SREENIVASA INSTITUTE OF TECHNOLOGY AND MANAGEMENT STUDIES (AUTONOMOUS)

QUESTION BANK

Year / Semester: I B.Tech II Semester **Regulation: R23**

Subject and Code: DIFFERENTIAL EQUATIONS AND VECTOR CALCULUS(23BSC121)

SYLLABUS

UNIT-I: DIFFERENTIAL EQUATIONS OF FIRST ORDER AND FIRST DEGREE (9)

Linear differential equations – Bernoulli's equations - Exact equations and equations reducible to exact form. Applications: Newton's Law of cooling – Law of natural growth and decay, Electrical circuits.

UNIT-II:LINEAR DIFFERENTIAL EQUATIONS OF HIGHER ORDER (CONSTANT COEFFICIENTS) (9)

Definitions, homogenous and non-homogenous, complimentary function, general solution, particular integral, Wronskean, Method of variation of parameters. Simultaneous linear equations, Applications to L-C-R Circuit problems and Simple Harmonic motion.

UNIT-III:PARTIAL DIFFERENTIAL EQUATIONS (9)

Introduction and formation of Partial Differential Equations by elimination of arbitrary constants and arbitrary functions, solutions of first order linear equations using Lagrange's method and Non-Linear (Standard forms) equations. Homogeneous Linear Partial differential equations with constant coefficients (Method of Separation of variables).

UNIT-IV: VECTOR DIFFERENTIATION (9)

Scalar and vector point functions, vector operator Del, Del applies to scalar point functions Gradient, Directional derivative, del applied to vector point functions-Divergence and Curl, vector identities.

UNIT-V:VECTOR INTEGRATION (9)

Line Integral-circulation-work done, surface integral-flux, Green's theorem in the plane (without proof), Stoke's theorem (without proof), volume integral, Divergence theorem (without proof) and related problems.

TEXT BOOKS:

1. Higher Engineering Mathematics, B. S. Grewal, Khanna Publishers, 2017, 44th Edition
2. Advanced Engineering Mathematics, Erwin Kreyszig, John Wiley & Sons, 2018, 10th Edition.

REFERRENCE BOOKS:

1. Thomas Calculus, George B. Thomas, Maurice D. Weir and Joel Hass, Pearson Publishers, 2018, 14th Edition.
2. Advanced Engineering Mathematics, Dennis G. Zill and Warren S. Wright, Jones and Bartlett, 2018.
3. Advanced Modern Engineering Mathematics, Glyn James, Pearson publishers, 2018, 5th Edition.
4. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Alpha Science International Ltd.,
5. Higher Engineering Mathematics, B. V. Ramana, , McGraw Hill Education, 2017

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Max Marks: 10

S.No.	CO	Questions	BT
		Unit I: DIFFERENTIAL EQUATIONS OF FIRST ORDER AND FIRST DEGREE	
1	1	**a.** Solve $e^y dx + (xe^y + 2y)dy = 0$ **b.** Solve $[y\left(1+\frac{1}{x}\right) + \cos y]dx + [x + \log x - x\, sin y]dy = 0$	L2
2	1	Solve $x^2 y dx - (x^3 + y^3)dy = 0$	L2
3	1	Solve $y(x^2y^2 + 2)dx + x(2 - x^2y^2)dy = 0$	L2
4	1	Solve $2xydy - (x^2 + y^2 + 1)dx = 0$	L2
5	1	Solve $x log\, x \frac{dy}{dx} + y = 2 \log x$	L2
6	1	Solve $(x+1)\frac{dy}{dx} - y = e^{2x}(x+1)^2$	L2
7	1	Solve $x\frac{dy}{dx} + y = x^3 y^6$	L2
8	1	Water temperature at 100^0C cools to 80^0C in 10 minutes in the room of temperature 25^0C. Find the Temperature of the water after 20 minutes.	L3
9	1	If the temperature of the air is 30^0C and a substance cools from 100^0C to 70^0C in 15 minutes, find the time when the temperature is 40^0C.	L3
10	1	The Number N of the bacteria in a culture grow at a rate proportional to N. The value N was initially 100 and increased to 332 in 1hr. What will be the value of N after $1\frac{1}{2}$ hour.	L3

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S.No.	CO	Questions	BT
Unit II: LINEAR DIFFERENTIAL EQUATIONS OF HIGHER ORDER (CONSTANT COEFFICIENTS)			
1	2	**a.** Solve $\frac{d^2y}{dx^2}+4\frac{dy}{dx}+3y=e^{2x}$ **b.** Solve $\frac{d^3y}{dx^3}-6\frac{d^2y}{dx^2}+11\frac{dy}{dx}-6y=e^{-2x}+e^{-3x}$	L2
2	2	Solve $(D^2-2D+2)y=e^x+\cos(x)$	L2
3	2	Solve $\left(D^2+D+1\right)y=\sin 2x$	L2
4	2	Solve $(D^2+5D+4)y=x^2$	L2
5	2	Solve $(D^2+3D+2)y=e^{-x}+x^2+\cos x$	L2
6	2	Solve $\frac{d^2y}{dx^2}-6\frac{dy}{dx}+13y=8e^{3x}\sin 2x$	L2
7	2	Solve $(D^2+9)y=x\sin(2x)$	L2
8	2	Solve $\frac{d^2y}{dx^2}+4y=\tan 2x$ by the Method of variation of Parameter	L3
9	2	Solve $\frac{d^2y}{dx^2}+9y=\sec 3x$ by the Method of variation of Parameter	L3
10	2	Solve $\frac{dx}{dt}-7x+y=0, \frac{dy}{dt}-2x-5y=0$	L3

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S.No.	CO	Questions	BT
Unit III: PARTIAL DIFFERENTIAL EQUATIONS			
1	3	Form the partial differential equation by eliminating the arbitrary constants a & b from $2z = \frac{x^2}{a^2} + \frac{y^2}{b^2}$	L2
2	3	Form the partial differential equation by eliminating the arbitrary constants a & b from $z = (x-a)^2 + (y-b)^2$	L2
3	3	Form the partial differential equation by eliminating the arbitrary constants h & k from $(x-h)^2 + (y-k)^2 + z^2 = a^2$	L2
4	3	Form the partial differential equation by eliminating the arbitrary function from $lx + my + nz = \emptyset(x^2 + y^2 + z^2)$	L2
5	3	Form the partial differential equation by eliminating the arbitrary function xyz=f(x+y+z)	L2
6	3	Solve yzp + zxq = xy	L2
7	3	Solve $(y^2 z/x)p + zxq = y^2$	L2
8	3	*Solve (mz-ny)p + (nx-lz)q = ly-mx*	L2
9	3	Solve $x\frac{\partial z}{\partial x} - y\frac{\partial z}{\partial y} = 0$, by the method of separation of variables	L3
10	3	Solve $\frac{\partial^2 z}{\partial x^2} = \frac{\partial z}{\partial y}$, by the method of separation of variables	L3

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S.No.	CO	Questions	BT
Unit IV: VECTOR DIFFERENTIATION			
1	4	**a.** Find a unit normal vector to the surface $z = x^2 + y^2$ at $(-1, -2, 5)$ **b.** If $\bar{f} = xy^2 i + 2x^2yzj - 3yz^2k$ then find $div\ \bar{f}$ at (1,-1,1)	L3
2	4	Find div $\bar{f}$ and curl $\bar{f}$ where $\bar{f} = (x^2 - y^2)i + 4xy\,j + (x^2 - xy)k$	L2
3	4	Find div $\bar{f}$ and curl $\bar{f}$ where $\bar{f} = (x^2 + yz)i + (y^2 + zx)\,j + (z^2 + xy)k$	L2
4	4	Show that V= (sin y + z)i+(x cos y – z)j+(x-y)k is irrotational	L3
5	4	Find the directional derivative of $f = xy + yz + zx$ in the direction of the vector $\bar{i} + 2\bar{j} + 2\bar{k}$ at the point $(1, 2, 0)$.	L3
6	4	Find the directional derivative of $f = 2xy + z^2$ at $(1, -1, 3)$ in the direction of the vector $\bar{i} + 2\bar{j} + 3\bar{k}$.	L3
7	4	Find the directional derivative of $f(x, y, z) = 2x^2 + 3y^2 + z^2$ at (2,1,3) in the direction of the vector i-2k	L3
8	4	Find the directional derivative of $f = x^2 - y^2 + 2z^2$ at the point $P = (1, 2, 3)$ in the direction of the line PQ where $Q = (5, 0, 4)$	L3
9	4	Find the angle between the surfaces $x^2 + y^2 + z^2 = 9$ and $z = x^2 + y^2 - 3$ at the point $(2, -1, 2)$.	L3
10	4	Find the constants a, b and c if the vector $\bar{f} = (2x + 3y + az)\bar{i} + (bx + 2y + 3z)\bar{j} + (2x + cy + 3z)\bar{k}$ is Irrotational	L3

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S.No.	CO	Questions	BT
Unit V: VECTOR INTEGRATION			
1	5	If $\bar{F} = x^2y^2i + yj$ then evaluate $\int_C \bar{F}.dr$ where C is the line y=x from (0,0) to (1,1)	L2
2	5	If $\bar{F} = y\,i - x\,j$ then evaluate $\int_C \bar{F}.dr$ where C is the curve $y = x^2$ in the xy plane from (0,0) to (1,1)	L2
3	5	If $\bar{F} = y\,i + 2\,x\,j$ then evaluate $\int_C \bar{F}.dr$ where C is straight line joining (2,0) and (1,3)	L2
4	5	Find $\int_C \bar{F}.dr$ where $(3x^2 + 6x)i - 14yzj + 20xz^2k$ and C is a straight line joining (0,0,0) and (1,1,1)	L3
5	5	Evaluate $\int_S \bar{F}.\bar{n}\,dS$, where $\bar{F} = 18zi - 12j + 3yk$, and S is the part of the surface of the plane 2x+3y+6z=12 located in the first octant.	L2
6	5	Evaluate $\int_C \left[\left(3x^2 - 8y^2\right)dx + \left(4y - 6xy\right)dy\right]$ where C is the region bounded by $x = 0,\ y = 0$ and $x + y = 1$ by Green's Theorem.	L2
7	5	Evaluate by Green's theorem $\int_C (y - \sin x)\,dx + \cos x\,dy$ where C is the triangle enclosed by the lines y=0,x=$\frac{\pi}{2}$, $\pi y = 2x$	L
8	5	Evaluate by Green's theorem $\int_C (x^2 - \cosh y)\,dx + (y + \sin x)\,dy$ where C is the rectangle with vertices (0,0),$(\pi, 0), (\pi, 1)$ and $(0,1)$	L3
9	5	Using Divergence theorem, evaluate $\iint_S (x\,dy\,dz + y\,dz\,dx + z\,dx\,dy)$, where $x^2 + y^2 + z^2 = a^2$.	L3
10	5	Verify Stoke's theorem for the function $\bar{F} = x^2i + xyj$ integrated round the square in the plan z=0 whose sides are along the lines x=0,y=0,x=a,y=a.	L3

Note: L1-Remembering, L2-Understanding, L3-Applying, L4-Analyzing, L5-Evaluating, and L6-Creating

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Instruction to Faculty Members:

The Six Levels of Bloom's Taxonomy:

1. **Remembering:** Retrieving, recognizing, and recalling relevant knowledge from long-term memory (e.g., list, define, name, locate).
2. **Understanding:** Constructing meaning, explaining ideas, or concepts (e.g., summarize, interpret, classify, compare).
3. **Applying:** Using information in new situations or implementing procedures to solve problems (e.g., solve, use, demonstrate, implement).
4. **Analyzing:** Breaking material into constituent parts, determining how the parts relate to one another and to an overall structure (e.g., contrast, categorize, distinguish, diagram).
5. **Evaluating:** Making judgments based on criteria and standards through checking and critiquing (e.g., judge, critique, justify, defend, argue).
6. **Creating:** Putting elements together to form a coherent or functional whole; reorganizing elements into a new pattern or structure (e.g., design, construct, develop, formulate).