DEPARTMENT OF MATHEMATICS				*CLASS: I B.Sc. Mathematics*				
Sem	**Course Type**	**Course Code**	**Course Title**	**Credits**	**Contact Hours/week**	**CIA**	**Ext**	**Total**
IV	Major Core	20U4MMC8	Differential Equations	3	4	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	
Skill oriented			Entrepreneurship oriented	

Objectives:

1. To introduce the basics of ordinary and partial differential equations
2. Introducing various methods to find the solution of ordinary and partial differential equations
3. Introducing different types to solve first order non-linear ordinary differential equations including Charpit's method
4. To solve second order ordinary differential equations using method of variation of parameters
5. To solve linear system of ordinary differential equations
6. To solve linear and non-linear partial differential equations with different methods.

Unit	**Description**	**Hours**	**K-level**	**CLO**
I	Differential equations – Definition and examples – order and degree of differential equations – Types of differential equations – Linear and non-linear differential equations – Solving first order and higher degree equations: Equations solvable for p – Equations solvable for x – Equations solvable for y – Clairaut's form.	12	Up to K3	CLO1
II	Second and higher order linear differential equations with constant coefficients – Method of finding complementary functions – Method of finding particular integral for functions of the form $e^{mx}, \sin mx \text{ or } \cos mx,\ x^m (m \in Z^+), e^{ax} V(x),\ x^m \sin ax \text{ or } x^m \cos ax,\ e^{ax} \sin bx\, x^m \text{or } e^{ax} \cos bx\, x^m$ -Simultaneous differential equations with constant coefficients.	12	Up to K4	CLO2
III	Higher order linear differential equations with variable coefficients - Euler's Homogeneous equations – Legendre's linear equations – Method of variation of parameters – Removal of the first derivative – Change of the dependent variable.	12	Up to K4	CLO3
IV	Partial differential equations – Definition and examples – Formation of partial differential equations by elimination of arbitrary constants – By elimination of arbitrary functions –Types of solution of partial differential equations – Solutions by direct integrals – Solving Lagrange's differential equations Pp+Qq=R by method of grouping and method of multipliers.	12	Up to K3	CLO4
V	First order non-linear partial differential equations - Standard fo : $f(p,q)=0$ – $z = px + qy + f(p,q)$ $f(x,p) = f(y,q) - f(x,p,q) = 0,\ f(y,p,q) = 0,\ f(z,p,q) = 0$ Charpit's method for solving first order non-linear partial differential equations.	12	Up to K4	CLO5

Book for Study:

1. S. Arumugam, A. ThangapandiIssac and A. Somasundaram, Differential Equations And Applications, 2020 Edition, Yes Dee Publishing Pvt. Ltd.
   Chapters: 1(1.1, 1.2 and 1.8), 2 (2.1 – 2.5, 2.6 (Type A, Type B, Type D), 2.7), 4 (4.1 – 4.5)

Books for References:

1. S. Narayanan and T. K. ManicavachagamPillai, Differential Equations and its Applications, 2003, S. Viswanathan Printers.
2. P. Kandasamy and K. Thilagavathi, Mathematics for B.Sc., Vol.III, 2004, S. Chand and Co., New Delhi.
3. M. K. Venkataraman and Mrs.Manorama Sridhar, Differential Equations and Lapalce Transforms, 2004, The National Publishing Company.

Web Resources:

1. http://eqworld.ipmnet.ru/en/solutions/ode.htm
2. https://www.khanacademy.org/math/differential-equations
3. https://mathinsight.org/ordinary_differential_equation_introduction
4. https://tutorial.math.lamar.edu/Classes/DE/DE.aspx
5. https://www.emathhelp.net/calculators/differential-equations/differential-equation-calculator/
6. https://www.wolframalpha.com/examples/mathematics/differential-equations/

Rationale and activities having direct bearing on Nature of Course

Knowledge and Skill

Differential equations have wide applications in various science disciplines. It is practically important for science students able to model physical and chemical problems using mathematical equations, then solve these equations so that the behavior of the systems concerned can be studied.

Pedagogy:

Lecture, Seminar, Quiz, Problem Solving, Tutorial, Group Discussion, PPT.

Course Learning Outcomes:

On the successful completion of the course. Students will be able to

Number	Course Learning outcome	Knowledge level
CLO1	Learn various techniques of getting exact solutions of certain solvable first order non-linear ODE's and linear ODE's of second and higher orders	Up to K3
CLO2	Grasp the concept of a general solution of a linear ODE of second order with variable coefficients and also learn a few methods to obtain the general solution of such equations.	Up to K4
CLO3	Apply a range of techniques to solve first order linear and non-linear PDE's.ODE's.	Up to K4
CLO4	Learn about general solution of first order linear PDE's using the Lagrange's method.	Up to K3
CLO5	Know how to solve first order non-linear PDE's using Charpit's method	Up to K4

K1- Remembering and recalling facts with specific answers
K2 –Basic understanding of facts and stating main ideas with general answers
K3 –Application oriented – solving problems
K4- Examining, analyzing, presentation and make inference with evidences.

Mapping of Course Outcomes (CLOs) with Program Outcomes & Program Specified Outcomes(PSOs)

CLOs/POs &PSOs	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PS04	PSO5	PSO6	PSO7
CLO1	3	3	2	3	2		3	2	3	2	3	3	2
CLO2	3	3	2	3	2		3	3	3	3	3	3	3
CLO3	3	3	2	3	3		3	3	3	3	1	3	3
CLO4	3	3	2	3	2		3	2	3	2	3	3	1
CLO5	3	3	2	3	2		3	2	3	-	1	3	2

1. Basic level 2. Intermediate level 3. Advance level

Blue Print

Mapping with Course Learning Outcomes (CLOs)

SL.No	CLOs	K-level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K-Level	No. of Questions	K-Level		
1	CLO 1	Up to K 3	2	K1 & K2	1	K1	2(K2 & K2)	1(K3)
2	CLO 2	Up to K 4	2	K1 & K2	1	K2	2(K3 & K3)	1(K4)
3	CLO 3	Up to K 4	2	K1 & K2	1	K2	2(K3 & K3)	1(K4)
4	CLO 4	Up to K 3	2	K1 & K2	1	K1	2(K2& K2)	1(K3)
5	CLO 5	Up to K 4	2	K1 & K2	1	K2	2(K3 & K3)	1(K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1- Remembering and recalling facts with specific answers
K2 – Basic understanding of facts and stating main ideas with general answers
K3 – Application oriented – solving problems
K4- Examining, analyzing, presentation and make inference with evidences.

Distribution of section wise marks with K levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/ or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	5	4	-	-	9	7.5	
K2	5	6	20	-	31	25.83	33.33%
K3	-	-	30	30	60	50.00	50.00%
K4	-	-	-	20	20	16.67	16.67%
Total marks	10	10	50	50	120	100	100%

Blue Print for CIA-I

SL.No	CLOs	K-level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K-Level	No. of Questions	K-Level		
1	CLO 1	Up to K 3	2	K1 & K2	1	K1	2(K2 &K2)	2(K2/K3)
2	CLO 2	Up to K4	2	K1 & K2	2	K2	2(K3 &K3)	1(K4)
No. of Questions to be asked			4		3		4	3
No. of Questions to be answered			4		3		2	2
Marks for each question			1		2		5	10
Total Marks for each Section			4		6		10	20

K1- Remembering and recalling facts with specific answers
K2 – Basic understanding of facts and stating main ideas with general answers
K3 – Application oriented – solving problems
K4- Examining, analyzing, presentation and make inference with evidences.

Distribution of section wise marks with K levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/ or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	2	2		-	4	6.67	
K2	2	4	10	10	26	43.33	50%
K3	-		10	10	20	33.33	33.33%
K4	-			10	10	16.67	16.67%
Total marks	4	6	20	30	60	100.00	100%

Blue Print for CIA-II

Mapping with Course Learning Outcomes (CLOs)

SL.No	CLOs	K-level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K-Level	No. of Questions	K-Level		
1	CLO 3	Up to K 4	2	K1 & K2	1	K2	2(K4 &K4)	1(K4)
2	CLO 4	Up to K 3	2	K1 & K2	2	K1	2(K2&K2)	2(K2/K3)
No. of Questions to be asked			4		3		4	3
No. of Questions to be answered			4		3		2	2
Marks for each question			1		2		5	10
Total Marks for each Section			4		6		10	20

K1- Remembering and recalling facts with specific answers
K2 – Basic understanding of facts and stating main ideas with general answers
K3 – Application oriented – solving problems
K4- Examining, analyzing, presentation and make inference with evidences.

Distribution of section wise marks with K levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/ or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	2	4		-	6	10.00	
K2	2	2	10	10	24	40.00	50%
K3	-			10	10	16.67	16.67%
K4	-		10	10	20	33.33	33.33%
Total marks	4	6	20	30	60	100.00	100%

Lesson Plan

Units	Description	Hours	Pedagogy
I	Ordinary differential Equations: Definition and Examples, Order and degrees of a DE's	2	Lecture
	Types of DE's, Linear and non-linear DE's, Solution of DE's	2	Lecture
	Solving first order but Higher degree DE's: Equations solvable for p	2	Lecture & PPT
	Equation solvable for x	2	Lecture
	Equations solvable for y	2	Lecture
	Clairaut's form	2	Lecture& Group Discussion
II	Second and higher order liner differential equations with constant coefficients	1	Lecture
	Method of finding complementary functions	1	Lecture& Seminar
	Method of finding particular integrals of the form: $e^{mx}, \sin mx \; or \; \cos mx$	2	Lecture
	Method of finding particular integrals of the form: $x^m \, (m \in Z^+), e^{ax} V(X)$	2	Lecture
	Method of finding particular integrals of the form: $x^m \sin ax \; or \; x^m \cos ax,$	2	Lecture & PPT
	Method of finding particular integrals of the form: $e^{ax} \sin bx \, x^m or \; e^{ax} \cos bx$	2	Lecture& Seminar
	Simultaneous Differential Equations with constant coefficients	2	Lecture &Group Discussion
III	Higher order linear differential equations with variable coefficients	1	Lecture
	Cauchy – Euler's Homogeneous Equations	2	Lecture& PPT
	Legendre's Linear Homogeneous Equations	2	Lecture
	Method of variation of parameters	2	Lecture
	Removal of the first derivative	2	Lecture & Seminar
	Change of dependent variable: Method of reduction of order	3	Lecture & Group Discussion
IV	Partial differential Equations: Definition and examples	1	Lecture
	Formation of PDE's by eliminating the arbitrary constants	2	Lecture
	Formation of PDE's by eliminating the arbitrary functions	2	Lecture & Seminar
	Types of solutions of PDE's, Solutions by direct integration	2	Lecture
	Solving Lagrange's PDE: Pp+Qq=R, by method of groupings	2	Lecture & PPT
	Method of multipliers	3	Lecture & Group Discussion
	Solving first order non-linear partial differential equations - Standard forms	1	Lecture
	Equations of the form $f(p,q)=0$	2	Lecture & Seminar

V	Equations of the form $f(x,p,q)=0$, $f(y,p,q)=0$, $f(z,p,q)=0$	3	Lecture
	Equations of the form $f(x,p)=f(y,q)$	2	Lecture & PPT
	Equations of the form $z=px+qy+f(p,q)$	2	Lecture
	Charpit's method for solving first order non-linear partial differential equations.	2	Lecture & Group Discussion
Total Hours		**60**	

Course Designer:

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