# INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

## COMPUTER SCIENCE AND ENGINEERING

## QUESTION BANK

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| Course Title | **DIFFERENTIAL EQUATIONS AND VECTOR CALCULUS** | | | | |
| Course Code | AHSD08 | | | | |
| Program | B.Tech | | | | |
| Semester | II | COMMON TO ALL BRANCHES | | | |
| Course Type | Foundation | | | | |
| Regulation | IARE - BT23 | | | | |
| Course Structure | Theory | | | Practical | |
| | Lecture | Tutorials | Credits | Laboratory | Credits |
| | 3 | 1 | 4 | - | - |
| Course Coordinator | Dr.P.Raja Kumari, Assistant Professor | | | | |

## COURSE OBJECTIVES:

**The students will try to learn:**

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| I | The analytical methods for solving first and higher order differential equations with constant coefficients. |
| II | The analytical methods for formation and solving partial differential equations . |
| III | The physical quantities of vector valued functions involved in engineering field.. |
| IV | The logic of vector theorems for finding line, surface and volume integrals.. |

## COURSE OUTCOMES:

**After successful completion of the course, students should be able to:**

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| CO 1 | **Utilize** the methods of differential equations for solving the orthogonal trajectories and Newton's law of cooling. | Apply |
| CO 2 | **Solve** the higher order linear differential equations with constant coefficients by using method of variation of parameters. | Apply |
| CO 3 | **Make use of** analytical methods for PDE formation to solve boundary value problems. | Apply |
| CO 4 | **Identify** various techniques of Lagrange's method for solving linear partial differential equations which occur in Science and engineering.. | Apply |
| CO 5 | **Interpret** the vector differential operators and their relationships for solving engineering problems. | Understand |

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| CO 6 | **Apply** the integral transformations to surface, volume and line of different geometrical models. | Apply |

## QUESTION BANK:

| Q.No | QUESTION | Taxonomy | How does this subsume the level | CO's |
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| | | **MODULE I** | | |
| | **FIRSR ORDER AND FIRST DEGREE ORDINARY DIFFERENTIAL EQUATIONS** | | | |
| | **PART A-PROBLEM SOLVING AND CRITICAL THINKING QUESTIONS** | | | |
| 1 | Find the general solution of the following differential equation $x^2ydx-(x^3+y^3)dy=0$ | Apply | Learner to recall the homogeneous differential equations, understand the exactness ,integrating factor and apply them to compute solution | CO 1 |
| 2 | Solve the given differential equation $2xydy-(x^2+y^2+1)dx=0$ to get the general solution | Apply | Learner to recall the homogeneous differential equations, understand the exactness ,integrating factor and apply them to compute solution | CO 1 |
| 3 | Determine the general solution of the differential equation $(1+x^2)\frac{dy}{dx}+2xy=4x^2$ . | Apply | Learner to recall the homogeneous differential equations, understand the exactness ,integrating factor and apply them to compute solution | CO 1 |
| 4 | Find the general solution for the given linear differential equation $\frac{dy}{dx}+2y=e^x+x$, | Apply | Learner to recall the homogeneous differential equations, understand the exactness ,integrating factor and apply them to compute solution | CO 1 |

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| 5 | Prove that the system of parabolas $y^2 = 4a(x + a)$ is self orthogonal | Apply | Learner to recall the differential equations, understand the orthogonal trajectories and apply them to compute solution | CO 1 |
| 6 | The temperature of a cup of coffee is $92^o$C,when freshly poured the room temperature being $24^o$ C.In one minute it was cooled to $80^o$ C. How long a period must elapse, before the temperature of the cup becomes $65^o$ C. | Apply | Learner to recall the differential equations, understand the variable seperable , rate of change of temperature and apply them to compute solution | CO 1 |
| 7 | Find the orthogonal trajectories of the family of curves $x^2 + y^2 = a^2$ | Apply | Learner to recall the differential equations, understand the orthogonal trajectories and apply them to compute solution | CO 1 |
| 8 | Solve the given first order differential equation $(x^4e^x - 2mxy^2)dx + 2mx^2ydy = 0$ | Apply | Learner to recall the homogeneous differential equations, understand the exactness ,integrating factor and apply them to compute solution | CO 1 |
| 9 | Find the Orthogonal trajectories of the family of circles passing through origin and centre on x-axis | Apply | Learner to recall differential equations, understand the Orthogonal trajectories and apply them to compute solution | CO 1 |
| 10 | The temperature of the body drops from $100^o$C to $75^o$C in ten minutes when the surrounding air is at $20^o$C temperature. What will be its temperature after half an hour. When will the temperature be $25^o$C | Apply | Learner to recall differential equations, understand the Newton's law of cooling and apply them to compute solution | CO 1 |

| PART-B LONG ANSWER QUESTIONS | | | | |
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| 1 | Solve the differential equation $(1+e^{\frac{x}{y}})dx+e^{\frac{x}{y}}(1-\frac{x}{y})dy=0$ to obtain the general solution | Apply | Learner to recall the differential equations, understand the exactness of the function and apply them to compute solution | CO 1 |
| 2 | Find the required general solution for given differential equation $(xe^{xy}+2y)\frac{dy}{dx}+ye^{xy}=0$ | Apply | Learner to recall the differential equations, understand the exactness of the function and apply them to compute solution | CO 1 |
| 3 | Check whether the given differential equation is exact or not and find the solution $x^3Sec^2y\frac{dy}{dx}+3x^2tany=cosx$ | Apply | Learner to recall the differential equations, understand the exactness of the function and apply them to compute solution | CO 1 |
| 4 | Find the solution for given differential equation $(x^2-y^2)dx=2xydy$ by checking its exactness | Apply | Learner to recall the differential equations, understand the exactness of the function and apply them to compute solution | CO 1 |
| 5 | An object cools from $120^o$F to $95^o$ F in half an hour surrounded by air whose temperature is $70^o$ F. Find its temperature at the end of another half an hour. | Apply | Learner to recall differential equations, understand the Newton's law of cooling and apply them to compute solution | CO 1 |
| 6 | Show that the system of rectangular hyperbolas $x^2-y^2=a^2$ and $xy=c^2$ are mutually orthogonal trajectories | Apply | Learner to recall differential equations, understand the Orthogonal trajectories and apply them to compute solution | CO 1 |
| 7 | Solve the ordinary differential equation $x(x-1)\frac{dy}{dx}-y=x^2(x-1)^2$ | Apply | Learner to recall the differential equations, understand the exactness of the function and apply them to compute solution | CO 1 |

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| 8 | Solve the following differential equation $e^x \frac{dy}{dx} = 2xy^2 + ye^x$ | Apply | Learner to recall the differential equations, understand the Bernoullis equation and apply them to compute solution | CO 1 |
| 9 | A body kept in air with temperature $25^o$C cools from $140^o$C to $80^o$C in 20 minutes. Find when the body cools down to $35^o$C | Apply | Learner to recall differential equations, understand the Newton's law of cooling and apply them to compute solution | CO 1 |
| 10 | Solve the given differential equation $x(1-x^2)\frac{dy}{dx} + (2x^2-1)y = x^3$ | Apply | Learner to recall the differential equations, understand the linear DE ,integrating factorand apply them to compute solution | CO 1 |
| 11 | Find the required general solution for given differential equation $\frac{dy}{dx}(x^2y^3 + xy) = 1$ | Apply | Learner to recall the differential equations, understand the Bernoullis equation ,integrating factor and apply them to compute solution | CO 1 |
| 12 | Solve the differential equation $2\frac{dy}{dx} - ysecx = y^3tanx$ | Apply | Learner to recall the differential equations, understand the linear DE, integrating factor and apply them to compute solution | CO 1 |
| 13 | Solve the differential equation $(1-x^2)\frac{dy}{dx} + xy = y^3sin^{-1}x$ | Apply | Learner to recall the differential equations, understand the linear DE, integrating factor and apply them to compute solution | CO 1 |
| 14 | Solve the differential equation $(xy^2 - x^2)dx + (3x^2y^2 + x^2y - 2x^3)dy = 0$ | Apply | Learner to recall the differential equations, understand the exactness of the function and apply them to compute solution | CO 1 |

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| 15 | Find the required general solution for given differential equation $x^2\frac{dy}{dx} = e^y - x$ | Apply | Learner to recall the differential equations, understand the linear DE,integrating factor apply them to compute solution | CO 1 |
| 16 | Solve the following differential equation $\frac{dy}{dx} + \frac{ycosx+siny+y}{sinx+xcosy+x} = 0$ | Apply | Learner to recall the differential equations, understand the exactness, and apply them to compute solution | CO 1 |
| 17 | Find the orthogonal trajectories of the family of circles $x^2 + y^2 + 2gx + c = 0$ Where g is the parameter. | Apply | Learner to recall differential equations, understand the Orthogonal trajectories and apply them to compute solution | CO 1 |
| 18 | Solve the first order differential equation $(x + 1)\frac{dy}{dx} - y = e^{3x}(x + 1)^2$ | Apply | Learner to recall differential equations, understand the linear DE,integrating factor and apply them to compute solution | CO 1 |
| 19 | Find the required general solution for given differential equation $(x^2 - ay)dx = (ax - y^2)dy$ . | Apply | Learner to recall differential equations, understand the exactness,integraing factor and apply them to compute solution | CO 1 |
| 20 | Determine solution fot the following differential equation $y(x^2y^2 + 2)dx + x(2 - 2x^2y^2)dy = 0$ | Apply | Learner to recall the differential equations, understand the exactness , integraing factor and apply them to compute solution | CO 1 |
| **PART-C SHORT ANSWER QUESTIONS** | | | | |
| 1 | Define differential equation | Remember | — | CO 1 |
| 2 | write the types of differential equations | Remember | — | CO 1 |
| 3 | Define ordinary differential equation | Remember | — | CO 1 |
| 4 | Define partial differential equation | Remember | — | CO 1 |
| 5 | Define the order and degree of a differential equation | Remember | — | CO 1 |
| 6 | what is integral of the differential equation | Remember | — | CO 1 |

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| 7 | Define the complete primitive of the equation | Remember | — | CO 1 |
| 8 | Defne the particular solution of a differential equation | Remember | —- | CO 1 |
| 9 | Obtain the differential equation by eliminating A and B from $Ax^2 + By^2 = 1$ | Apply | | CO 1 |
| 10 | Obtain the differential equation $y = Ae^{-2t} + Be^{3x}$ by eliminating the arbitrary Constants | Apply | | CO 1 |
| 11 | Writ e the differential equation of the family of straight lines | Remember | — | CO 1 |
| 12 | Form a differential equation by eliminating 'a' from $r = 2a(sint - cost)$ | Apply | Learner to recall the differential equations of first order, understand formation and apply them to compute solution. | CO 1 |
| 13 | Solve the differential equation $dy/dx = e^{x-y} + x^2e^{-y}$ | Apply | — | CO 1 |
| 14 | Define the Homogenous differential equation | Remember | —- | CO 1 |
| 15 | What is the condition for exactness | Remember | | CO 1 |
| 16 | Define a linear differential equation of first order | Remember | —- | CO 1 |
| 17 | write the form of Bernoulli's equation | Remember | — | CO 1 |
| 18 | Define an orthogonal trajectory of the family of curves | Remember | —- | CO 1 |
| 19 | Find the orthognal trajectory of the family of y=ax | Apply | Learner to recall the differential equations of first order, understand the orthogonal trajectoriesl and apply them to compute solution | CO 1 |
| 20 | State the Newton's law of cooling | Remember | —- | CO 1 |

| MODULE II | | | | |
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| **ORDINARY DIFFERENTIAL EQUATIONS OF HIGHER ORDER** | | | | |
| **PART A-PROBLEM SOLVING AND CRITICAL THINKING QUESTIONS** | | | | |
| 1 | Solve the differential equation $(D^2+4)y{=}sin2x$. | Apply | Learner to recall the non-homogeneous differential equations, understand the method of variation of parameters and apply them to compute solution. | CO 2 |
| 2 | Apply the method of variation of parameters to solve $(D^2-2D)y{=}e^x sinx$ | Apply | Learner to recall the non-homogeneous differential equations, understand the method of variation of parameters and apply them to compute solution. | CO 2 |
| 3 | Using the of method of variation of Parameters, solve $\frac{d^2y}{dx^2}+y=Cosecx$. | Apply | Learner to recall the non-homogeneous differential equations, understand the method of variation of parameters and apply them to compute solution. | CO 2 |
| 4 | Find the general solution of $y^{1111}+8y^{11}+16y=0$. | Apply | Learner to recall the homogeneous differential equations, understand the complementary function and apply them to compute solution. | CO 2 |
| 5 | Solve the differential equation $y^{1111}+18y^{11}+81y=64Cosx+108Cos3x$. | Apply | Learner to recall the non-homogeneous differential equations, understand the complementary function and particular integral and apply them to compute solution. | CO 2 |

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| 6 | Using the method of variation of Parameters, solve $(D^2+4)y= Sec2x$. | Apply | Learner to recall the concept of homogeneous differential equatios , understand the procedure and apply complementary function, particular integral to find solution of non-homogeneous differential equations. | CO 2 |
| 7 | Using the method of variation of Parameters, solve $(D^2+1)y = Tanx$ | Apply | Learner to recall the non-homogeneous differential equations, understand the method of variation of parameters and apply them to compute solution. | CO 2 |
| 8 | Using the method of variation of Parameters, solve $(D^2-2D+2)y = e^x Tanx$ | Apply | Learner to recall the non-homogeneous differential equations, understand the method of variation of parameters and apply them to compute solution. | CO 2 |
| 9 | Using the method of variation of Parameters, solve $(D^2-6D+9)y = \frac{e^{3x}}{x^2}$ | Apply | Learner to recall the non-homogeneous differential equations, understand the method of variation of parameters and apply them to compute solution. | CO 2 |
| 10 | Using the of method of variation of Parameters, solve $(D^2-2D+1)y = e^x logx$. | Apply | Learner to recall the non-homogeneous differential equations, understand the method of variation of parameters and apply them to compute solution. | CO 2 |
| **PART-B LONG ANSWER QUESTIONS** | | | | |

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| 1 | Solve the differential equation $(D^2+3D+2)y = 2cos(2x+3)+2e^x+x^2$. | Apply | Learner to recall the non-homogeneous differential equations, understand the complementary function and particular integral and apply them to compute solution. | CO 2 |
| 2 | Solve the differential equation $(D^2+4)y = 96x^2+sin2x-k$. | Apply | Learner to recall the non-homogeneous differential equations, understand the complementary function and particular integral and apply them to compute solution. | CO 2 |
| 3 | Solve the differential equation $(D^2-2D+1)y = x^2e^{3x}$-sin2x+3 | Apply | Learner to recall the non-homogeneous differential equations, understand the complementary function and particular integral and apply them to compute solution. | CO 2 |
| 4 | Solve the differential equation $(D^3-6D^2+11D-6)y = e^{-2x}+e^{-3x}$. | Apply | Learner to recall the non-homogeneous differential equations, understand the complementary function and particular integral and apply them to compute solution. | CO 2 |
| 5 | Solve the differential equation $(D^2+1)y = sinxsin2x+e^xx^2$. | Apply | Learner to recall the non-homogeneous differential equations, understand the complementary function and particular integral and apply them to compute solution. | CO 2 |

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| 6 | Solve the differential equation $(D^3+1)y{=}3+5e^x$. | Apply | Learner to recall the non-homogeneous differential equations, understand the complementary function and particular integral and apply them to compute solution. | CO 2 |
| 7 | Solve the differential equation $(D^2-4)y=2cos^2x$ . | Apply | Learner to recall the non-homogeneous differential equations, understand the complementary function and particular integral and apply them to compute solution. | CO 2 |
| 8 | Solve the differential equation $(D^2+1)y{=}SinxSin2x$. | Apply | Learner to recall the non-homogeneous differential equations, understand the complementary function and particular integral and apply them to compute solution. | CO 2 |
| 9 | Solve the differential equation $(D^2+9)y{=}cos3x+sin2x$. | Apply | Learner to recall the non homogeneous differential equations understand the complementary function and particular integral and apply them to compute solution. | CO 2 |
| 10 | Solve the differential equation $(D^2+5D-6)y{=}Sin4xSinx$ . | Apply | Learner to recall the non-homogeneous differential equations, understand the complementary function and particular integral and apply them to compute solution. | CO 2 |

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| 11 | Solve the differential equation .$(D^2 + D + 1)y{=}sin2x$ | Apply | Learner to recall the non-homogeneous differential equations, understand the complementary function and particular integral and apply them to compute solution. | CO 2 |
| 12 | By using method of variation of parameters solve $(D^2 + 4)y{=}\ Sec2x$ | Apply | Learner to recall the non-homogeneous differential equations, understand the complementary function and particular integral and apply them to compute solution. | CO 2 |
| 13 | Solve the differential equation $(D^3 - 4D^2 - D + 4)y{=}e^{3x}cos2x$ | Apply | Learner to recall the non-homogeneous differential equations, understand the complementary function and particular integral and apply them to compute solution. | CO 2 |
| 14 | Evaluate the differential equation $(D^2 + 9)y = Cos3x$ | Apply | Learner to recall the non-homogeneous differential equations, understand the complementary function and particular integral and apply them to compute solution. | CO 2 |
| 15 | Find the differential equation $(D^3 - 7D^2 + 14D - 8)y = e^x\ Cos2x.$ | Apply | Learner to recall the non-homogeneous differential equations, understand the complementary function and particular integral and apply them to compute solution. | CO 2 |

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| 16 | Solve the differential equation $(D^3 - 4D^2 - D + 4)y = e^{3x}$.. | Apply | Learner to recall the non-homogeneous differential equations, understand the complementary function and particular integral and apply them to compute solution. | CO 2 |
| 17 | Solve the differential equation $(D^3 + 4D)y = sin2x$ | Apply | Learner to recall the non-homogeneous differential equations, understand the complementary function and particular integral and apply them to compute solution | CO 2 |
| 18 | Solve the differential equation $(D^2 + 4D + 4)y = 3Sinx + 4Cosx$. | Apply | Learner to recall the non-homogeneous differential equations, understand the complementary function and particular integral and apply them to compute solution. | CO2 |
| 19 | By using method of variation of parameters solve $(D^2 + 1)y{=}sinx$ . | Apply | Learner to recall the non-homogeneous differential equations, understand the method of variation of parameters and apply them to compute solution. | CO 2 |
| 20 | Solve the differential equation $(D^3 - 1)y = e^x + Sin3x + 2$. | Apply | Learner to recall the non-homogeneous differential equations, understand the method of variation of parameters and apply them to compute solution. | CO 2 |

| PART-C SHORT ANSWER QUESTIONS | | | | |
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| 1 | Write the solution of the $\frac{d^2y}{dx^2}$ - 3 $\frac{dy}{dx}$ + 2y = 0 | Apply | Learner to recall the non-homogeneous differential equations, understand the complementary function and particular integral and apply them to compute solution | CO 2 |
| 2 | Write the solution of the $(4D^2 - 4D + 1)y = 100$ | Apply | Learner to recall the non-homogeneous differential equations, understand the complementary function and particular integral and apply them to compute solution | CO 2 |
| 3 | Define wronskian of the functions. | Apply | Learner to recall the non-homogeneous differential equations, understand the complementary function and particular integral and apply them to compute solution. and define wronskian function | CO 2 |
| 4 | Find the particular value of $\frac{1}{D-3}$ x | Apply | Learner to recall the non-homogeneous differential equations, understand the complementary function and particular integral and apply them to compute solution. | CO 2 |
| 5 | Find the particular value of $\frac{1}{(D-2)(D-3)}$ $e^{2x}$. | Apply | Learner to recall the non-homogeneous differential equations, understand the complementary function and particular integral and apply them to compute solution. | CO 2 |

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| 6 | Solve the differential equation $(D^4 - 2D^3 - 3D^2 + 4D + 4)y$=0. | Apply | Learner to recall the non-homogeneous differential equations, understand the complementary function and particular integral and apply them to compute solution. | CO 2 |
| 7 | Solve the differential equation $(D^4 - 1)y$=0. | Apply | Learner to recall the non-homogeneous differential equations, understand the complementary function and particular integral and apply them to compute solution. | CO 2 |
| 8 | Write the particular values of $\frac{1}{(D^2+a^2)}cosax$ and $\frac{1}{(D^2+a^2)}sinax$. | Apply | Learner to recall the non-homogeneous differential equations, understand the complementary function and particular integral and apply them to compute solution. | CO 2 |
| 9 | Find the particular integral of $(D^2 - 3D + 2)y$=$cos3x$ | Apply | Learner to recall the non-homogeneous differential equations, understand the complementary function and particular integral and apply them to compute solution. | CO 2 |
| 10 | Write the particular values of $\frac{1}{(D^2+4)}sin2x$. | Apply | Learner to recall the non-homogeneous differential equations, understand the complementary function and particular integral and apply them to compute solution. | CO 2 |

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| 11 | Solve the differential equation $\frac{d^3y}{dx^3} + y = 0$. | Apply | Learner to recall the non-homogeneous differential equations, understand the complementary function and particular integral and apply them to compute solution. | CO 2 |
| 12 | Fine the particular integral of $\frac{1}{(D^2-1)}$ x. | Apply | Learner to recall the non-homogeneous differential equations, understand the complementary function and particular integral and apply them to compute solution. | CO 2 |
| 13 | Solve the differential equation $(D^2 + a^2)y = 0$. | Apply | Learner to recall the non-homogeneous differential equations, understand the complementary function and particular integral and apply them to compute solution. | CO 2 |
| 14 | Find the particular integral of $(D^2 + 2D)y = 24x$. | Apply | Learner to recall the non-homogeneous differential equations, understand the complementary function and particular integral and apply them to compute solution. | CO 2 |
| 15 | Find the general solution of the differential equation $y^{11} + y^1 - 2y = 0$ | Apply | Learner to recall the non-homogeneous differential equations, understand the complementary function and particular integral and apply them to compute solution. | CO 2 |

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| 16 | What is general solution of higher order differential equation. | Apply | Learner to recall the non-homogeneous differential equations, understand the complementary function and particular integral and apply them to compute solution and define general solution of higher order differential equation | CO 2 |
| 17 | Write the solution of the $\frac{d^2y}{dx^2} - 5\frac{dy}{dx} + 6y = 0$. | Apply | Learner to recall the non-homogeneous differential equations, understand the complementary function and particular integral and apply them to compute solution. | CO 2 |
| 18 | Write the particular values of $\frac{1}{(D^2+9)}cos3x$ and $\frac{1}{(D^2+16)}sin4x$. | Apply | Learner to recall the non-homogeneous differential equations, understand the complementary function and particular integral and apply them to compute solution. | CO 2 |
| 19 | Solve the differential equation $(D^2 + D)y = 0$. | Apply | Learner to recall the non-homogeneous differential equations, understand the complementary function and particular integral and apply them to compute solution. | CO 2 |
| 20 | Solve the differential equation $(D^4 - 16)y = 0$. | Apply | Learner to recall the non-homogeneous differential equations, understand the complementary function and particular integral and apply them to compute solution. | CO 2 |

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| **MODULE III** | | | | |
| **PARTIAL DIFFERENTIAL EQUATIONS** | | | | |
| **PART A-PROBLEM SOLVING AND CRITICAL THINKING QUESTIONS** | | | | |
| 1 | Form the partial differential equation by eliminating arbitrary function $lx+my+nz=\phi(x^2+y^2+z^2)$ | Apply | Recall dependent and independent variables, explain partial derivatives, and applyit to form PDE by eliminating arbitrary function.. | CO 3 |
| 2 | Form the partial differential equation by eliminating arbitrary function $xy+yz+zx=f(\frac{z}{(x+y)})$. | Apply | Recall dependent and independent variables, explain partial derivatives, and applyit to form PDE by eliminating arbitrary function. | CO 3 |
| 3 | Form the partial differential equation by eliminating arbitrary function from$f(x^2-y^2,x^2-z^2)=0$ | Apply | Recall dependent and independent variables, explain Lagrange's Linear equation, apply suitable method to solve linear partial differential equations of first order. | CO 3 |
| 4 | Form the partial differential equation by eliminating the arbitrary constant 'c ' from $z=f(x+ct)+g(x-ct)$ | Apply | Recall dependent and independent variables, explain Lagrange's Linear equation, apply suitable method to solve linear partial differential equations of first order. | CO 4 |
| 5 | Form the partial differential equation by eliminating the arbitrary function from $z=f(x+iy)+g(x+iy)$ | Apply | Recall dependent and independent variables, explain Lagrange's Linear equation, apply suitable method to solve linear partial differential equations of first order. | CO 4 |
| **CIE-II** | | | | |

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| 6 | Solve the partial differential equation.$(z^2 - 2yz - y^2)p + (xy + xz)q = xy - zx$ | Apply | Recall dependent and independent variables, explain Lagrange's Linear equation, apply suitable method to solve linear partial differential equations of first order. | CO 4 |
| 7 | Solve $p\sqrt{x} + q\sqrt{y} = \sqrt{z}$ | Apply | Recall dependent and independent variables, explain partial derivatives, and apply standard forms to solve nonlinear partial differential equations.. | CO 4 |
| 8 | Solve $\frac{p}{x^2} + \frac{q}{y^2} = z$ . | Apply | Recall dependent and independent variables, explain partial derivatives, and apply standard forms to solve nonlinear partial differential equations. | CO 4 |
| 9 | Solve $xp + yq = 1$. | Apply | Recall dependent and independent variables, explain partial derivatives, and apply standard forms to solve nonlinear partial differential equations | CO 4 |
| 10 | Solve the partial differential equation $y^2p + x^2q = x^2y^2z^2$ | Apply | Recall dependent and independent variables, explain Lagrange's Linear equation, apply suitable method to solve linear partial differential equations of first order. | CO 4 |
| **PART-B LONG ANSWER QUESTIONS** | | | | |
| 1 | Form the partial differential equation by eliminating arbitray function from $f(x^2 + y^2 + z^2, z^2 - 2xy) = 0$. | Apply | Recall dependent and independent variables, explain partial derivatives, and applyit to form PDE by eliminating arbitrary function.. | CO 3 |

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| 2 | Form a partial differential equation by eliminating a, b, c from $\frac{x^2}{a^2}+\frac{y^2}{b^2}+\frac{z^2}{c^2}=1$ | Apply | Recall dependent and independent variables, explain partial derivatives, and apply it to form PDE by eliminating arbitrary constants. | CO 3 |
| 3 | Solve the partial differential equation $(x^2-yz)p+(y^2-zx)q=z^2-xy$ Form the partial differential equation by eliminating arbitrary constants $z=ax^3+by^3$ | Apply | Recall dependent and independent variables, explain Lagrange's Linear equation, apply suitable method to solve linear partial differential equations of first order. | CO 4 |
| 4 | Form the partial differential equation by eliminating arbitrary constants h,k from $(x-h)^2+(y-k)^2+z^2=a^2$ | Apply | Recall dependent and independent variables, explain Lagrange's Linear equation, apply suitable method to solve linear partial differential equations of first order. | CO 4 |
| 5 | Form the partial differential equation by eliminating arbitrary function $z=f(x)+e^y g(x)$ | Apply | Recall dependent and independent variables, explain Lagrange's Linear equation, apply suitable method to solve linear partial differential equations of first order. | CO 4 |
| 6 | Find the differential equation of all spheres whose centres lie on z-axis with a given radius r. . | Apply | Recall dependent and independent variables, explain Lagrange's Linear equation, apply suitable method to solve linear partial differential equations of first order. | CO 4 |
| 7 | Form the partial differential equation by eliminating arbitrary function f from $z=xy+f(x^2+y^2)$ | Apply | Recall dependent and independent variables, explain Lagrange's Linear equation, apply suitable method to solve linear partial differential equations of first order. | CO 4 |

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| 8 | Form the partial differential equation by eliminating arbitrary function from $f(x^2+y^2+z^2, z^2-2xy)=0$ . | Apply | Recall dependent and independent variables, explain Lagrange's Linear equation, apply suitable method to solve linear partial differential equations of first order | CO 4 |
| 9 | Form the partial differential equation by eliminating a and b from $log(az-1)=x+ay+b$ | Apply | Recall dependent and independent variables, explain Lagrange's Linear equation, apply suitable method to solve linear partial differential equations of first order. | CO 4 |
| 10 | Form the partial differential equation by eliminating arbitrary function f from $xyz=f(x^2+y^2+z^2)$ | Apply | Recall dependent and independent variables, explain Lagrange's Linear equation, apply suitable method to solve linear partial differential equations of first order. | CO 4 |
| **CIE-II** | | | | |
| 11 | Solve the partial differential equation $px^2+qy^2=z(x+y)$. | Apply | Recall dependent and independent variables, explain Lagrange's Linear equation, apply suitable method to solve linear partial differential equations of first order. | CO 4 |
| 12 | Solve $p-x^2=y^2+q$. | Apply | Recall dependent and independent variables, explain Lagrange's Linear equation, apply suitable method to solve linear partial differential equations of first order. | CO 4 |
| 13 | Solve the partial differential equation $y^2zp+x^2zq=xy^2$ | Apply | Recall dependent and independent variables, explain Lagrange's Linear equation, apply suitable method to solve linear partial differential equations of first order. | CO 4 |

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| 14 | Solve the partial differential equation $ptanx + qtany = tanz$. | Apply | Recall dependent and independent variables, explain Lagrange's Linear equation, apply suitable method to solve linear partial differential equations of first order. . | CO 4 |
| 15 | Solve the partial differential equation $(x - a)p + (y - b)q + (c - z) = 0$. | Apply | Recall dependent and independent variables, explain Lagrange's Linear equation, apply suitable method to solve linear partial differential equations of first order. | CO 4 |
| 16 | Solve $px^2 + qy^2 = z(x + y)$. | Apply | Recall dependent and independent variables, explain Lagrange's Linear equation, apply suitable method to solve linear partial differential equations of first order. | CO 4 |
| 17 | Solve the partial differential equation $pz - qz = z^2 + (x + y)^2$. | Apply | Recall dependent and independent variables, explain Lagrange's Linear equation, apply suitable method to solve linear partial differential equations of first order.. | CO 4 |
| 18 | Solve the partial differential equation $\frac{y^2z}{x}p + xzq = y^2$. | Apply | Recall dependent and independent variables, explain Lagrange's Linear equation, apply suitable method to solve linear partial differential equations of first order.. | CO 4 |
| 19 | Solve $x(y^2 - z^2)p - y(z^2 + x^2)q = z(x^2 + y^2)$. | Apply | Recall dependent and independent variables, explain Lagrange's Linear equation, apply suitable method to solve linear partial differential equations of first order | CO 4 |

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| 20 | Solve $(x-y)p+(y-x-z)q=z$.. | Apply | Recall dependent and independent variables, explain Lagrange's Linear equation, apply suitable method to solve linear partial differential equations of first order | CO 4 |
| **PART-C SHORT ANSWER QUESTIONS** | | | | |
| 1 | Define order and degree with reference to partial differential equation. | Remember | - | CO 3 |
| 2 | Form the partial differential equation by eliminate the arbitrary constants from $z=ax^3+by^3$. | Apply | Recall dependent and independent variables, explain partial derivatives, and apply it to form PDE by eliminating arbitrary constants. | CO 3 |
| 3 | Form the partial differential equation by eliminating arbitrary function $z=f(x^z+y^2)$ | Apply | Recall dependent and independent variables, explain partial derivatives, and apply it to form PDE by eliminating arbitrary functions. | CO 3 |
| 4 | Solve the partial differential equation $p\sqrt{x}+q\sqrt{y}=\sqrt{z}$. | Apply | Recall dependent and independent variables, explain Lagrange's Linear equation, apply suitable method to solve linear partial differential equations of first order | CO 4 |
| 5 | Form the partial differential equation by eliminating a and b from $log(az-1)=x+ay+b$ | Apply | Recall dependent and independent variables, explain partial derivatives, and apply it to form PDE by eliminating arbitrary constants. | CO 4 |

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| 6 | Form the partial differential equation by eliminating the constants from $(x-a)^2+(y-b)^2=z^2cot^2\alpha$ where $\alpha$ is a parameter. | Apply | Recall dependent and independent variables, explain partial derivatives, and apply it to form PDE by eliminating arbitrary constants. | CO 4 |
| 7 | Eliminate the arbitrary constants from $z=(x^2+a)(y^2+b)$. | Apply | Recall dependent and independent variables, explain Lagrange's Linear equation, apply suitable method to solve linear partial differential equations of first order | CO 4 |
| 8 | Solve the partial differential equation $x(y-z)p+y(z-x)q=z(x-y)$. | Apply | Recall dependent and independent variables, explain Lagrange's Linear equation, apply suitable method to solve linear partial differential equations of first order | CO 4 |
| 9 | Solve. $p+q=z$ | Apply | Recall dependent and independent variables, explain Lagrange's Linear equation, apply suitable method to solve linear partial differential equations of first order | CO 4 |
| 10 | Solve. $zp+yq=x$ | Apply | Recall dependent and independent variables, explain Lagrange's Linear equation, apply suitable method to solve linear partial differential equations of first order | CO 4 |
| **CIE-II** | | | | |
| 11 | Solve $xp+yq=3z$. | Remember | | CO 4 |
| 12 | Solve $xp+yq=1$.. | Apply | Recall dependent and independent variables, explain Lagrange's Linear equation, apply suitable method to solve linear partial differential equations of first order | CO 4 |

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| 13 | Solve $px + qy = z$ | Apply | Recall dependent and independent variables, explain Lagrange's Linear equation, apply suitable method to solve linear partial differential equations of first order | CO 4 |
| 14 | Solve, $p + 3q = 5z + tan(y - 3x)$ | Apply | Recall dependent and independent variables, explain Lagrange's Linear equation, apply suitable method to solve linear partial differential equations of first order | CO 4 |
| 15 | Solve. $2p + 3q = 1$ | Remember | Recall dependent and independent variables, explain Lagrange's Linear equation, apply suitable method to solve linear partial differential equations of first order | CO 4 |
| 16 | Solve. $(x + y)p - (x + y)q = z$ | Apply | Recall dependent and independent variables, explain Lagrange's Linear equation, apply suitable method to solve linear partial differential equations of first order | CO 4 |
| 17 | Solve. $p - q = log(x + y)$ . | Apply | Recall dependent and independent variables, explain Lagrange's Linear equation, apply suitable method to solve linear partial differential equations of first order | CO 4 |
| 18 | Solve. $y^2p - xyq = x(z - 2y)$. | Apply | Recall dependent and independent variables, explain Lagrange's Linear equation, apply suitable method to solve linear partial differential equations of first order | CO 4 |
| 19 | Explain linear partial differential equation. . | Remembe | - | CO 4 |

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| 20 | write the general solution of first order linear differential equation. | Remember | - | CO 4 |
| **MODULE IV** | | | | |
| **VECTOR DIFFERENTIATION** | | | | |
| **PART A-PROBLEM SOLVING AND CRITICAL THINKING QUESTIONS** | | | | |
| 1 | Find the angle between the surfaces $x^2+y^2+z^2=9$ and $z=x^2+y^2-3$ at the point(2,-1,2) | Understand | Learner to recall vector and scalar functions, explain gradient and obtain the transformation between surface and volume of a bounded region of cube. | CO 5 |
| 2 | Find the angle between the normals to the surfaces $x^2=yz$ at the points (1,1,1)and (2,4,1). | Understand | Learner to recall vector and scalar functions, explain gradient and apply to the surfaces. | CO 5 |
| 3 | Prove that $div(gradr^m)=m(m+1)r^{m-2}$ where $\bar{r}=x\bar{i}+y\bar{j}+z\bar{k}$ | Understand | Learner to recall vector and scalar functions, explain gradient and apply line integral to obtain the work done by the force. | CO 5 |
| 4 | Show that the vector $(x^2-yz)\bar{i}+(y^2-zx)\bar{j}+(z^2-xy)\bar{k}$ is irrotational and find its scalar potential function. | Understand | Learner to recall vector and scalar functions, explain curl of the gradient, and apply it to obtain irrotational and scalar potential function | CO 5 |
| 5 | Determine a unit vector normal to the surface $xy^3z^2=4$ at the point (-1,-1,2) | Understand | Learner to recall vector and scalar functions, explain gradient and apply Gauss divergence theorem to obtain the transformation between surface and volume of a bounded region of cylinder | CO 5 |
| 6 | Find the directional derivative of $\phi(x,y,z)=x^2yz+4xz^2$ at the point (1, -2, -1) in the direction of the normal to the surface $f(x,y,z)=x\log z – y^2$ at (-1,2,1). | Understand | Learner to recall vector and scalar functions, explain the gradient, and apply it to obtain the direction derivative of the function. | CO 5 |

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| 7 | Prove that $\nabla r^n = nr^{n-2}\bar{r}$ | Understand | Learner to recall vector and scalar functions, explain gradient and of a bounded region of parabolas. | CO 5 |
| 8 | Show that $\nabla f(r) = \frac{\bar{f}(r)}{r} where r = xi + yj + zk$ | Understand | Learner to recall vector and scalar functions, explain gradient and apply Green's theorem to obtain the transformation of a bounded region of parabolas. | CO 5 |
| 9 | Find the directional derivative of the function $xy^2 + yz^2 + zx^2$ along the tangent to the curve $x = t, y = t^2, z = t^3$ at the point (11,1) | Understand | Learner to recall vector and scalar functions, explain gradient and to obtain the transformation between bounded region of a plane. | CO 5 |
| 10 | If the temperature at any point in space is given by $t = xy + yz + zx$, find the direction in which temperature changes most rapidly with distance from the point (1,1,1) and determine the maximum rate of change | Understand | Learner to recall vector and scalar functions, explain gradient and apply Stoke's theorem to obtain the transformation between line and surface of a bounded region of a plane. | CO 5 |
| **PART-B LONG ANSWER QUESTIONS** | | | | |
| 1 | If the vector field F is irrotational find the constants a,b,c where $\bar{f} = (x+2y+az)\bar{i}+(bx-3y-z)\bar{j}+(4x+cy+2z)\bar{k}$ and also find its scalar potential. | Understand | Learner to recall vector and scalar functions, explain gradient and apply it to obtain solution of line integral. | CO 5 |
| 2 | Find the constants a and b so that the surface $ax^2 - byz = (a+2)x$ will be orthogonal to the surface $4xx^2y + z^3 = 4$ at the point (1,-1,2) | Understand | Learner to recall vector and scalar functions, explain gradient and normal forces, and apply it to compute solution . | CO 5 |

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| 3 | Show that $\bar{A} = 3y^4z^2i + 4x^3z^2j - 3x^2y^2k$ is solenoidal | Understand | Learner to recall vector and scalar functions, explain gradient and normal forces, and apply it to compute solution . | CO 5 |
| 4 | Prove that $\bar{A} = (6xy + z^3)i + (3x^2 - z)j + (3xz^2 - y)k$ is irrotational and find the scalar function . | Understand | Learner to recall vector and scalar functions, explain gradient and normal forces, and apply it to compute solution . | CO 5 |
| 5 | If $\nabla f = (y^2 - 2xyz^3)i + (3 + 2xy - x^2z^3)j + (6z^3 - 3x^2yz^2)k$, find f if f(1,0,1)=8. | Understand | Learner to recall vector and scalar functions, explain gradient and normal forces, and apply it to compute solution . | CO 5 |
| 6 | Find the curl of $\bar{V} = e^{xyz}(\bar{i} + \bar{j} + \bar{k})$ at the point (1,2,3) | Understand | Learner to recall vector and scalar functions, explain gradient ,divergence and curl and apply it to compute solution . | CO 5 |
| 7 | If f(r) is differentiable and $r = (x^2 + y^2 + z^2)^1/2$ , show that$f(r)\bar{r}$ is irrotational | Understand | Learner to recall vector and scalar functions, explain gradient ,divergence and curl and apply it to compute solution . | CO 5 |
| 8 | If $f = x^2yz$ and $g = xy - 3z^2$, calculate $\nabla(\nabla f.\nabla g)$ | Understand | Learner to recall vector and scalar functions, explain gradient ,divergence and curl and apply it to compute solution | CO 5 |
| 9 | Find the angle of intersection of the spheres $x^2 + y^2 + z^2 = 29$ and $x^2 + y^2 + z^2 + 4x - 6y - 8z = 47$ at (4,-3,2) | Understand | Learner to recall vector and scalar functions, explain gradient ,divergence and curl and apply it to compute solution | CO 5 |

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| 10 | Determine the angle between the normals to the surface $xy = z^2$ at the points (4,1,2) and (3,3,-3) . | Understand | Learner to recall vector and scalar functions, explain gradient ,divergence and curl and apply it to compute solution . | CO 5 |
| 11 | Calculate the angle between the normals to the surface $2x^2 + 3y^2 = 5z$ at the points (2,-2,4) and (-1,-1,1) | Understand | Learner to recall vector and scalar functions, explain gradient ,divergence and curl and apply it to compute solution | CO 5 |
| 12 | Find the directional derivative of the function $\phi = xy^2 + yz^3$ at the point P (1,-2,-1) in the direction to the surface | Understand | Learner to recall vector and scalar functions, explain gradient ,divergence and curl and apply it to compute solution | CO 5 |
| 13 | Determine the constants a,b,c so that$\bar{A} = (2x + 3y + az)i + (bx + 2y + 3z)j + (2x + cy + 3z)k$ is irrotational.Find the scalar function | Understand | Learner to recall vector and scalar functions, explain gradient ,divergence and curl and apply it to compute solution . | CO 5 |
| 14 | Determine curl of $xyz^2i + yzx^2j + zxy^2k$ at the point (1,2,3) | Understand | Learner to recall vector and scalar functions, explain gradient ,divergence and curl and apply it to compute solution | CO 5 |
| 15 | Find the value of constant b such that $\bar{A} = (bxy - z^3)i + (b - 2)x^2j + (1 - b)xz^2k$ has its curl identically equal to zero. | Understand | Learner to recall vector and scalar functions, explain gradient ,divergence and curl and apply it to compute solution | CO 5 |
| 16 | Determine $div\bar{f}$ where $\bar{f} = r^n\bar{r}$ and calculate n if it is solenoid ? | Understand | Learner to recall vector and scalar functions, explain gradient ,divergence and curl and apply it to compute solution | CO 5 |

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| 17 | If $a = x + y + z$,$b = x^2 + y^2 + z^2$,$c = xy + yz + zx$,prove that [grada,gradb,gradc]=0 . | Understand | Learner to recall vector and scalar functions, explain gradient ,divergence and curl and apply it to compute solution e | CO 5 |
| 18 | Prove that $(y^2 - z^2 + 3yz - 2x)i + (3xz + 2xy)j + (3xy - 2xz + 2z)$ is both solenoidal and irrotational . | Understand | Learner to recall vector and scalar functions, explain gradient ,divergence and curl and apply it to compute solution | CO 5 |
| 19 | Find the directional derivative of $\nabla.(\nabla f)$ at the point (1,-2,1) in the direction of the normal to the surface $xy^2z = 3x + z^2$ where $f = 2x^3y^2z^4$ . | Understand | Learner to recall vector and scalar functions, explain gradient ,divergence and curl and apply it to compute solution | CO 5 |
| 20 | Calculate $\nabla^2 f$ when $f = 3x^2z - y^2z^3 + 4x^3y + 2x - 3y - 5$ at the point (1,1,0) | Understand | Learner to recall vector and scalar functions, explain gradient ,divergence and curl and apply it to compute solution | CO 5 |
| **PART-C SHORT ANSWER QUESTIONS** | | | | |
| 1 | Define gradient of scalar point function. | Remember | — | CO 5 |
| 2 | Define divergence of vector point function. | Remember | — | CO 5 |
| 3 | Define curl of vector point function. | Remember | — | CO 5 |
| 4 | State Laplacian operator. | Remember | — | CO 5 |
| 5 | Find$curl \bar{f}$where $\bar{f} = grad(x^3 + y^3 + z^3 - 3xyz)$ | Remember | — | CO 5 |
| 6 | Find the angle between the normal to the surface $xy = z^2$ at the points $(4, 1, 2) and (3, 3, -3)$ . | Apply | Learner to recall vector and scalar functions, explain gradient and apply it to obtain the angle between the normal surfaces | CO 5 |
| 7 | Find a unit normal vector to the given surface $x^2y + 2xz = 4$ at the point (2,-2,3). | Apply | Learner to recall vector and scalar functions, explain gradient and apply it to obtain the unit vector of normal surfaces. | CO 5 |

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| 8 | If is a vector then prove that $\vec{\nabla}(\bar{a}, \bar{r}) = \bar{a}$ | Apply | Learner to recall vector and scalar functions, explain gradient and apply it to obtain the required solution of normal surfaces | CO 5 |
| 9 | Define ir rotational vector and solenoidal vector of vector point function. | Remember | — | CO 5 |
| 10 | Show that $\vec{\nabla}(f(r)) = \frac{(r)}{r} f'(r)$ | Apply | Learner to recall vector and scalar functions, explain gradient and apply it to obtain the required solution of normal surfaces | CO 5 |
| 11 | Prove that $f = yz\bar{i} + zx\bar{j} + xy\bar{k}$ is irrotational vector. | Apply | Learner to recall vector and scalar functions, explain gradient and apply it to obtain the irrotational vector | CO 5 |
| 12 | Show that $(x+3y)\bar{i} + (y-2z)\bar{j} + (x-2z)\bar{k}$ is solenoidal. | Apply | Learner to recall vector and scalar functions, explain gradient and apply it to obtain conservation of mass | CO 5 |
| 13 | Show that $\vec{\nabla} \times (\vec{\nabla}(\phi)) = 0$ where $\phi$ is scalar point function. | Apply | Learner to recall vector and scalar functions, explain gradient and apply it to obtain solution of scalar point function | CO 5 |
| 14 | Define the derivative of vector function | Remember | — | CO 5 |
| 15 | Prove that $[div\vec{\nabla}\times = 0]$ where . $$\overline{f} = f_1\bar{i} + f_2\bar{j} + f_3\bar{k}$$ | Remember | — | CO 5 |
| 16 | what is unit tangent vector | Remember | — | CO 5 |
| 17 | If$\bar{A} = 5t^2i + tj - t^3k$ and $\bar{B} = sinti - costj$ find $\frac{d}{dt}(\bar{A}.\bar{B})$ | Remember | — | CO 5 |
| 18 | Define the operator del | Remember | — | CO 5 |
| 19 | Define the divergence of a vector | Remember | — | CO 5 |
| 20 | Define the curlof a vector | Remember | — | CO 5 |

| MODULE V | | | | |
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| VECTOR INTEGRATION | | | | |
| PART A-PROBLEM SOLVING AND CRITICAL THINKING QUESTIONS | | | | |
| 1 | Verify Gauss divergence theorem for $\bar{f} = x^2\bar{i} + y^2\bar{j} + z^2\bar{k}$ taken over the cube bounded by x=0, x=a, y=0, y=b, z=0, z=c. . | Apply | Learner to recall vector and scalar functions, explain gradient and apply Gauss divergence theorem to obtain the transformation between surface and volume of a bounded region of cube | CO 6 |
| 2 | Using Gauss divergence theorem evaluate $\int\int_s \bar{F}.ds$ ,for the $\bar{F} = y\bar{i} + x\bar{j} + z^2\bar{k}$ for the cylinder region S given by $x^2 + y^2 = a^2$, z = 0 and z = b. | Apply | Learner to recall vector and scalar functions, explain gradient and apply Gauss divergence theorem to obtain the transformation between surface and volume of a bounded region of cylinder | CO 6 |
| 3 | Using Green's theorem in the plane evaluate $\int_c (2xy - x^2)dx + (x^2 + y^2)dy$ where C is the region bounded by $y = x^2$ and $y^2 = x$ . | Apply | Learner to recall vector and scalar functions, explain gradient and apply Green's theorem to obtain the transformation between line and double integral of a bounded region of parabolas. | CO 6 |
| 4 | Applying Green's theorem evaluate $\int_c (xy + y^2)dx + (x^2)dy$ where C is the region bounded by $y = \sqrt{x}$ and $y = x^2$ . | Apply | Learner to recall vector and scalar functions, explain gradient and apply Green's theorem to obtain the transformation between line and double integral of a bounded region of parabolas. | CO 6 |

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| 5 | Verify Green's Theorem in the plane for $\int_c (3x^2 - 8y^2)dx + (4y - 6xy)dy$ where C is the region bounded by x=0, y=0 and x + y=1. | Apply | Learner to recall vector and scalar functions, explain gradient and apply Stoke's theorem to obtain the transformation between line and surface of a bounded region of a plane. | CO 6 |
| 6 | Verify Stokes theorem for $\bar{F} = (y - z + 2)\bar{i} + (yz + 4)\bar{j} - xz\bar{k}$ where S is the surface of the cube x=0, y=0, z=0 and x=2, y=2, z=2 above the xy-plane. | Apply | Learner to recall vector and scalar functions, explain gradient and apply Stoke's theorem to obtain the transformation between line and surface of a bounded region of a plane. | CO 6 |
| 7 | Verify Gauss divergence theorem for the vector point function $\bar{F} = (x^3 - yz)\bar{i} - 2xy\bar{j} + 2z\bar{k}$ over the cube bounded by $x = y = z = 0$ and$x = y = z = a$. | Apply | Learner to recall vector and scalar functions, explain gradient and apply Gauss divergence theorem to obtain the transformation between surface and volume of a bounded region of cube . | CO 6 |
| 8 | Verify Green's theorem in the plane for $\int_c (3x^2 - 8y^2)dx + (4y - 6xy)dy$ where C is a region bounded by $y = \sqrt{x}$ and $y = x^2$ | Apply | Learner to recall vector and scalar functions, explain gradient and apply Green's theorem to obtain the transformation between surface and volume of a bounded region of cube .. | CO 6 |
| 9 | If $\bar{F} = (x^2 + y^2)\bar{i} - 2xy\bar{j}$ evaluate $\int \bar{F}.\bar{d}r$ where curve c is the rectangle in xy-plane bounded by $y = 0, y = b, x = 0, x = a$. | Apply | Learner to recall vector and scalar functions, explain gradient and apply Gauss divergence theorem to obtain the transformation between surface and volume of a bounded region of cube . | CO 6 |

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| 10 | If $\bar{F}=(2x+y^2)i+(3y-4x)j$evaluate $\int_c \bar{F}.\bar{d}r$ around a triangle ABC in the xy-plane with A(0,0), B(2,0),C(2,1) in the counter clock wise direction and opposite direction | Apply | Learner to recall vector and scalar functions, explain gradient and apply Gauss divergence theorem to obtain the transformation between surface and volume of a bounded region of cube . | CO 6 |
| **PART-B LONG ANSWER QUESTIONS** | | | | |
| 1 | Evaluate $\iint_s \bar{F}.ds$ if $\bar{F}=yz\bar{i}+2y^2\bar{j}+xz^2\bar{k}$ and S is the Surface of the cylinder $x^2+y^2=9$ contained in the first octant between the planes z=0 and z=2. | Apply | Learner to recall vector and scalar functions, explain gradient and normal forces, and apply it to value the area of the cylinder . | CO 6 |
| 2 | Find the work done in moving a particle in the force field $\bar{F}=3x^2\bar{i}+(2zx-y)\bar{j}+z\bar{k}$ along the straight line from (0,0,0) to (2,1,3) . | Apply | Learner to recall vector and scalar functions, explain gradient and apply line integral to value the work done by the force. | CO 6 |
| 3 | Find the circulation of $\bar{F}=(2x-y+2z)\bar{i}+(x+y-z)\bar{j}+(3x-2y-5z)\bar{k}$ along the circle $x^2+y^2=4$ in the xy plane. | Apply | Learner to recall vector and scalar functions, explain gradient and apply line integral to value the work done by the force. | CO 6 |
| 4 | Verify Gauss divergence theorem for the vector point function $\bar{F}=(x^3-yz)\bar{i}-2xy\bar{j}+2z\bar{k}$ over the cube bounded by $x=y=z=0$ and$x=y=z=a$. | Apply | Learner to recall vector and scalar functions, explain gradient and apply Gauss divergence theorem to obtain the transformation between surface and volume of a bounded region of cylinder | CO 6 |
| 5 | Verify Gauss divergence theorem for $2x^2y\bar{i}-y^2\bar{j}+4xz^2\bar{k}$ taken over the region of first octant of the cylinder $y^2+z^2=9$ and x=2. | Apply | Learner to recall vector and scalar functions, explain gradient and apply Gauss divergence theorem to obtain the transformation between surface and volume of a bounded region of cylinder | CO 6 |

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| 6 | Verify Green's theorem in the plane for $\int_c (x^2 - xy)dx + (y^2 - 2xy)dy$ where C is a square with vertices (0,0) ,(2,0) ,(2,2),(0,2). | Apply | Learner to recall vector and scalar functions, explain gradient and apply Green's theorem to obtain the transformation between line and double integral of a square bounded region . | CO 6 |
| 7 | Applying Green's theorem evaluate $\int_c (y - sinx)dx + cosydy$ where C is the plane triangle enclosed by y= 0 .y $= \frac{2x}{\pi}$ ,and $x = \frac{\pi}{2}$. | Apply | Learner to recall vector and scalar functions, explain gradient and apply Green's theorem to obtain the transformation between line and double integral of a square bounded region . | CO 6 |
| 8 | Apply Green's Theorem in the plane for $\int_c (2x^2 - y^2)dx + (x^2 + y^2)dy$ where C is a is the boundary of the area enclosed by the x-axis and upper half of the circle$x^2 + y^2 = a^2$ . | Apply | Learner to recall vector and scalar functions, explain gradient and apply Green's theorem to obtain the transformation between line and double integral of a triangle bounded region | CO 6 |
| 9 | Verify Stokes theorem for $\bar{f} = (2x - y)\bar{i} - yz^2\bar{j} - y^2z\bar{k}$ where S is the upper half surface of the sphere $x^2 + y^2 + z^2 = 1$ bounded by the projection of the xy plane. | Apply | Learner to recall vector and scalar functions, explain gradient and apply Stoke's theorem to the transformation between line and surface of a bounded region of sphere. | CO 6 |
| 10 | Verify Stokes theorem for $\bar{f} = -y^3\bar{i} + x^3\bar{j}$ where S is the circular disc $x^2 + y^2 \leq 1$, z=0. | Apply | Learner to recall vector and scalar functions, explain gradient and apply Stoke's theorem to the transformation between line and surface of a bounded region of sphere | CO 6 |

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| 11 | If $\bar{F} = 4xz\bar{i} - y^2\bar{j} + yz\bar{k}$ evaluate$\int_s \bar{F}.\bar{n}ds$ where S is the surface of the cube x= 0 ,x=a, y=0,y=a.z=0,z=a | Apply | Learner to recall vector and scalar functions, explain gradient and apply Gauss divergence theorem to obtain the transformation between surface and volume of a bounded region of cube. | CO 6 |
| 12 | If $\bar{f} = (5xy - 6x^2)\bar{i} + (2y - 4x)\bar{j}$ evaluate$\int_c \bar{f}.d\bar{r}$ along the curve C in $y = x^3$ plane from (1,1) to (2,8) | Apply | Learner to recall vector and scalar functions, explain gradient and apply line integral to obtain the work done by the force. | CO 6 |
| 13 | Evaluate the line integral r $\int_c (x^2 + xy)dx + (x^2 + y^2)dy$ where C is the square formed by lines $x = \pm 1, y = \pm 1$ . | Apply | Learner to recall vector and scalar functions, explain gradient and apply line integral to obtain the work done by the force | CO 6 |
| 14 | Evaluate by Stokes theorem $\int_c (e^x dx + 2ydy - dz)$where c is the curve $x^2 + y^2 = 9$ and z=2 | Apply | Learner to recall vector and scalar functions, explain gradient and apply Stoke's theorem to obtain the transformation between line and surface of a bounded region of a plane | CO 6 |
| 15 | Verify Stokes theorem for the function $x^2\bar{i} + xy\bar{j}$ integrated round the square in the plane z=0 whose sides are along the line x=0,y=0 ,x=a,y=a | Apply | Learner to recall vector and scalar functions, explain gradient and apply Stoke's theorem to obtain the transformation between line and surface of a bounded region of a plane | CO 6 |

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| 16 | Evaluate by Stokes theorem $\int_c (x+y)dx + (2x-z)dy + (y+z)dz$ where C is the boundary of the triangle with vertices (0,0,0),(1,0,0),(1,1,1) | Apply | Learner to recall vector and scalar functions, explain gradient and apply Stoke's theorem to obtain the transformation between line and surface of a square bounded region | CO 6 |
| 17 | Verify Green's theorem in the plane for $\int_c (3x^2-8y^2)dx + (4y-6xy)dy$ where C is a region bounded by $y=\sqrt{x}$ and $y=x^2$ . | Apply | Learner to recall vector and scalar functions, explain gradient and apply Green's theorem to obtain the transformation between line and double integral of a bounded region of parabola | CO 6 |
| 18 | Determine whether the force field $\bar{F} = 2xz\bar{i} + (x^2-y)\bar{j} + (2z-x^2)\bar{k}$ is conservative or not | Apply | Learner to recall vector and scalar functions, explain gradient and apply line integral to obtain the work done by the force. | CO 6 |
| 19 | Evaluate $\int\int_s \bar{A}.\bar{n}ds where \bar{A} = z\bar{i} + x\bar{j} - 3y^2z\bar{k}$ and s is the surface of the cylinder $x^2+y^2=16$ included in the first octant between z=0 and z=5 | Apply | Learner to recall vector and scalar functions, explain gradient and volume integral to obtain the transformation between line and surface of a square bounded region | CO 6 |
| 20 | Evaluate by Green's theorem $\int (y - sinx)dx + cosxdy$ where 'C' is the triangle enclosed by the lines $y=0, x=\pi/2, \pi y = 2x.$ . | Apply | Learner to recall vector and scalar functions, explain gradient and apply Green's theorem to obtain the transformation between line and double integral of a bounded region of parabola. | CO 6 |
| | **PART-C SHORT ANSWER QUESTIONS** | | | |
| 1 | Define gradient of scalar point function. | Remember | — | CO 6 |
| 2 | Define divergence of vector point function. | Remember | —- | CO 6 |
| 3 | Define curl of vector point function. | Remember | — | CO 6 |

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| 4 | State Laplacian operator. | Remember | —- | CO 6 |
| 5 | State Stokes theorem of transformation between line integral and surface integral. | Remember | — | CO 6 |
| 6 | Define line integral on vector point function. | Remember | — | CO 6 |
| 7 | State Green's theorem | Remember | — | CO 6 |
| 8 | Define the line integral of vector point function | Remember | — | CO 6 |
| 9 | Define surface integral of vector point function $\bar{F}$. | Remember | — | CO 6 |
| 10 | Define volume integral on closed surface S of volume V. | Remember | —r | CO 6 |
| 11 | State Green's theorem of transformation between line integral and double integral. | Remember | — | CO 6 |
| 12 | State Gauss divergence theorem of transformation between surface integral and volume integral. | Remember | — | CO 6 |
| 13 | What is the surface area of the surface S whose equation is F(x,y,z)=0? | Apply | Recall dependent and independent variables, explain Lagrange's Linear equation, apply suitable method | CO 6 |
| 14 | Find the surface area of the plane$x + 2y + 2z = 12$ cut off by x=0,y=0,x=1,y=1 | Apply | Recall dependent and independent variables, explain Lagrange's Linear equation, apply suitable method | CO 6 |
| 15 | Find the surface area of $z = x^2 + y^2$ included between z=0 z=1 | Apply | Recall dependent and independent variables, explain Lagrange's Linear equation, apply suitable method | CO 6 |
| 16 | Evaluate $\int y^2 dx - 2x^2 dy$ along the parabola $y = x^2 from (0, 0) to (2, 4)$ | Apply | Recall dependent and independent variables, apply suitable method | CO 6 |
| 17 | Compute the area of the ellipse $x = acos^3 t$ $y = bsint$ | Apply | Recall dependent and independent variables, apply suitable method t | CO 6 |
| 18 | What is the surface area of a curved surface | Apply | Remember | CO 6 |
| 19 | what are the applications of line integral | Remember | — | CO 6 |
| 20 | Define volume integral on closed surface S of volume V. | Remember | — | CO 6 |

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