for $f(z) = cosz$ about $z = \frac{\pi}{2}$.	BTL-2	Understanding
24	Define removable singularity with an example.	BTL-1	Remembering
25	State Laurent's Theorem.	BTL-1	Remembering
	PART -B		
1(a)	Find the Taylor's series to represent the function $\frac{z^2-1}{(z+2)(z+3)}$ in $\lvert z\rvert < 2$	BTL-4	Analyzing
1(b)	Applying Cauchy's integral formula solve $\int_C \frac{cos\pi z^2+sin\pi z^2}{(z-1)(z-2)} dz$, C is the circle $\lvert z\rvert = 3$	BTL-2	Understanding
2(a)	Identify the Taylor's series to represent the function $\frac{1}{(z+2)(z+3)}$ in $\lvert z\rvert < 2$	BTL-1	Remembering
2(b)	Evaluate using Cauchy's integral formula $\int_C \frac{(z+1)}{(z-3)(z-1)} dz$ where C is the circle $\lvert z\rvert = 2$.	BTL-2	Understanding
3(a)	Identify the Laurent's series of $f(z) = \frac{(z+3)}{(z-1)(z-4)}$, valid in $\lvert z\rvert > 4$ and $0 < \lvert z-1\rvert < 1$.	BTL 3	Applying
3(b)	Evaluate $\int_C \frac{zdz}{(z-1)(z-2)^2}$ where C is the circle $\lvert z-2\rvert = \frac{1}{2}$.		
4	Identify the Laurent's series expansion for the function $f(z) = \frac{4z}{(z^2-1)(z-4)}$ in the regions $2 < \lvert z-1\rvert < 3\ and \lvert z-1\rvert > 4$.	BTL-1	Remembering
5(a)	Identify the Laurent's series expansion for the function $\frac{7z-2}{(z+1)z(z-2)}$ in the region1 < ∣z + 1∣ < 3.	BTL 3	Applying
5(b)	Apply the calculus of residues to evaluate $\int_0^\infty \frac{xsinx}{(x^2+1)(x^2+4)} dx$.	BTL 3	Applying
6(a)	Expand as Laurent's series of the function $\frac{z}{(z^2-3z+2)}$ in the regions (i) $\lvert z\rvert < 1$ (ii)$1 < \lvert z\rvert < 2$ (iii) $\lvert z\rvert > 3$.	BTL-4	Analyzing
6(b)	Evaluate $\int_C \frac{z^2 dz}{(z-1)^2(z+2)}$ where C is $\lvert z\rvert = 3$	BTL-5	Evaluating
7	Apply the calculus of residues to prove that$\int_0^\infty \frac{dx}{(x^2+a^2)^2} = \frac{\pi}{4a^3}$.	BTL-1	Remembering

8	Apply the calculus of residues to prove that $\int_0^\infty \frac{dx}{(x^4+a^4)} = \frac{\pi\sqrt{2}}{4a^3}$.	BTL-1	Remembering
9	Evaluate using contour integration $\int_0^\infty \frac{cosx}{(x^2+a^2)(x^2+b^2)} dx, a > b > 0$.	BTL-5	Evaluating
10	Formulate $\int_0^{2\pi} \frac{d\theta}{13+5\sin\theta}$, using the method of contour integration.	BTL-6	Creating
11	Using Contour Integration evaluate $\int_{-\infty}^\infty \frac{x^2dx}{(x^2+4)(x^2+9)}$.	BTL-5	Evaluating
12	Apply the calculus of residues to evaluate $\int_0^\infty \frac{xsinmx}{x^2+a^2} dx, a > 0, m > 0$.	BTL-4	Analyzing
13	Evaluate $\int_0^{2\pi} \frac{cos3\theta d\theta}{(5+4cos\theta)}$ using contour integration.	BTL-5	Evaluating
14	Evaluate $\int_0^{2\pi} \frac{d\theta}{(13+12cos\theta)} (a > b > 0)$, using contour integration.	BTL-5	Evaluating
15	Find the Laurent's series of $f(z) = \frac{z^2-1}{(z+2)(z+3)}$ in $(i)\|z\| < 2, (ii) 2 < \|z\| < 3$ and $\|z\| > 3$	BTL-4	Analyzing
16	Find the Taylor's series expansion of $f(z) = \frac{z}{(z+1)(z+2)}$ $about\, Z = i$.	BTL-5	Evaluating
17	Using Cauchy's Residue Theorem, solve $\int_C \frac{zdz}{(z-1)(z-2)^2}$ $where\, C\, is\, \|z-2\| = 1/2$.	BTL-2	Understanding
18	Evaluate $\int_0^{2\pi} \frac{d\theta}{(15+4cos\theta)} (a > b > 0)$, using contour integration.	BTL-5	Evaluating
	PART-C		
1	Using contour integration estimate $\int_{-\infty}^\infty \frac{x^2dx}{(x^2+a^2)(x^2+b^2)} a > b > 0$.	BTL-2	Understanding
2	Evaluate $\int_0^{2\pi} \frac{d\theta}{(a+bcos\theta)} (a > 0, b > 0)$, using contour integration.	BTL-5	Evaluating
3	Evaluate using contour integration $\int_0^\infty \frac{cosax}{(x^2+b^2)^2} dx, a > 0, b > 0$.	BTL-5	Evaluating
4	Using Laurent's series, find $\frac{1}{z(z-1)}$ valid in (i) $\|z+1\| < 1$ (ii) $1 < \|z+1\| < 2$ (iii) $\|z+1\| > 1$.	BTL-2	Understanding
5	Find the residues of $f(z) = \frac{z^2}{(z-1)(z+2)^2}$ at its isolated singularities, using Laurent's series Expansions.	BTL-4	Analyzing