Holy Cross College (Autonomous), Nagercoil - 629004

Kanyakumari District, Tamil Nadu.

Nationally Accredited with A^+ by NAAC IV cycle – CGPA 3.35

Affiliated to

Manonmaniam Sundaranar University, Tirunelveli

DEPARTMENT OF MATHEMATICS

TEACHING PLAN (UG)

EVEN SEMESTER 2024-2025

Vision

To empower women globally competent with human values and ethics acquiring academic and entrepreneurship skills through holistic education.

Mission

1. To create opportunities which will ensure academic excellence in critical thinking, humanistic and scientific inquiry.
2. To develop application-oriented courses with the necessary input of values.
3. To create a possible environment for innovation, team spirit and entrepreneurial leadership.
4. To form young women of competence, commitment and compassion.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEOs	**Upon completion of B.Sc. Degree Programme, the graduates will be able to**	**Mission addressed**
PEO 1	apply appropriate theory and scientific knowledge to participate in activities that support humanity and economic development nationally and globally, developing as leaders in their fields of expertise.	**M1 & M2**
PEO 2	inculcate practical knowledge for developing professional empowerment and entrepreneurship and societal services.	**M2, M3, M4 & M5**
PEO 3	pursue lifelong learning and continuous improvement of the knowledge and skills with the highest professional and ethical standards.	**M3, M4, M5 & M6**

PROGRAMME OUTCOMES (POs)

POs	Upon completion of B.Sc. Degree Programme, the graduates will be able to:	PEOs Addressed
PO1	obtain comprehensive knowledge and skills to pursue higher studies in the relevant field of science.	**PEO 1**
PO2	create innovative ideas to enhance entrepreneurial skills for economic independence.	**PEO2**
PO3	reflect upon green initiatives and take responsible steps to build a sustainable environment.	**PEO 2**
PO4	enhance leadership qualities, team spirit and communication skills to face challenging competitive examinations for a better developmental career.	**PEO 1&PEO 3**
PO5	communicate effectively and collaborate successfully with peers to become competent professionals.	**PEO 2&PEO 3**
PO6	absorb ethical, moral and social values in personal and social life leading to highly cultured and civilized personality	**PEO 2& PEO 3**
PO7	participate in learning activities throughout life, through self-paced and self-directed learning to develop knowledge and skills.	**PEO1 & PEO 3**

PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO	Upon completion of B.Sc. Mathematics, the graduates will be able to:	Mapping with POs
PSO – 1	acquire good knowledge and understanding, to solve specific theoretical & applied problems in different area of mathematics & statistics.	**PO1**
PSO – 2	understand, formulate, develop mathematical arguments, logically and use quantitative models to address issues arising in social sciences, business and other context /fields.	**PO6**
PSO - 3	apply Mathematical theories and principles accurately, precisely and effectively including higher research and extensions	**PO3 &PO7**
PSO – 4	prepare the students who will demonstrate respectful engagement with other's ideas, behaviours, beliefs and apply diverse frames of references to decisions and actions.	**PO5 &PO6**
PSO – 5	create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate start-ups and high potential organizations.	**PO2 &PO4**

Department of Mathematics
UG Teaching Plan 24-25
Even Semester

Department : Mathematics
Class : I B. Sc.
Title of the Course : Coordinate and Spatial Geometry
Semester : II
Course Code : MU232CC1

Course Code	L	T	P	Credits	Inst. Hours	Total Hours	Marks		
							CIA	External	Total
MU232CC1	4	-	-	3	4	60	25	75	100

Objectives

- To analyze characteristics and properties of two- and three-dimensional geometric shapes.
- To develop mathematical arguments about geometric relationships.
- To solve real world problems on geometry and its applications.

Course outcomes

CO	Upon completion of this course, the students will be able to:	PSO Addressed	Cognitive Level
CO - 1	recall the definitions and formulae of key concepts in coordinate and spatial geometry	PSO - 1	R
CO - 2	describe the relationships between geometric shapes and their equations and summarize the properties of different transformations on the coordinate plane	PSO - 2	U
CO - 3	solve real world problems involving lines, planes and spheres using analytical geometry concepts	PSO - 3	Ap
CO - 4	analyze the properties of equations of lines, planes and spheres	PSO - 4	An
CO - 5	evaluate complex problems that require the application of coordinate and spatial geometry concepts.	PSO - 5	E

Total Contact hours: 60 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment/ Evaluation
I	**Polar and Pole, Diameters**					
	1.	Polar and pole-definition, illustration, conjugate points and conjugate lines - definition & illustration	3	K2	Context Based	Quiz Questioning in the classroom
	2.	Diameters - examples, conjugate diameters - definition – remark, Exercise	3	K3	Problem solving	Assignment
	3.	Eccentric angles of the ends of a pair of conjugate semi-diameters of an ellipse - examples, conjugate diameters of a hyperbola	3	K3	Flipped Classroom	MCQ
II	**Polar Coordinates, Equation of Line, Circle, Conic, Chord, Tangent, Normal, Hyperbola**					
	4.	Polar coordinates - introduction, general polar equation of a straight line, polar equation of circle, equation of straight line - illustration, remark, exercise	3	K2	Brainstorming	MCQ
	5.	Equation of a circle, equation of a conic - illustration - remarks - examples, equations of the asymptotes of hyperbola - examples	3	K3	Lecture with Illustration	Group Discussion
	6.	Equation of a chord, equation of a tangent, equation of a normal, remark, exercise	3	K3	Blended Classroom	Online Assignment
III	**The Plane**					
	7.	General equation of first degree - related theorems	3	K2	Reflexive thinking	Surprise Test

	8.	Transformation to the normal form, direction cosines of the normal to a plane, angle between two planes, parallelism and perpendicularity of two planes	3	K3	Problem Solving	Group Discussion
	9.	Determination of plane under given conditions - intercept form of the equation of plane - finding the equation of plane through three points	3	K3	Lecture with PPT	Student presentations
	10.	System of planes - examples, two sides of a plane, length of the perpendicular from a point to a plane - examples	3	K2	Experimental Learning	Home Work
	11.	Bisectors of angles between two planes - examples, joint equation of two planes, orthogonal projection on a plane - examples, volume of a tetrahedron - examples	3	K3	Collaborative Learning	Quiz
IV	**Representation of Line**					
	12.	Representation of line - equation of the line through a given point drawn in a given direction - equation of a line through two points - examples	3	K2	Lecture method	Oral test.
	13.	Two forms of equation of a line, transformation from the unsymmetrical form to symmetrical form - examples, angle between a line and a plane	3	K3	Blended Learning	Assignments
	14.	Conditions for a line to lie in a plane -	3	K3	Integrative teaching	MCQ

		examples, coplanar lines - conditions for the coplanarity of lines - examples - remarks, number of arbitrary constants in the equations of a straight line, determination of lines satisfying given conditions - example,				
	15.	The shortest distance between two lines - examples, length of the perpendicular from a point to a line - examples, intersection of three lines - examples	3	K3	Problem Solving	Student presentations
V	**The Sphere**					
	16.	Equation of a sphere, general equation of a sphere - examples, the sphere through four given points - examples	3	K3	Blended Learning	Open-Book Test
	17.	Plane section of a sphere, intersection of two spheres, sphere with a given diameter, equation of a circle - examples, sphere through a given circle –examples	4	K3	Heuristic Method	SlipTest
	18.	Intersection of a sphere and a line, power point, equation of a tangent plane - examples, plane of contact, polar plane, pole of a plane, some results concerning poles and polars, conjugate points, conjugate planes, polar lines - examples,	4	K2	Problem Solving	Group Discussion

	19.	Angle of intersection of two spheres, condition for orthogonality of two spheres, radical plane, radical line, radical centre	4	K3	Interactive Lectures	Class Test

Course Focusing on Employability/ Entrepreneurship/ Skill Development: Skill Development
Activities (SD): Quiz, Problem Solving, Group Discussion
Assignment: Problem Solving from the Line and Sphere sections

Sample questions (minimum one question from each unit)

Part A
1. The product of the slope of the pair of conjugate diameter is.............
2. The equation of the conic is.........
3. The number of arbitrary constants in the equation $Ax + By + Cz + D = 0$ is:
   (a) 4 (b) 3 (c) 2 (d) 1
4. For every point (x, y, z) on x-axis:
   (a) y = 0, z = 0 (b) x = 0, z = 0 (c) x = 0, y = 0 (d) y = 0, z = 0
5. State True or False: The curve of intersection of two spheres is a circle.

Part B
1. Find the eccentric angles of the ends of the poles of conjugate semi diameter of an ellipse.
2. Find the equation of the asymptotes of the hyperbola.
3. Prove that every equation of the first degree in x, y, z represents a plane.
4. Derive the conditions for the line to lie in a plane.
5. Find the equation of sphere through the points (0, 0, 0), (0, 1,-1), (-1, 2,0), (1, 2,3).

Part C
1. Derive the formula for the conjugate diameter of the parabola.
2. Find the equation of circle.
3. Derive the formula for the volume of tetrahedron.
4. Derive the equation of line through the given point drawn in a given direction.
5. Find the equation of the circle circumscribing the triangle formed by three points (a, 0, 0), (0, b, 0), (0, 0, c). Obtain also the co-ordinates of this circle.

Head of the Department **Course Instructor**

Dr. T. Sheeba Helen **Dr. T. Sheeba Helen**

TEACHING PLAN

Department: **Mathematics**
Class: **I B.Sc**
Title of the Course: Core Course IV: Integral Calculus
Semester: **II**
Course Code: MU232CC2

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
MU232CC2	4	-	-	-	4	4	60	25	75	100

Learning Objectives

1. Knowledge on integration and its geometrical applications, double, triple integrals and improper integrals.
2. Knowledge about Beta and Gamma functions and skills to determine Fourier series expansions.

Course Outcome

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	determine the integrals of algebraic, trigonometric and logarithmic functions and to find the reduction formulae.	PSO - 1	K_1(R)
CO - 2	evaluate double and triple integrals and problems using change of order of integration.	PSO - 2	K_2(U)
CO - 3	solve multiple integrals and to find the areas of curved surfaces and volumes of solids of revolution.	PSO - 5	K_3(An)
CO - 4	explain beta and gamma function sand to use them in solving problems of integration.	PSO - 4	K_2(U)
CO - 5	explain Geometric and Physical applications of integral calculus.	PSO - 3	K_2(U)

Total contact hours: 90 (Including lectures, assignments, and tests)

Unit	Module	Topics	Lecture hours	Cognitive level	Pedagogy	Assessment/ Evaluation
I	**Reduction formulae -Types**					
	1.	Integration of product of powers of algebraic and trigonometric functions	3	K_2(U)	Introductory session, Group Discussion. PPT.	Simple definitions, MCQ, Recall formulae
	2.	Integration of powers of trigonometric functions	3	K_3(Ap)	Transmissive method using Chalk and talk, Problem-solving, Group Discussion.	Quiz through Quizzes, MCQ, Recall formulae
	3.	Integration of product of powers of algebraic and logarithmic functions	2	K_3(Ap)	Transmissive method using Chalk and talk, Problem-solving, Group Discussion.	Suggest formulae, Solve problems, Home work
	4.	Integration of product of powers of algebraic functions	2	K_2(U)	Transmissive method using Chalk and talk, Problem-solving, and Group Discussion.	Class test, Problem solving questions, Homework
	5.	*i*ntegration of the product of powers of	2	K_3(Ap)	The transmissive method uses	Problem-solving,

		trigonometric functions			chalk and talk, problem-solving, and PPT.	Homework
II	**Double Integrals**					
	1	definition of double integrals	1	K_1(R)	Transmissive method using Chalk and talk, Problem-solving, and PPT.	Check knowledge in specific situations.
	2	evaluation of double integrals	4	K_2(U)	Problem-solving, Demonstration.	Evaluation through short tests.
	3	double integrals in polar coordinates	4	K_3(Ap)	Problem-solving, Group Peer tutoring.	Formative Assessment.
	4	Change of order of integration.	3	K_3(Ap)	Transmissive method using videos and problem-solving.	Online Quiz, Assignment
III	**Triple Integrals**					
	1	applications of multiple integrals	3	K_2(U)	Transmissive method using videos.	Evaluation through short tests.
	2	volumes of solids of revolution	2	K_2(U)	Introductory session, Group Discussion.	MCQ, True/False.
	3	areas of curved surfaces	2	K_3(Ap)	PPT, Review.	Evaluation through short tests and seminars.

	4	Change of variables	2	K_3(Ap)	Transmissive method using Chalk and talk, Problem-solving, and Group Discussion.	Concept explanations.
IV	**Beta and Gamma functions**					
	1	Beta and Gamma functions – definitions	2	K_1(R)	Peer tutoring and lectures using videos.	Evaluation through short tests.
	2	recurrence formula of Gamma functions	3	K_2(U)	Transmissive method using Chalk and talk, Problem-solving.	Concept definitions through Nearpod.
	3	properties of Beta and Gamma functions	3	K_3(Ap)	Problem-solving, Group Discussion.	MCQ, True/False.
	4	relation between Beta and Gamma functions	2	K_3(Ap)	Problem-solving, Group Discussion.	Concept definitions through Nearpod
	5	Application s.	2	K_3(Ap)	Group Discussion.	Slip Test
V	**Fourier Series**					
	1	Fourier Series – Definition	3	K_2(U)	Transmissive method, chalk and talk, problem-	Concept definitions

					solving, and group discussion.	
	2	The Cosine Series	3	K_1(R)	Peer tutoring and lectures using videos.	Formative assessment
	3	The Sine Series	2	K_3(Ap)	Problem-solving, PPT.	SlipTest
	4	Half range Fourier Cosine and Sine Series	2	K_3(Ap)	Problem-solving, Group Discussion.	Assignment.
	5	Half range Fourier Sine Series	2	K_3(Ap)	Transmissive method	Quiz through Quizzes.

Course Focussing on Skill Development

Activities (Em/ En/SD): Quiz, MCQ, Slip Test, Problem Solving, Assignment. Presentation,

Course Focussing on Cross-Cutting Issues (Professional Ethics/ Human Values/Environment Sustainability/ Gender Equity): (Mention)

Activities related to Cross-Cutting Issues:

Assignment: Beta and Gamma functions

Seminar Topic: Fourier Series

Sample questions (minimum one question from each unit)

Part A

1. The reduction formula for $\int x^n e^{ax} dx$ where n $\in N$ is ---------

2. The value of $\int_0^{\pi} \int_0^1 r^2 sin\theta \; dr \; d\theta$ is ------

a) 2/3 b) 1/3 c) 1 d) 3

3. Under suitable conditions a given triple integral can be expressed as an integrated integral in ------ other ways by permuting the variables

a) 3 b) 4 c) 5 d) 6

4. **Say true or false:** The Beta function β(m, n) can be expressed as a definite integral with 0, ∞ as limits

5. **Say true or false:** f(x) cos (n x) is an even function

Part B

1. Evaluate the reduction formula for $I_n = \int \sec^n x dx$
2. Evaluate $\int_0^{\frac{\pi}{2}} \int_0^{\infty} \frac{r}{(r^2+a^2)^2}\, dr\, d\theta$
3. Evaluate $\int_0^a \int_0^x \int_0^y xyz\, dz\, dy\, dx$
4. Express $\int_0^1 x^m (1-x^n)^p dx$ in terms of Gamma functions.
5. Find the Fourier series for $f(x) = x^2$ in $-1 < x < 1$.

Part C

1. Evaluate a reduction formula for $I_{m,n} = \int \sin^m x \cos^n xdx$ where m, n ≥ 1
2. Evaluate $\int_1^4 \int_{\sqrt{y}}^2 (x^2 + y^2)\, dx\, dy$ by changing the order of integration.
3. Evaluate $\int_0^{loga} \int_0^x \int_0^{x+y} e^{x+y+z}\, dz\, dy\, dx$
4. Evaluate in terms of Gamma functions the integral $\iiint x^p y^q z^r dxdydz$ taken over the volume of the tetrahedron given by $x \geq 0$, $y \geq 0$, $z \geq 0$ and $x + y + z \leq 1$
5. Show that in the range 0 to 2π,the Fourier series expansion for e^x is $\frac{e^{2\pi-1}}{\pi}\left\{\frac{1}{2} + \sum_{n=1}^{\infty}\left(\frac{\cos nx}{n^2+1}\right) - \sum_{n=1}^{\infty}\left(\frac{\text{n}\sin nx}{n^2+1}\right)\right\}$

Head of the Department | **Course Instructor**

Dr. T. Sheeba Helen | **Mrs. J C Mahizha**

Teaching Plan

Department : Mathematics

Class : I B. Sc. Physics

Title of the Course: Elective II – Vector Calculus and Fourier Series

Semester : II

Course Code : MU232EC1

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
MU232EC1	5	1	-	-	4	6	90	25	75	100

Learning Objectives:

1. To understand the concepts of vector differentiation and vector integration
2. To apply the concepts in their respective disciplines

Course Outcomes

On the success completion of the course, students will be able to:		
1	remember the formulae of vector differentiation, integration and Fourier series	**K1**
2	understand various theorems related to vector differentiation, integration and Beta, Gamma functions	**K2**
3	solve problems on vector differentiation, integration, Beta, Gamma functions and Fourier series	**K3**
4	compare double and triple integrals, line, surface integrals, Beta, Gamma functions and Fourier series for Even and odd functions	**K2**

Total Contact hours: 90 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching hours	CL	Pedagogy	Assessment/ Evaluation
I	**Vector Differentiation**					
	1.	Revision of dot and cross product of vectors	2	K1	Brainstorming	Questioning

	2.	Gradient of a scalar function and its properties, Problems based on Gradient	3	K2	Heuristic Method	Recall Steps
	3.	Equation of tangent plane and normal line for a single surface	3	K3	Blended Learning	Slip Test
	4.	Equation of tangent line and normal plane for the intersection of two surfaces, Angle between two surfaces	3	K2	PPT	True or False
	5.	Divergence of vectors and its properties	2	K3	Interactive Method	Peer Discussion with questions
	6.	Curl of vectors and its properties, Solenoidal and irrotational vectors	2	K3	Inductive Learning	Short Summary
II	**Evaluation of Double and Triple Integrals**					
	7.	Introduction	2	K2	Blended Learning	Questioning
	8.	Definition of double integral and area of the region S	3	K2	Blended Learning	Slip Test
	9.	Solved Problems in double integrals	4	K3	Flipped Classroom	Short Answer
	10.	Definition of triple integral and volume of the region D	3	K3	Heuristic Method	MCQ
	11.	Solved Problems in triple integrals	3	K3	Analytic Method	Recall Steps
III	**Vector Integration**					
	12.	Work done by a force	3	K3	Brainstorming	Questioning
	13.	Evaluation of line integrals	3	K3	Interactive Method	Slip Test
	14.	Evaluation of surface integrals	3	K2	PPT	True or False
	15.	Green's theorems with problem	3	K2	Heuristic Method	Peer Discussion with questions
	16.	Stokes theorems with problems	3	K2	Blended Learning	Creating Quiz with

						Group Discussion
IV	**Beta and Gamma Functions**					
	17.	Properties of Beta and Gamma functions	4	K2	Analytic Method	Quiz
	18.	Results on of Beta and Gamma functions	3	K1	Interactive Method	Slip Test
	19.	Evaluation of integrals using Beta and Gamma Functions	4	K3	PPT	True or False
	20.	Relation between Beta and Gamma functions.	4	K2	Heuristic Method	Peer Discussion with questions
V	**Fourier Series**					
	21.	Even and odd functions	2	K3	Brainstorming	Questioning
	22.	Fourier series and coefficients	2	K3	Interactive Method	Slip Test
	23.	Problems on Fourier coefficients	3	K4	PPT	True or False
	24.	Half range Expansion	2	K3	Heuristic Method	Peer Discussion with questions
	25.	Sine series and related Problems	3	K4	Blended Learning	Group Discussion
	26.	Cosine series and related Problems	3	K3	Analytic Method	MCQ

Sample questions

Part A

1. True or False: $\vec{a}\times\vec{b}=\vec{b}\times\vec{a}$

2. The value of $\int_0^a\int_0^a\int_0^a dz\,dy\,dx$ is __________ .

a) a^3 b) a^2 c) a d) 1

3. Parametric equation of the line joining (0, 0, 0) and (2, 1, 1) can be taken as

(a) $x = 2t, y = t, z = t$ where $0 \le t \le 1$ (b) $x = t^2, y = t, z = t$ where $0 \le t \le 1$

(c) $x = t, y = t^2, z = t$ where $0 \le t \le 1$ (d) $x = t, y = t^2, z = t^2$ where $0 \le t \le 1$

4. The value of beta and gamma functions are connected by ______________ .

(a) $\beta(m,n) = \frac{\Gamma(m+n)}{\Gamma(m)\,\Gamma(n)}$ (b) $\beta(m,n) = \frac{\Gamma(m)\,\Gamma(n)}{\Gamma(m+(n)}$

(c) $\beta(m,n) = \frac{\Gamma(m)+\Gamma(n)}{\Gamma(mn)}$ (d) $\beta(m,n) = \frac{\Gamma(m)\,\Gamma(n)}{\Gamma(mn)}$

5. A function $f(x)$ is an even function if _________ .

a) $f(x) = f(x^2)$ b) $f(x) = f(-x^2)$

c) $f(x) = f(-x)$ d) $f(x) = -f(-x)$

Part B

1. In what direction from the point (1,3,2) is the directional derivative of $\varphi = 2xz - y^2$ maximum? What is the magnitude of this maximum?
2. Find the area of the region D bounded by the parabola $y = x^2$ and $x = y^2$.
3. Find the work done in moving a particle in a field of force $\vec{f} = 2xy\hat{i} - 3xj - 5zk$ along the curve x = t, y = $t^2 + 1$ and z = $2t^2$ from t = 0 to t = 1.
4. Prove that $\beta(m,n) = \beta(n,m)$.
5. Determine the Fourier expansion of $f(x) = x$ where $-\pi < x < \pi$.

Part C

1. Show that the surface $5x^2 - 2yz - 9x = 0$ is perpendicular to the surface $4x^2y + z^3 = 4$ at the point (1, -1, 2).
2. Evaluate $I = \iint_D xy\,dy\,dx$ where D is the region bounded by the curve $x = y^2$, $x = 2 - y$, $y = 0$ and $y = 1$.
3. Evaluate $\iint_S \vec{f}.\hat{n}\,ds$ where $\vec{f} = 4xz\hat{i} - y^2 j + yz\hat{k}$ and S is the surface of the cube bounded by x = 0, x = 1, y = 0, y = 1, z = 0 and z = 1.
4. State and prove duplication formula.
5. Find the Fourier (i) cosine series (ii) sine series for the function $f(x) = \pi - x$ in $(0,\pi)$.

Head of the Department **Course Instructor**

Dr. T. Sheeba Helen **Sr. S. Antin Mary**

Teaching Plan

Department : **Mathematics**

Class : **I B. Sc Chemistry**

Title of the Course : **ELECTIVE – II : VECTOR CALCULUS AND FOURIER SERIES**

Semester : **II**

Course Code : **MU232EC1**

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
MU232EC1	5	1	-		4	6	90	25	75	100

Objectives

1. To understand the concepts of vector differentiation and vector integration.
2. To apply the concepts in their respective disciplines.

Course Outcomes

On the successful completion of the course, students will be able to:		PSO Addressed	Cognitive Level
1.	remember the formulae of vector differentiation, integration and Fourier series	PSO 1	K1
2.	understand various theorems related to vector differentiation, integration and Beta, Gamma functions	PSO 2	K2
3.	solve problems on vector differentiation, integration, Beta, Gamma functions and Fourier series	PSO 1	K3
4.	compare double and triple integrals, line, surface integrals, Beta, Gamma functions and Fourier series for Even and odd functions	PSO 3	K2

Total contact hours: 90 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment/ Evaluation
I	**Vector Differentiation**					
	1.	Revision of dot and cross product of vectors	2	K1	Brainstorming	Questioning
	2.	Gradient of a scalar function and its properties, Problems based on Gradient	3	K2	Heuristic Method	Recall Steps
	3.	Equation of tangent plane and normal line for a single surface	3	K3	Blended Learning	Slip Test
	4.	Equation of tangent line and normal plane for the intersection of two surfaces, Angle between two surfaces	3	K2	PPT	True or False
	5.	Divergence of vectors and its properties,	2	K3	Interactive Method	Peer Discussion with questions
	6.	Curl of vectors and its properties, Solenoidal and irrotational vectors	2	K3	Inductive Learning	Short Summary
II	**Evaluation of double and triple integrals**					
	7.	Introduction	2	K2	Blended Learning	Questioning
	8.	Definition of double integral and area of the region S	3	K2	Blended Learning	Slip Test
	9.	Solved Problems in double integrals	4	K3	Flipped Classroom	Short Answer
	10.	Definition of triple integral and volume of the region D	3	K3	Heuristic Method	MCQ
	11.	Solved Problems in triple integrals	3	K3	Analytic Method	Recall Steps
III	**Vector integration**					
	12.	Work done by a force	3	K3	Brainstorming	Questioning
	13.	Evaluation of line integrals	3	K3	Interactive Method	Slip Test
	14.	Evaluation of surface integrals	3	K2	PPT	True or False
	15.	Green’s theorems with problem	3	K2	Heuristic Method	Peer Discussion with questions
	16.	Stokes theorems with problems	3	K2	Blended Learning	Creating Quiz with Group Discussion

IV	**Beta and Gamma Function**					
	17.	Properties of Beta and Gamma functions	4	K2	Analytic Method	Quiz
	18	Results on of Beta and Gamma functions	3	K1	Interactive Method	Slip Test
	19	Evaluation of integrals using Beta and Gamma Functions	4	K3	PPT	True or False
	20	Relation between Beta and Gamma functions.	4	K2	Heuristic Method	Peer Discussion with questions
V	**Fourier series**					
	21.	Even and odd functions	2	K3	Brainstorming	Questioning
	22.	Fourier series and coefficients	2	K3	Interactive Method	Slip Test
	23.	Problems on Fourier coefficients	3	K4	PPT	True or False
	24.	Half range Expansion	2	K3	Heuristic Method	Peer Discussion with questions
	25.	Sine series and related Problems	3	K4	Blended Learning	Group Discussion
	26.	Cosine series and related Problems	3	K3	Analytic Method	MCQ

Sample questions

PART- A

1. A vector function $\vec{f}$ is said to be solenoidal if

a) div $\vec{f}$ = 0 b) grad f = 0 c) curl $\vec{f}$ = 0 d) div f = 0

2. The work done by a force $\vec{f}$ in moving a particle along a curve C is ....

3. The value of beta and gamma functions are connected by--------------

(a) $\beta(m,n) = \frac{\Gamma(m+n)}{\Gamma(m)\,\Gamma(n)}$ (b) $\beta(m,n) = \frac{\Gamma(m)\,\Gamma(n)}{\Gamma(m+(n)}$

(c) $\beta(m,n) = \frac{\Gamma(m)+\Gamma(n)}{\Gamma(mn)}$ (d) $\beta(m,n) = \frac{\Gamma(m)\,\Gamma(n)}{\Gamma(mn)}$

4. For any integer n the value of cosnπ is---------------

(a) 0 (b)1 (c)-1 (d)$(-1)^n$

5. If $f(x)$ is an even function in $(-\pi,\pi)$ the Fourier coefficient b_n for $f(x)$ is given by --
----

PART - B

1. Find curl curl $\vec{f}$ at the point (1,1,1) if $\vec{f} = x^2 y\,\hat{i} + zx\,\hat{j} + 2yz\,\hat{k}$

2. If $\vec{r} = \vec{a}\cos\omega t + \vec{b}\sin\omega t$ where $\vec{a}, \vec{b}$ are constant vectors and ω is a constant, Prove that $div\left(\vec{r} \times \vec{a}\right) = 0$

3. Evaluate $\int_{(1,1)}^{(4,2)} \vec{f}.d\vec{r}$ if $\vec{f} = (x+y)\hat{i} + (y-x)j$ joining the parabola $y^2 = x$

4. Prove that $\beta(m,n) = \beta(n,m)$.

5. Determine the Fourier expansion of $f(x) = x$ where $-\pi < x < \pi$.

PART - C

1. Find the equation of the (i) tangent plane and (ii) normal line to the surface xyz = 4 at the point (1, 2, 2).

2. Prove that $div(r^n \vec{r}) = (n+3)r^n$, Deduce that $r^n \vec{r}$ is solenoidal iff $n = -3$.

3. Evaluate $\int_C \vec{f}.d\vec{r}$ where $\vec{f} = (x^2 + y^2)\hat{i} - 2xy\hat{j}$ and the curve C is the rectangle in the x-y plane bounded by y = 0,y = b, x = 0, x = a.

4. Prove that $\beta(m,n) = \dfrac{\Gamma(m)\Gamma(n)}{\Gamma(m+n)}$. Hence find the value of $\beta\left(5, \frac{7}{2}\right)$

5. Find the Fourier (i) Cosine series (ii) sine series for the function $f(x) = \pi - x$ in $(0,\pi)$.

Course Instructor: Dr. K. Jeya Daisy **HOD :Dr. T. Sheeba Helen**

Teaching Plan

Class : **I UG**

Semester : **II**

Name of the Course : **Non-Major Elective Course : Mathematics for Competitive Examinations II**

Course Code : **MU234CC2**

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
MU232NM1	2	-	-	-	2	2	30	50	50	100

Learning Objectives

1. To understand the problems stated in various competitive examinations and realize the approach to get solution.
2. To acquire skill in solving quantitative aptitude by simple methods.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	understand the problems and remember the methods to solve problems.	**K2**
2.	identify the appropriate method to solve problems.	**K1**
3.	apply the best mathematical method and obtain the solution in short.	**K3**
4.	apply fundamental mathematical concepts to calculate simple interest, compound interest.	**K3**
5.	develop problem-solving skills and critical thinking by effectively solving real-world scenarios involving financial calculation	**K2**

Teaching plan

Total Contact hours: 75 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment/ Evaluation
I	**Simple Interest and Compound Interest**					
	1.	Finding simple interest	3	K2	Brain Storming	Slip Test
	3.	Finding principal amount	3	K2	Problem Solving	Quiz
II	**Time and work**					
	1.	Work sharing, Individual work and Combined work	3	K1	Brain Storming	Home work
	2.	Time taken for work	3	K1	Inquiry based approach	Solved Problem
III	**Time and Distance**					
	1.	Comparing speed and Average speed	2	K3	Brain Storming	Assignment
	2.	Distance travelled by vehicles	2	K3	Inquiry based	Discussion
	3.	Travelling Time	2	K3	Flipped classroom	Recall formulae
IV	**Chain Rule**					
	1.	Direct Proportion	3	K3	Gamification	Home work
	2.	Indirect Proportion	3	K3	Simulation	Slip Test
V	**Pipes and Cisterns**					
	1.	Filling the tank	3	K2	Blended Learning	Assignment
	2.	Emptying the tank	3	K2	Problem Solving	Slip test

Course Focussing on Employability/Entrepreneurship/Skill Development: Skill Development

Activities (Em/ En/SD): **Memory game, Analyse Problem Situations**

Course Focussing on Cross Cutting Issues (Professional Ethics/ Human Values/Environment Sustainability/ Gender Equity): -

Activities related to Cross Cutting Issues: -

Assignment: **Solving Exercise problems**

Sample questions

Part A

1. At what rate of simple interest a certain sum will be double in 15 years?
2. A and B together can complete a piece of work in 15 days and B alone in 20 days. In how many days can A alone complete the work?
3. A train travels 82. 6 km/hr. How many meters will it travel in 15 minutes?
4. 35 women can do a piece of work in 15 days. How many women would be required to do the same work in 25 days?
5. Pipe A can fill a tank in 30 hours and pipe B in 45 hours. If both the pipes are opened in an empty tank, how much time will they take to fill it?

Part B

1. The simple interest on a sum of money is 4/9 of the principal. Find the rate percent and time if both are numerically equal.
2. A can do a piece of work in 7 days of 9 hours each and B can do it in 6 days of 7 hours each. How long will they take to do it, working together $8\frac{2}{5}$ hours a day?
3. While covering a distance of 24 km, a man noticed that after walking for 1 hour and 40 minutes, the distance covered by him was $\frac{5}{7}$ of the remaining distance. What was his speed in meters per second?
4. 8 men working for 9 hours a day complete a piece of work in 20 days. In how many days can 7 men working for 10 hours a day complete the same piece of work?
5. Two pipes can fill a cistern in 14 hours and 16 hours respectively. The pipes are opened simultaneously and it is found that due to leakage in the bottom it took 32 minutes more t empty it?o fill the cistern. When the cistern is full, in what time will the leak

Part C

1. The difference between compound and simple interests on a certain sum of money at the interest rate of 10% per annum for $1\frac{1}{2}$ years is Rs. 183, when the interest is compounded semi-annually. Find the sum of money.

2. A can complete a work in 10 days, B in 12 days and C in 15 days. All of them began the work together, but A had to leave the work after 2 days of the start and B, 3 days before the completion of the work. How long the work last?
3. A man covers a certain distance on a toy train. Had the train moved 4 km/hr faster, it would have taken 30 minutes less. If it moved 2 km/hr slower, it would have taken 20 minutes more. Find the distance.
4. A contract is to be completed in 50 days and 105 men were set to work, each working 8 hours a day. After 25 days, $\frac{2}{5}$ of the work is finished. How many additional men be employed so that the work may be complete on time, each man now working 9 hours a day?
5. A cistern has three pipes A, B and C. A and B can fill it in 3 hours and 4 hours respectively while C can empty the completely filled cistern in 1 hour. If the pipes are opened in order at 3, 4 and 5 p.m. respectively, at what time will the cistern be empty?

Head of the Department | Course Instructor

[Dr. T. Sheeba Helen] | [Dr. M. K. Angel Jebitha]

TEACHING PLAN

Department: Mathematics

Class: I B. Sc

Title of the Course: Skill Enhancement Course -SEC-I:

Introduction to Computational Mathematics

Semester: II

Course Code: MU232SE1

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
MU232SE1	2	-	-	-	2	2	30	25	75	100

Prerequisites: Students should have basic knowledge on Mathematical calculations.

Learning Objectives

1) To study and design mathematical models for the numerical solution of scientific problems
2) To acquire the skills and confidence to learn new mathematical knowledge as becomes necessary in the course of a lifetime.

Course Outcomes

On the successful completion of the course, student will be able to**:**		
CO1	gain an appreciation for the role of computers in mathematics, science, and engineering as a complement to analytical and experimental approaches.	**K1 & K2**
CO2	acquire a strong foundation in numerical analysis, enabling students to evaluate and analyze numerical solutions for mathematical problems.	**K2**
CO3	use and evaluate alternative numerical methods for the solution of systems of equations.	**K3**

CO4	foster critical thinking skills in assessing computational methods for problem solving.	**K3**
CO5	apply mathematical concepts to practical problems through computational approaches.	**K3**

K1 - Remember; **K2** - Understand; **K3** - Apply

Teaching plan

Total Contact hours: 30 (Including lectures, assignments and tests)

Unit	**Module**	**Topic**	**Teaching Hours**	**Cognitive level**	**Pedagogy**	**Assessment/ Evaluation**
I	**Errors in Numerical Calculations**					
	1.	Computer and Numerical Software	1	K1	Brainstorming	Questioning
	2.	Computer Languages, Software Packages	2	K1	Inductive Learning	Recall Steps
	3.	Mathematical Preliminaries	1	K2	Blended Learning	True or False
	4.	Errors and their computations, A general error formula	2	K1, K2	Lecture with Illustration	Slip Test
II	**Solution of Algebraic and Transcendental Equations**					
	6.	Introduction	2	K2	Brainstorming	Questioning
	7.	Bisection method,	2	K2	PPT using near pod	Short Answer – Google Form
	8.	Method of False Position	2	K2	Lecture with Illustration	Slip Test
III	**Interpolation**					
	14.	Finite differences	2	K3	Heuristic Method	Solve Problem

	15.	Forward Differences, Backward Differences	2	K3	Flipped Classroom	Slip Test
	16.	Central Differences	2	K3	Problem Solving	Relay Race
IV	**Numerical Differentiation and Integration**					
	17.	Errors in Numerical Differentiation, Cubic Splines Method	2	K2	Brainstorming	PPT Presentation
	18.	Differentiation formulae with function values	2	K3	Discussion	Riddles
	19.	Trapezoidal Rule	2	K2	Interactive Method	MCQ
V	**Numerical Linear Algebra**					
	21.	Triangular Matrices, LU Decomposition of a Matrix	2	K3	Blended Learning	Riddles
	22.	Vector and Matrix Norms, Solutions	2	K2	Heuristic Method	Relay Race

Course Focusing on Employability/ Entrepreneurship/ Skill Development: Skill Development

Activities (SD): Quiz, MCQ, Slip Test, Problem Solving, Relay Race, Poster Presentation, Riddles, PPT Presentation

Course Focusing on Cross Cutting Issues (Professional Ethics/ Human Values/Environment Sustainability/ Gender Equity): -

Activities related to Cross Cutting Issues: - Assignment: Central Differences

Self-Study: Solutions of linear systems Direct Method-Gauss Elimination Method.

Sample questions (minimum one question from each unit)

Part A

1. Which is the oldest method for finding the real root of a nonlinear equation
2. Which one of the following is a linear transformation

a) $y = ax + b$ b) $x\, y^a = b$ c) $y = ax + y$

3. Choose the best answer: Back substitution method is useful in

a) Gauss Jacobi method b) Gauss Seidel method c) Gauss elimination method

d) Gauss Jordan method

4. The total error in Euler's method is --------------
5. State Trapezoidal rule.

Part: B

6. Derive Trapezoidal formula.
7. Find the Forward difference formula
8. Find the backward difference formula
9. Find the solutions of Cubic Splines Method
10. Explain Errors in Numerical Differentiation.

Part: C

11. Use Gauss elimination method to solve the system
12. Take a problem and find a solution by using Bisection method.
13. Differentiation formulae – Derive.
14. Explain with example-Cubic Splines Method
15. Derive some of the properties of Finite difference.

Course Instructor: Mrs. J C Mahizha HOD: Dr. T Sheeba Helen

Department : **Mathematics**

Class : **II B.Sc Mathematics**

Title of the Course : **Core Course VII Groups and Rings**

Semester : **IV**

Course Code : **MU234CC1**

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
MU234CC1	5	-	-	-	5	5	75	25	75	100

Pre-requisite:

Basic Algebra

Objectives: 1. To introduce the concepts of Group theory and Ring theory.

2. To gain more knowledge essential for higher studies in Abstract-algebra.

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO – 1	recall the definitions of groups ,rings, functions and also examples of groups and rings	PSO - 1	K1
CO – 2	explain the properties of groups, rings and different typesof groups and rings	PSO - 1	K2
CO - 3	develop proofs of results on Permutation groups ,Cyclic groups, Quotient group, Subgroups, subrings , quotient rings	PSO - 5	K3
CO - 4	test the homomorphic and isomorphic properties of groupsandrings	PSO - 5	K4
CO - 5	examine the properties of Ideals-Maximal and Primeideals-Cosets-order of an element	PSO - 4	K5

Teaching Plan

Total contact hours: 75 (Including instruction hours, assignments and tests)

Unit	Module	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment/ Evaluation
I	**Groups.**					
	1.	Definition and examples on Groups	4	K1	Brainstorming	Evaluation through test
	2.	Definition and examples on Permutation Groups	3	K1 & K6	Illustrative Method	Questioning
	3.	Definition of cycle and theorem based on cycles	2	K1 & K6	Content based	Open Book Assignment
	4.	Theorems on even and odd permutations	2	K2 & K6	Chalk and Talk	Quiz
	5.	Definition examples, theorems and problems of sub groups	2	K2 & K6	Illustrative method	Group Discussion
	6.	Theorems on cyclic groups and problems based on cyclic groups	2	K2 & K6	Content based	Questioning
II	**Sub Groups**					
	1.	Definition and Theorems on order of an Element	3	K1 & K2	Brainstorming	Test
	2.	Problems on order of an element	3	K2	Flipped Class	Open book assignment
	3.	Definition of Cosets and problems on cosets	3	K2	Illustrative Method	Questioning
	4.	Lagrange's Theorem, Euler's Theorem, Fermats theorem	2	K2 & K3	Content based	MCQ
	5.	Normal subgroups - Definition and Examples	2	K2	Collaborative learning	Home work
	6.	Problems and theorems on Normal Subgroups	2	K2 & K3	Content Based	Slip Test

III	**Normal Subgroups**					
	1.	Definition, theorems and Examples of Isomorphism	3	K1	Brainstorming	Quiz
	2.	Cayley's Theorem and Theorem on Automorphism and generators	3	K4	Content Based	Slip Test
	3.	Definition of Homomorphism and Examples	3	K1	Illustrative Method	Test
	4.	Fundamental Theorem of Homomorphism	3	K4	Chalk and Talk	Questioning
	5.	Problems on Kernel	3	K2 & K3	Collaborative learning	MCQ
IV	**Rings**					
	1.	Definition, Elementary properties and examples of Rings	2	K1	Brainstorming	Quiz
	2.	Problems based on Isomorphism of Rings	3	K4	Collaborative learning	Questioning
	3.	Types of Rings and Theorems	2	K2 & K3	Content based	Slip Test
	4.	Examples of Skew fields and Theorems based on Skew fields	3	K2	Illustrative Method	Home Work
	5.	Definition and Theorems on integral Domains	2	K1 & K5	Chalk and Talk	Assignment
	6.	Characteristic of a Ring	3	K3	Flipped Class	Recall Concepts
V	**Ideals**					
	1.	Definition and Examples of Left and Right Ideal	2	K1	Brainstorming	Open book test
	2.	Problems and Theorems on Left and Right Ideal	2	K6	Collaborative learning	Questioning
	3.	Definition, Theorems and Examples Principal Ideals	3	K1 & K3	Content based	Slip test
	4.	Ordered integral Domains	3	K3	Flipped Class	Assignment
	5.	Maximal and Prime Ideals	3	K5	Chalk and Talk	MCQ
	6.	Homomorphism of Rings	2	K4	Blended learning	Concept Explanation

Course Focussing on Employability/ Entrepreneurship/ Skill Development: **Employability.**

Activities (Em/ En/SD): **Poster Presentation, Model Making (Application of algebraic concept).**

Assignment: **Solving Algebraic Problems.**

Sample questions

Part A

1. The number of elements in the symmetric group S_n is

   a. n b. 1 c. n! d. 0

2. Any group which is cyclic has proper_________________
3. State whether it is true or false.

   Every subgroup of (Z_n, $\oplus$) is normal.

4. Which of the following is not a field

   a)(N,+,.) b) (C, +,.) c) (Q,+, .) d) (R,+,.)

5. An integral domain R is said to be a_______________.

Part B

1. Prove that a non empty subset H of a group G is a subgroup of G iff a, b $\in$ H $\Longrightarrow$

   $ab^{-1} \in$ H.

2. State and prove Lagrange's Theorem.
3. Prove that any ordered integral domain D is of characteristic zero.
4. Prove that Z_7 is an integral domain.
5. Define Ideal in the context of rings and describe the difference between left, right, and two-sided ideals.

Part C

1. Prove that the union of two subgroups of a group G is a subgroup if and if one is contained in the other.
2. Explain the Fundamental Theorem of Finite Abelian Groups. Classify the abelian groups of order 12.
3. State and prove the fundamental theorem of homomorphism of Rings.
4. Prove that the set F of all real numbers of the form $a+b\sqrt{2}$ where a,b $\in$ Q is a field under the usual addition and multiplication of real numbers.

5. Prove that

   (i) The field of complex numbers is not an ordered field.

   (ii) Z is an Euclidean domain

Head of the Department	Course Instructor
Dr. T. Sheeba Helen	Dr. L.Jesmalar

Teaching Plan

Department : **Mathematics**

Class : **II B.Sc**

Semester : **IV**

Name of the Course : **Core Course VIII : Elements of Mathematical Analysis**

Course Code : **MU234CC2**

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
MU232CC2	5	-	-	-	5	5	75	25	75	100

Learning Objectives

1. To introduce the primary concepts of sequences and series of real numbers.

2. To develop problem solving skills.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	recall the basic concepts of real numbers, definitions on sequences and series of real numbers	**K1**
2.	explain the primary concepts of sequences and series of real numbers	**K2**
3.	calculate limit of the sequences and determine the convergence of the series by applying Cauchy’s principles, root test and ratio tests	**K3**
4.	analyse the properties of real numbers, nature of sequences and series	**K3,K4**
5.	evaluate the behavior of sequences and the convergence of series using different types of tests	**K5**

Teaching plan

Total Contact hours: 75 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment/ Evaluation
I	**The Real Numbers- Preliminaries**					
	1.	Finite and Infinite Sets	5	K1, K2	Brain Storming	Slip Test
	3.	The algebraic and order properties of R	5	K1, K2	Gamification	Quiz
	4.	Absolute value and the real line	4	K3	Interactive Method	Assignment
II	**The Real Numbers**					
	1.	The completeness property of R.	5	K2	KWL	Concept explanations
	2.	Applications of the supremum property	4	K2, K3	Inquiry based approach	Solved Problem
	3.	Intervals	4	K2	Context based	Slip Test
III	**Sequences**					
	1.	Sequences- Definitions Range of Sequences	3	K1	Brain Storming	Quiz
	2.	Limit of a Sequence	2	K2	Inquiry based	Discussion
	3.	Bounded Sequence	3	K2	Flipped classroom	Recall the concept
	4.	Monotonic Sequence	3	K1, K2	Lecture with Interactive PPT	Observation Notes
	5.	Convergent Sequence	3	K2	Blended Learning	Slip test
	6.	Behavior of monotonic sequence	3	K4	Problem Solving	Quiz
IV	**Cauchy's Sequences**					
	1.	Subsequences	3	K1, K2	Gamification	Home work
	2.	Peak points	2	K2	Simulation	Recall definition
	3.	Limit points	3	K2	Lecture with Interactive PPT	Recall concepts
	4.	Cauchy's sequences	4	K2, K3	Context based	Discussion
V	**Series**					
	1.	Series-Definition& Examples	2	K1, K2	Blended Learning	Oral Test
	2.	Infinite series	1	K6	Lecture with Illustration	Slip test
	3.	Theorems and problems based on Comparison Test	4	K4, K5	Brainstorming	Questioning

	4.	Problems based on Kummer's Test	3	K4	Flipped classroom	Recall steps
	5.	Problems based on Ratio Test	4	K5	Problem Solving	Online Assignment
	6.	Problems based on Root Test and Condensation Test	5	K5	Problem Solving	Recall steps

Course Focussing on Employability/Entrepreneurship/Skill Development: Skill Development

Activities (Em/ En/SD): **Poster Presentation, Interactive PPT and Memory game**

Course Focussing on Cross Cutting Issues (Professional Ethics/ Human Values/Environment Sustainability/ Gender Equity): -

Activities related to Cross Cutting Issues: -

Assignment: **Solving Exercise problems**

Sample questions

Part A

Unit I

1. The set $\mathbb{N} \times \mathbb{N}$ is

   (a) countable
   (b) uncountable
   (c) denumerable
   (d) none of the above

2. Suppose that A and B are subsets of $\mathbb{R}$ that satisfy the property: $a \leq b$ for all $a \in A$ and all $b \in B$.

   (a) $sup\ A \leq inf\ B$ (b) $sup\ A \geq inf\ B$

   (b) $sup\ A = inf\ B$ (d) None of the above

3. The peak points of the sequence 1,1/2,1/3,-1,-1,-1,…… are

   (a) 1,-1,0 (b) 1,1/2,1/3 (c) 1,2,3 (d) no peak points

4. The value of $\lim_{n\to\infty} n^{\frac{1}{n}}$ is ---------------------

5. $\sum (-1)^n \frac{1}{n}$ is ----------------------------.

Part B

1. Define denumerable and give two examples of denumerable sets.
2. State and prove Archimedean property.
3. Describe the boundedness of the sequence which is diverging to ∞.

4. Every bounded sequence has at least one limit point.

5. Test the convergence of $\sum\left(1+\frac{1}{n}\right)^{-n}$

Part C

1. Show that the following statements are equivalent:
   (i) S is a countable set
   (ii) There exists a surjection of $\mathbb{N}$ onto S
   (iii) There exists an injection of S into $\mathbb{N}$
2. If $I_n = [a_n, b_n], n \in \mathbb{N}$ is a nested sequences of closed and bounded intervals such that the length $b_n - a_n$ of I_n satisfy $\inf\{b_n - a_n : n \in \mathbb{N}\} = 0$, then prove that the number ξ contained in I_n for all $n \in \mathbb{N}$ is unique.
3. Discuss the behaviour of geometric sequence.
4. Prove that a sequence (a_n) converges to l if and only if (a_n) is bounded and l is the only limit point of the sequence.
5. (i) Discuss the convergence of $\sum \frac{1^2+2^2+......n^2}{n^3+5n+2}$

   (ii) Show that $\sum\frac{4^n+5^n}{6^n}$ converges

Head of the Department — Course Instructor

[Dr. T. Sheeba Helen] — [Dr. M. K. Angel Jebitha]

Teaching Plan

Department : Mathematics

Class : II B.Sc. Mathematics

Title of the Course : Transform Techniques

Semester : IV

Course Code : MU234EC1

Course Code	L	T	P	Credits	Inst. Hours	Total Hours	Marks		
							CIA	External	Total
MU234EC1	4	-	-	3	4	60	25	75	100

Pre-requisite:

Understanding calculus concepts such as differentiation, integration, limits, and series is essential as these concepts form the basis for many transform techniques.

Learning Objectives:

1. To develop proficiency in solving Mathematical problems and analyzing signals using transform techniques.
2. To build a strong foundation in transform techniques and develop problem-solving skills applicable to a wide range of mathematical and engineering contexts.

Course outcomes

On the successful completion of the course, students will be able to:		
1	recall basic knowledge about Laplace transforms, inverse Laplace transforms, Fourier series, Fourier transform, and Z-transforms, including their definitions, properties, and fundamental concepts.	K1
2	demonstrate a solid understanding of the principles and concepts underlying Laplace transforms, inverse Laplace transforms, Fourier series, Fourier transform, and Z-transforms, including their applications in mathematical analysis and signal processing.	K2
3	apply Fourier sine and cosine transforms to solve difference equations.	K3
4	apply transform techniques to evaluate integrals, and solve ordinary and partial differential equations with constant and variable coefficients.	K3, K4
5	analyze and decompose periodic functions using the Fourier series, including expansion of periodic functions of period 2π, expansion of even and odd functions, and representation of functions over half intervals.	K5

Teaching plan

Total Contact hours: 75 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment/ Evaluation
I	**The Laplace Transforms**					
	1.	Introduction, Definitions	1	K1	Lecture with Illustration	Concept Explanations
	2.	Sufficient Conditions for the Existence of the Laplace Transform	3	K2	Inductive Learning	Formula Relay
	3.	Laplace Transform of Periodic Functions	2	K2	Blended Learning	Class Test
	4.	Some General Theorems	4	K2	Heuristic Method	Slip Test
	5.	Evaluation of Integrals using Laplace Transform	1	K3	Problem Solving	Solving a definite integral using Laplace Transform
II	**The Inverse Transforms**					
	6.	The Inverse Transform Definition and Examples	5	K2	Brainstorming	Quiz - Nearpod
	7.	Applications of Laplace Transform of Ordinary Differential Equations with Constant Coefficient	3	K3, K4	Video using Zoom	Solving an ordinary differential equation using Inverse Laplace Transform
	8.	Applications of Laplace Transform of Ordinary Differential Equations with Variable Coefficient	2	K3, K4	PPT using Gamma	Problem Relay
	9.	Simultaneous Equations and Equations involving Integrals	3	K3, K4	Derivative Method	MCQ
III	**Fourier series**					
	10.	Fourier series, Introduction	2	K1, K2	Lecture method	Open-Book Test

	11.	Expansion of periodic functions of period 2π	4	K2	Heuristic Method	Slip Test
	12.	Expansion of even and odd functions	3	K2	Problem Solving	Group Discussion
	13.	Half range Fourier series	3	K2	Collaborative Learning	Student presentations
	14.	Change of interval	3	K1, K2	Lecture with PPT	Assignments
IV	**Fourier Transform**					
	15.	Complex form of Fourier Integral Formula	2	K2	Lecture method	Home Work
	16.	Fourier Integral Theorem	2	K2	Blended Learning	Quiz
	17.	Properties of Fourier Transform	4	K3	Integrative teaching	Oral test
V	**Fourier cosine and sine Transform**					
	18.	Fourier cosine Transform	2	K3	Derivative Method	Assignment
	19.	Fourier sine Transform	2	K3	Heuristic Method	Presentation
	20.	Properties of F_c and F_s	3	K2	Inductive Method	Quiz using Slido
	21.	Parseval's identity	3	K3, K4	Interactive Lectures	Class Test
	22.	Convolution theorem	3	K3, K4	Problem Solving	Home Work

Course Focussing on Employability/ Entrepreneurship/ Skill Development: **Employability**

Activities (SD): **Quiz, MCQ, Slip Test, Problem Solving, Formula Relay, Poster Presentation, Riddles, PPT Presentation, Theorem Relay**

Course Focussing on Cross Cutting Issues (Professional Ethics/ Human Values/Environment Sustainability/ Gender Equity): -

Activities related to Cross Cutting Issues: -

Assignment: **Change of Interval, Fourier Cosine Transform.**

Sample questions (minimum one question from each unit)

Part A

Unit I

1. What is the value of $F(S)$, the Laplace transform of $f(t)$, when $S \to \infty$?

   (a) 1 (b) 0 (c) $F(t)$ (d) ∞

2. True or False: The value of $L(cos\ at) = \frac{s}{s^2+a^2}$.

Unit II

1. Write the relationship between Laplace transform and inverse Laplace transform.
2. Find $L^{-1}\left[\frac{1}{s}\right]$.

Unit III

1. $\int_0^{\pi} \sin^2 mx dx =$ ----------- if m=n

   (a) 0 (b) 2 (c) $\frac{\pi}{2}$ (d) 2π

2. Say True or False: $1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + ... = \frac{\pi}{8}$

Unit IV

1. F(s) is a purely imaginary function if f(t) is a -------------

   (a) real function (b) real even function

   (c) real odd function (d) none of these.

2. F $\{F(x)\} = ------$

   (a) $f(s)$ (b) $f(-s)$ (c) $f(-x)$ (d) $f(x)$

Unit V

1. The value of $F_s\{F_s(x)\} =$ ....
2. The convolution of two functions f(x) and g(x) is defined by ------

   (a) $\frac{1}{\sqrt{2\pi}} \int f(x) g(x-t) dt$

   (b) $\frac{1}{\sqrt{2\pi}} \int f(t) g(x-t) dt$

   (c) $\frac{1}{\sqrt{2\pi}} \int f(t) g(t) dt$

   (d) $\frac{1}{\sqrt{2\pi}} \int f(t) g(x) dt$

Part B

Unit I

1. Find the value of (a) $L(e^{at})$ (b) $L(cosh\ at)$ (c) $L(sin\ at)$.
2. Find the value of the following Laplace transform.

   (a). $L(te^{-t}sin\ t)$ (b). $L(t\ cos^2 t)$

Unit II

1. Derive the value of the inverse Laplace transform $L^{-1}\left[\frac{s}{s^2a^2+b^2}\right]$.
2. Derive the value of $L^{-1}\left[\frac{1}{(s+1)(s^2+2s+2)}\right]$.

Unit III

1. Express f(x) = x ($-\pi$ <x< π) as a Fourier Series with period 2π.
2. Express f(x) = $\frac{1}{2}(\pi - x)$ as a Fourier series with period 2π.

Unit IV

1. Prove that F{f(ax)] = $\frac{1}{|a|}F(\frac{s}{a})$.
2. Prove the following.

   (a) $F\{\overline{f(x)}\} = \overline{F(-s)}$

   (b) $F\overline{\{f(-x)\}} = \overline{F(s)}$

Unit V

1. Prove the following properties of Fourier Transforms.

   (a) $F_c\{f(x)cos(ax)\} = \frac{1}{2}[F_c(s+a) + F_c(s-a)]$.

   (b) $F_c\{f'(x)\} = -sF_c(s)$.
2. Solve the integral equation $\frac{1}{2}\int_{-\infty}^{\infty} f(t)e^{-|x-t|}dt = h(x)$ where $h(x)$ is a given function.

Part C

Unit I

1. Evaluate the following integrals.

   (a). $\int_0^\infty \frac{e^{-t}-e^{-2t}}{t}dt.$

   (b). $\int_0^\infty \frac{e^{-t}sin\ t}{t}dt.$

2. Prove the following.

(a). If $L\{f(t)\} = F(s)$, then $L\{t\, f(t)\} = -\frac{d}{ds}F(s)$.

(b). If $L\{f(t)\} = F(s)$ and if $\frac{f(t)}{t}$ has a limit as $t \to 0$, then $L\left\{\frac{f(t)}{t}\right\} = \int_s^\infty F(s)ds$.

Unit II

1. Solve the equation $\frac{d^2y}{dt^2} + 2\,\frac{dy}{dt} - 3y = sin\ t$, given that $y = \frac{dy}{dt} = 0$ when $t = 0$.
2. Solve the equation $t\,\frac{d^2y}{dt^2} - (2+t)\frac{dy}{dt} + 3y = t - 1$ when $y(0) = 0$.

Unit III

1. Show that $x^2 = \frac{\pi^2}{3} + 4\sum_{n=1}^{\infty}(-1)^n \frac{\cos nx}{n^2}$ in the interval ($-\pi \le x \le \pi$).
2. A function f(x) is defined within the range($0,2\pi$) by the relations

$$f(x) = x \quad \text{in the range } (0, \pi)$$
$$= 2\pi - x \quad \text{in the range } (\pi, 2\pi)$$

Express f(x) as a Fourier series in the range ($0, 2\pi$).

Unit IV

1. Prove the following.

(i)$F\{\frac{d^n}{dx^n} f(x)\} = (-is)^n F(s)$ (ii) $F\{x^n f(x)\} = (-i)^n \frac{d^n}{ds^n} F\{f(x)\}$

2. State and prove the Fourier Integral Theorem.

Unit V

1. Prove that (i) $F_c\{xf(x)\} = \frac{dF_s}{ds}$.

(c) $F_s\{x\, f(x)\} = -\frac{dF_c}{ds}$. Determine $F_c\{x\, e^{-ax}\}$ and $F_s\{xe^{-ax}\}$.

2. Find the Fourier Cosine transform for F(x) if

$$f(x) = 1 \text{ when } |x| < 1$$
$$= 0 \text{ when } |x| > 1$$

Head of the Department

[Dr. T. Sheeba Helen]

Course Instructors

[Dr. T. Sheeba Helen]

[Dr. A. Anat Jaslin Jini

Teaching Plan

Department : Mathematics

Class : III B.Sc Mathematics

Title of the Course : Complex Analysis

Semester : VI

Course Code : MC2061

Course Code	L	T	P	Credits	Inst. Hours	Total Hours	Marks		
							CIA	External	Total
MC2061	6	-	-	5	6	90	25	75	100

Objectives

- To introduce the basic concepts of differentiation and integration of Complex functions
- To apply the related concepts in higher studies

Course outcomes

CO	Upon completion of this course, the students will be able to:	PSO Addressed	Cognitive Level
CO - 1	understand the geometric representation of mappings	PSO - 1	U
CO - 2	use differentiation rules to compute derivatives and express complex- differentiable functions as power series	PSO - 4	E
CO - 3	compute line integrals by using Cauchy's integral theorem and formula	PSO - 3	E
CO - 4	identify the isolated singularities of a function and determine whether they are removable, poles or essential	PSO - 1	U
CO - 5	evaluate definite integrals by using residues theorem	PSO - 5	C

Teaching plan

Total Contact hours: 90 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment/ Evaluation
I	**Analytic Functions**					
	1.	Differentiability	2	K5	Brainstorming	Questioning
	2.	The Cauchy-Riemann Equations	3	K5	Inductive Learning	Recall Steps
	3.	Complex form of Cauchy-Riemann Equations, Cauchy Riemann Equations in Polar Coordinates	5	K5	Blended Learning	True or False
	4.	Analytic Functions	2	K5	Lecture with Illustration	Slip Test
	5.	Harmonic Functions	5	K5	Inductive Learning	Peer Discussion with questions
II	**Bilinear Transformations**					
	6.	Elementary Transformations	2	K2	PPT using nearpod	Quiz - nearpod
	7.	Bilinear Transformations	2	K2	Video using Zoom	Short Answer – Google Form
	8.	Cross Ratio	2	K2	PPT using Gamma	Match the Following – Gamma
	9.	Fixed Points of Bilinear Transformations	3	K2	Lecture with PPT	Questioning
	10.	Mappings $w = z^2$	2	K2	PPT using nearpod	Quiz – nearpod
	11.	Mappings $w = e^z$	2	K2	Video using Zoom	Slip Test
	12.	Mappings w = Sin z, Cos z	2	K2	Demonstration Method	Poster Presentation
	13.	Mappings w = Coshz	2	K2	Video using Zoom	Quiz – Socrative
III	**Complex Integration**					
	14.	Definite Integral	5	K5	Heuristic Method	Solve Problem
	15.	Cauchy’s Theorem	4	K5	Flipped Classroom	Slip Test

	16.	Cauchy's Integral Formula	5	K5	Problem Solving	Relay Race
IV	**Series Expansion**					
	17.	Taylor's Theorem	4	K5	Brainstorming	PPT Presentation
	18.	Laurent's Series	4	K5	Discussion	Riddles
	19.	Zeros of an Analytic Function	2	K2	Interactive Method	MCQ
	20.	Singularities	3	K2	Analytic Method	Quiz – Quizzes
V	**Calculus of Residues**					
	21.	Residues	4	K6	Blended Learning	Riddles
	22.	Cauchy's Residue Theorem	5	K6	Heuristic Method	Relay Race
	23.	Evaluation of Definite Integrals	5	K6	Problem Solving	Solve Problems

Course Focussing on Employability/ Entrepreneurship/ Skill Development: **Skill Development**

Activities (SD): **Quiz, MCQ, Slip Test, Problem Solving, Relay Race, Poster Presentation, Riddles, PPT Presentation**

Course Focussing on Cross Cutting Issues (Professional Ethics/ Human Values/Environment Sustainability/ Gender Equity): -

Activities related to Cross Cutting Issues: -

Assignment: **Evaluation of Definite Integrals using Cauchy's Residue Theorem, Conformal Mapping, Bilinear Transformation, Mappings w = z^2, Mappings w = e^z, Mappings w = Sin z, Cos z, Mappings w = Coshz**

Sample questions (minimum one question from each unit)

Part A

Unit I

1. True or False: The function $f(z) = z^2$ is differentiable only at $z = 0$
2. Write the sufficient condition to prove the differentiability of the function $f(z)$
3. State the Cauchy Riemann equation in Polar Coordinates
4. Which implies which: Analytic function, Differentiability
5. The real part of an analytic function is ……….

Unit II

1. The transformation $w = bz$, where $b > 0$ and real is called as ....
2. Match the following

a. Circle not passing through the origin mapped into	1. A line passing through the origin
b. Circle passing through the origin is mapped into	2. A circle passing through the origin
c. Straight line not passing through the origin mapped into	3. A straight line not passing through the origin
d. Straight line passing through the origin is mapped into	4. A circle not passing through the origin

3. Give an example of bilinear transformation
4. Under which transformation the family of circles are transformed into family of circle
5. Four distinct points z_1, z_2, z_3, z_4 are collinear if and only if ....
   (i) (z_1, z_2, z_3, z_4) are real (ii) (z_1, z_2, z_3, z_4) are imaginary
   (iii) z_1, z_2, z_3, z_4 lies on a circle (iv) z_1, z_2, z_3, z_4 lies on a straight line

Unit III

1. Define length of the piecewise differentiable curve
2. The value of $\int_C \frac{dz}{z-a}$ is
3. True or False: $\int_C (z-a)^n\, dz = 0$ for every closed curve C, provided $n \geq 1$
4. State the difference between simply connected and multiple connected region
5. The value of the function at the centre is equal to the ....

Unit IV

1. Taylor series expansion of $f(z)$ about the point zero is called as
   (i) Maclaurin's series (ii) Laurent's series
   (iii) Cauchy's series (iv) None of these
2. The order of $z = 0$ for $f(z) = sin\, z$ is ......
3. What are the poles for the function $f(z) = tanz$
4. Give an example of a meromorphic function
5. A function f which is bounded and analytic in a region $0 < |z - z_0| < \delta$ is ......

Unit V

1. If $z = a$ is a simple pole for $f(z)$, then

   (i) Res { f(z); a} = $\frac{h(a)}{k'(a)}$ (ii) Res { f(z); a} = $\lim_{z\to a}(z-a)f(z)$

   (iii) Res { f(z); a} = $\frac{g^{(m-1)}(a)}{(m-1)!}$ (iv) None of these

2. The residue of $cot\, z$ at $z = 0$ is ....

3. True or False: If $f(z)$ is analytic inside and on C and not zero on C, then $\frac{1}{2\pi i}\int_C \frac{f'(z)}{f(z)}dz = N$
4. Fundamental theorem of algebra can deduct from which theorem?
5. State the application of Cauchy's Integral formula

Part B

Unit I

1. If $f(z)$ is differentiative at a point z, then it is continuous at that point. Show by an example that converse part need not be true
2. Prove that the function $f(z) = |z|^2$ is differentiable at $z = 0$
3. Derive the complex form of Cauchy Riemann Equation
4. Prove that the functions $f(z)$ and $\overline{f(z)}$ are simultaneously analytic
5. Prove that $u = 2x - x^3 + 3xy^2$ is harmonic and find its harmonic conjugate. Also find the corresponding analytic function.

Unit II

1. Under the transformation $w = iz + i$, show that the half plane $x > 0$ maps onto the half plane $v > 1$
2. Show that the transformation $w = \frac{5-4z}{4z-2}$ maps the unit circle $|z| = 1$ into a circle of radius unity and centre -1/2
3. Find the general bilinear transformation which maps the unit circle $|z| = 1$ onto $|w| = 1$ and the points $z = 1$ to $w = 1$ and $z = -1$ to $w = -1$
4. Find the image of the circle with centre origin and radius r under $w = z^2$
5. Under the mapping $w = e^z$, discuss the transforms of the lines
   (i) $y = 0$ (ii) $y = \pi/2$ (iii) $y = \pi$

Unit III

1. Prove that $\left|\int_a^b f(t)dt\right| \le \int_a^b |f(t)|dt$
2. Prove that $\int_C \frac{dz}{(z-a)^n} = \begin{cases} 0 & if\ n \neq 1 \\ 2\pi i & if\ n = 1 \end{cases}$ where C is the circle with centre a and radius r and $n \in \mathbb{Z}$
3. State and prove Maximum Modulus Theorem
4. Evaluate $\int_C \frac{z}{z^2+4}dz$ where C is positively oriented circle $|z - i| = 2$
5. Evaluate $\frac{z}{(9-z^2)(z+i)}dz$ where C is the circle $|z| = 2$ taken in the positive sense

Unit IV

1. Expand $f(z) = sin\ z$ in a Taylor's series about $z = \pi/4$ and determine the region of convergence of this series

2. Find the Laurent's series for $\frac{z}{(z+1)(z+2)}$ about $z = -2$
3. Suppose that $f(z)$ is analytic in a region D and is not identically zero in D. Then the set of all zeros of $f(z)$ is isolated
4. Determine and classify the singular points of $f(z) = \frac{z}{e^z-1}$
5. An isolated singularity a of $f(z)$ is a pole if and only if $\lim_{z \to a} f(z) = \infty$

Unit V

1. If a is a simple pole for $f(z)$ and if $f(z)$ is of the form $\frac{h(z)}{k(z)}$ where $h(z)$ and $k(z)$ are analytic at a and $h(a) \neq 0$ and $k(a) = 0$, then

$$\text{Res } \{ f \text{ (z); a}\} = \frac{h(a)}{k'(a)}$$

2. Find the residue of $\frac{1}{(z^2+a^2)^2}$ at $z = ai$
3. State and prove the fundamental theorem of algebra
4. Evaluate $\int_C \; tanz \; dz$ where C is $|z| = 2$
5. Evaluate $\int_0^{2\pi} \frac{d\theta}{5+4 \; sin\theta}$

Part C

Unit I

1. Let $f(z) = u(x, y) + iv(x, y)$ be differentiable at a point $z_0 = x_0 + iy_0$. Then $u(x, y)$ and $v(x, y)$ have first order partial derivatives $u_x(x_0, y_0)$, $u_y(x_0, y_0)$, $v_x(x_0, y_0)$ and $v_y(x_0, y_0)$ at (x_0, y_0) and these partial derivatives satisfy the Cauchy-Riemann equations given by
$u_x(x_0, y_0) = v_y(x_0, y_0)$ and $u_y(x_0, y_0) = -v_x(x_0, y_0)$.
Also $f'(z_0) \quad = u_x(x_0, y_0) + iv_x(x_0, y_0)$
$\qquad\qquad\; = v_y(x_0, y_0) - iu_y(x_0, y_0)$
2. Prove that $f(z) = \begin{cases} \frac{z \; Re \; z}{|z|} & if \; z \neq 0 \\ 0 & if \; z = 0 \end{cases}$ is continuous at $z = 0$ but not differentiable at $z = 0$
3. (i). An analytic function in a region D with its derivative zero at every point of the domain is a constant
(ii). An analytic function in a region with constant modules is constant
(iii). An analytic function $f(z) = u + iv$ with $arg \; f(z)$ constant is itself a constant function
4. Given that $v(x, y) = x^4 - 6x^2y^2 + y^4$. Then find $f(z) = u(x, y) + iv(x, y)$ such that $f(z)$ is analytic

5. Given the function $w = z^3$ where $w = u + iv$. Show that u and v satisfy the Cauchy-Riemann equations. Prove that the families of curves $u = c_1$ and $v = c_2$ (c_1 and c_2 are constants) are orthogonal to each other

Unit II

1. Find the image of the circle $|z - 3i| = 3$ under the map $w = 1/z$
2. Determine the bilinear transformation which maps $0, 1, \infty$ into $i, -1, -i$ respectively. Under this transformation, show that the interior of the unit circle of the plane maps onto the half plane upper to the v axis
3. Show that any bilinear transformation which maps the real axis onto unit circle $|w| = 1$ can be written in the form $w = w^{i\lambda}(\frac{z-\alpha}{z-\bar{\alpha}})$, where λ is real
4. Discuss the mapping $w = sin\, z$
5. Find the image of the following lines under the transformation $w = coshz$
   (i) $y = 0$ (ii) $y = \pi/2$ (iii) $y = \pi$ (iv) $x = 0$

Unit III

1. Show that $\int_C |z|^2 dz = -1 + i$ where C is the square with vertices O(0, 0), A(1, 0), B(1, 1) and C(0, 1)
2. Evaluate $\int_C |z|\bar{z}\ dz$ where C is the closed curve consisting of the upper semicircle $|z| = 1$ and the segment $-1 \leq x \leq 1$
3. State and prove Cauchy's Theorem
4. State and prove Cauchy's Integral formula
5. (i). Evaluate $\int_C \frac{e^z}{z^2+4} dz$ where C is positively oriented circle $|z - i| = 2$
   (ii). Let C denote the boundary of the square whose sides lie along the lines $x = \pm 2$ and $y = \pm 2$ where C is described in the positive sense.
   Evaluate (i) $\int_C \frac{z}{2z+1} dz$ nad (ii) $\int_C \frac{cos\, z}{z(z^2+8)} dz$

Unit IV

1. Expand $f(z) = \frac{z-1}{z+1}$ as a Taylor's Series
   (i) about the point $z = 0$ (ii) About the point $z = 1$
   Determine the region of convergence in each cases
2. State and Prove Taylor's Theorem
3. Expand $f(z) = \frac{z}{(z-1)(2-z)}$ in a Laurent's series valid for
   (i) $|z| < 1$ (ii) $1 < |z| < 2$ (iii) $|z| > 2$ (iv) $|z - 1| > 1$

4. For the function $f(z) = \frac{2z^3+1}{z(z+1)}$, find
   (i) a Taylor's series valid in a neighbourhood of $z = i$
   (ii) a Laurent's series valid within an annulus of which centre is the origin

5. Let $f(z)$ be a function having a as an isolated singular point. Prove that the following are equivalent
   (i) a is a pole of order r for $f(z)$
   (ii) $f(z)$ can be written in the form $f(z) = \frac{1}{(z-a)^r}\theta(z)$, where $\theta(z)$ has a removable singularity at $z = a$ and $\lim_{z \to a} \theta(z) \neq 0$
   (iii) a is a zero of order r for $1/f(z)$

Unit V

1. Find the residue of $\frac{e^z}{z^2(z^2+9)}$ at its poles
2. State and prove Argument theorem
3. Evaluate using (i) Cauchy's Integral formula (ii) Cauchy Residue theorem $\int_C \frac{z+1}{z^2+2z+4} dz$, where C is the circle $|z + i + i| = 2$
4. Prove that $\int_0^{2\pi} \frac{d\theta}{1+a\, sin\theta} = \frac{2\pi}{\sqrt{1-a^2}}, (-1 < a < 1)$
5. Use contour integration technique to find the value of $\int_0^{2\pi} \frac{d\theta}{2+cos\theta}$

Head of the Department — Course Instructor

[Dr. T. Sheeba Helen] — [Dr. A. Anat Jaslin Jini]

Department : **Mathematics**

Class : **III B. Sc**

Title of the Course : **Major Core XI- Mechanics**

Semester : **VI**

Course Code : **MC2062**

Course Code	L	T	P	Credits	Inst. Hours	Total Hours	Marks		
							CIA	External	Total
MC2064	6	-	-	5	6	90	25	75	100

Objectives:

1. To visualize the application of Mathematics in Physical Sciences.
2. To develop the capacity to predict the effects of force and motion.

Course Outcomes

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO -1	calculate the reactions necessary to ensure static equilibrium	PSO - 2	K2
CO - 2	apply the principles of static equilibrium to particles and rigidbodies	PSO - 4	K3
CO - 3	understand the ways of distributing loads	PSO - 5	K5
CO - 4	identify internal forces and moments of a rigid body	PSO - 3	K3
CO - 5	apply the basic principles of projectiles into real world problems	PSO - 2	K3
CO - 6	classify the laws of friction	PSO - 4	K4

Total contact hours: 90 (Including lectures, assignments, quizzes and tests)

Unit	Module	Topics	Teaching Hours	Cognitive level	Pedagogy	Assessment/ Evaluation
I	**Forces Acting at a Point, Parallel Forces and Moments**					
	1	Forces Acting at a Point:Resultant and Components - Sample cases of finding the resultant, Analytical expression for the resultant of two forces acting at a point, Triangle forces, Perperndicular Triangular forces, Converse of the Trigangle of Forces, The Polygon of Forces,Lami's Theorem, Problems based on Lami's Theorem	4	K2	Demonstration, PPT	Concept explanations
	2	Resultant of two like parallel forces, two unlike and unequal parallel forces, Resultant of number of parallel forces, equilibrium of three coplanar parallel forces	3	K3	Flipped Classroom	Questioning
	3	Moment of a force, Geometrical representation, Varignon's theorem of moments	4	K4	Peer Teaching	MCQ

	4	Generalised theorem of moments, Problems based on Varignon's theorem of moments, Generalised theorem of moments	4	K3	Blended classroom, Lecture using videos	Slip Test
II	**Couples, Coplanar Forces**					
	1	Couples – Equilibrium of two couples – Representation of a couple by a vector – Resultant of coplanar couples – Resultant of couple and a force – Problems based on Couples, Introduction and reduction of any number of coplanar forces, Analytical proof	4	K2	Lecture Illustration	Home Assignment
	2	Conditions for forces to reduce a single force or couple, Change of the base point & Equation to the line of action of the resultant	3	K2	Group discussion	Evaluation through Quiz using slido
	3	Problems based on reduction of number of coplanar forces	2	K3	Lecture using videos, Problem solving	MCQ
	4	Problems based on forces to reduce a single force or couple	3	K3	Collaborative learning	Quiz (Google forms)

	5	Problems based on Equation to the line of action of the resultant	3	K4	Blended classroom	Evaluation through poll
III	**Friction**					
	1	Introduction, Statical, Dynamical, Limiting friction and Laws of friction, Coefficient of friction, Angle of friction, Cone of friction	4	K2	Lecture with PPT Illustration	Assignment
	2	Equilibrium of a particle on a rough inclined plane, Equilibrium of a body on a rough inclined plane under a force parallel to the plane, Equilibrium of a body on a rough inclined plane under any force	3	K3	Peer Teaching	MCQ
	3	Problems based on Coefficient of friction, angle of friction	4	K3	Blended classroom	Self Assessment
	4	Problems based on Equilibrium of a particle on a rough inclined plane and equilibrium of a body on a rough inclined plane under a force parallel to the plane	4	K4	Group Discussion	Slip Test using Quizziz

IV	**Projectiles**					
	1	Fundamental principles,Path of a projectile, Characteristics of the motion of a projectile	3	K2	Lecture with PPT Illustration	Quiz
	2	Path of a projectile at a certain height above the ground, Problems based on Path of a projectile, Problems based on Characteristics of the motion of a projectile	4	K3	Flipped Classroom	Quiz through slido
	3	Maximum horizontal range, Two possible directions of projection, Problems based on maximum horizontal range and Two possible directions of projection	4	K3	Introductory session, Group Discussion	MCQ
	4	Velocity of the projectile,Velocity of the projectile falling freely from the directrix, Problems based on Velocity of the projectile	4	K4	Lecture with Illustration	Self Assessm ent
V	**Motion under the action of central forces**					
	1	Motion under the action of central forces - Introduction – Velocity and Acceleration in Polar Coordinates	4	K2	Lecture with PPT Illustration	Test

	2	Equation of Motion in Polar Coordinates – Noteon the equiangularspiral – Motion under a central force	4	K1	Collaborative learning	Formative Assessment Test
	3	Differential Equation ofcentral orbits – Perpendicular from the pole on the tangent – Pedal equation of the central orbit – Pedal equation of some of the well-known curves	4	K2	Problem Solving	Assignment
	4	Velocities in a centralorbit - Two – fold problems in central orbits	3	K4	Lecture withPPT	Assignment &Quiz
	5	Johnson's Algorithmfor Sparse Graphs-Preserving shortest paths by reweighting and related Lemma	2	K3	Group Discussion	Assignment

Course Focussing on Employability/ Entrepreneurship/ Skill Development: Skill Development

Activities (Em/ En/SD): Poster Presentation, Group Discussion

Assignment: Verification of Lami's Theorem.

Sample questions

Part A

1. In a system where forces acting on a body maintain equilibrium, what is the algebraic sum of their moments about any line in the body? (Ap)

   a) zero b) one c) infinite d) finite

2. Forces lying on a same plane are called as ---------- forces. (U)
3. When a body is sliding over another, what type of friction is exerted? (Ap)

   a) Static friction b) Limiting friction c) Dynamic friction d) Maximum friction

4. **Say true or false:** Greatest height attained by a projectile is $u^2 \sin^2 \alpha$. (U)
5. What is the path described by a particle under the influence of a central force called? (An)

   a) Linear trajectory b) Circular orbit c) Tangential path d) Central orbit

Part B

1. Show that the resultant of couples in the same plane on a rigid body is a single couple whose moment is equal to the algebraic sum of the moments of the several couples. (Ap)
2. Two men carry a load of 224kg at which hangs from a light pole of length 8m each end of which rests on a shoulder of one of the men. The point from which the load is hung is 2m nearer to one man than the other what is the pressure on each shoulder. (Ap)
3. A uniform ladder is in equilibrium with one end resting on the ground and the other against vertical wall; if the ground and wall be both rough, the coefficients of friction being μ and μ^1 respectively, and if the ladder be on the point of slipping at both ends, show that θ, the inclination of the ladder to the horizon is given by $tan\,\theta = \frac{1-\mu\mu^1}{2\mu}$. (U)
4. If h and h^1 be the greatest heights in the two paths of a projectile with a given velocity for a given range R. Prove that $R = 4\sqrt{hh^1}$. (Ap)
5. A particle moves in a curve under a central attraction so that its velocity at any point is equal to that in a circle at the same distance and under the same attraction. Show that the path is an equiangular spiral and that the law of force is that of the inverse cube. (An)

Part C

1. State and prove Lami's theorem. (Ap)
2. Forces 3, 2, 4, 5 kg wt act respectively along the sides AB, BC, CD and DA of a square. Find the magnitude of their resultant and the points where its line of action meets AB and AD. (An)

3. A weight can be supported on a rough inclined plane by a force P acting along the plane or by a force Q acting horizontally. Show that the weight is $\frac{PQ}{\sqrt{Q^2 sec^2\lambda - P^2}}$ where λ is the angle of friction. (C)
4. Show that the greatest height which a particle with initial velocity v can reach on a vertical wall at a distance a from the point of projection is $\frac{v^2}{2g} - \frac{ga^2}{2v^2}$. Prove also that the greatest height above the point of projection attained by the particle in its flight is $V^6 / 2g(v^4 + g^2a^2)$. (U)
5. A particle moves in an ellipse under a force which is always directed towards its focus. Find the law of force, the velocity at any point of the path and its periodic time. (Ap)

Course Instructor

Dr. V. Sujin Flower

Head of the Department

Dr. T. Sheeba Helen

Semester VI
Major Core XII- Number Theory
Course Code: MC2063

No. of hours per week	Credits	Total No. of hours	Marks
5	4	75	100

Objectives: 1. To introduce the fundamental principles and concepts in Number Theory.
2. To apply these principles in other branches of Mathematics.

Course Outcome

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	express the concepts and results of divisibility of integers effectively	PSO - 1	U
CO - 2	construct mathematical proofs of theorems and find counter examples for false statements	PSO - 2	Ap
CO - 3	collect and use numerical data to form conjectures about the integers	PSO - 5	Ap
CO - 4	understand the logic and methods behind the major proofs in Number Theory	PSO - 4	An
CO - 5	solve challenging problems related to Chinese remainder theorem effectively	PSO - 3	E
CO - 6	build up the basic theory of the integers from a list of axioms	PSO - 1	U

Total contact hours: 75 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching hours	Cognitive Level	Pedagogy	Assessment/ evaluation
I	Divisibility Theory in the Integers					
	1	Preliminaries – Numbers, integers, Divisors and Divisibility Theory in the Integers	3	U & Ap	Brainstorming & Lecture with Illustration	Evaluation through appreciative inquiry
	2	The Division Algorithm theorem and its applications	3	Ap & An	Lecture with illustration	Evaluation through quizzes and discussions.
	3	The greatest common divisor and least common multiple	3	U & Ap	Problem Solving	Slip Test
	4	Euclid’s lemma and Euclidean Algorithm.	3	An & Ap	Analytic Method & Problem solving	Quiz and Test
II	Diophantine Equation					

	1	The Diophantine Equation $ax + by = c$	3	U & Ap	Lecture and Discussion	Concept explanations
	2	Primes and their Distribution.	3	U & Ap	Problem solving	Evaluation through appreciative inquiry
	3	The fundamental theorem of arithmetic	3	Ap & An	Lecture with illustration	Formative Assessment Test
	4	The Sieve of Eratosthenes	3	U	Group Discussion	Simple Questions
III	**Theory of Congruences**					
	1	Theory of Congruences	3	U	Brainstorming & Discussion	Slip Test
	2	Basic properties of congruence	3	U	Flipped Class	Questioning
	3	Linear congruences and the Chinese remainder theorem.	3	U & E	Lecture with Illustration	Slip Test
	4	Problems based on Chinese remainder theorem.	3	U & Ap	Problem Solving and Group Discussion	Quiz and Test
IV	**Pseudoprimes**					
	1	Fermat's Little theorem and Pseudoprimes	2	U & E	Lecture with PPT Illustration	MCQ
	2	Absolute pseudoprimes	3	U & An	Flipped Class	Questioning
	3	Wilsons theorem	3	U & E	Lecture with Illustration	Formative Assessment Test
	4	Quadratic Congruence.	3	U	Group Discussion	Slip Test
V	**Number Theoretic Functions**					
	1	Number Theoretic Functions	3	U	Collaborative learning	Concept Explanation
	2	The sum and number of divisors	3	U & Ap	Lecture and group discussion	Evaluation through Assignment
	3	The Mobius Inversion formula.	3	U & E	Flipped class	Formative Assessment Test
	4	The greatest integer function.	3	U & E	Lecture with Illustration	Slip Test

Course Focussing on Employability/ Entrepreneurship/ Skill Development: **Skill Development & Employability**

Activities (Em/ En/SD): **Poster Presentation, Solving Problems on Relay**

Course Focussing on Cross Cutting Issues (Professional Ethics/ Human Values/Environment Sustainability/ Gender Equity): -

Activities related to Cross Cutting Issues: -

Assignment: **Make an interactive PPT (Any topic from the syllabus)**

Seminar Topic: **Number Theoretic Functions**

Sample questions

Part A

1. If a|b and c|d then

   a) ab|cd b) ac|bd c) bd|ac d) ad|bc

2. The Diophantine equation ax+by=c , *d* = gcd(*a*, *b*) has a solution if and only if

   a) d|c b) c|d c) a|ac d) ad|bc

3. If $9x \equiv 21 \pmod{30}$ then the linear congruence has ___________ solutions.

   a)one b) two c) three d) no

4. If p is a prime, then (p-1)! ≡__________(mod p)
5. Say true or false: For a positive integer r, the product of any r consecutive positive integers is divisible by r!

Part B

1. State and prove Euclid’s lemma.
2. Solve the Diophantine equation 221*x*+ 35*y* = 11.
3. If a≡b(mod n) and b≡cmod n, then a≡cmod n.
4. State and prove Fermat’s Theorem.
5. Find τ(180) and σ(180)

Part C

1. State and prove Division Algorithm.

2. State and prove Fundamental theorem of Arithmetic
3. State and prove Chinese remainder theorem.
4. State and prove Wilson's Theorem.
5. Derive the Mobius inversion formula.

Course Instructor: Dr. S.Sujitha **HoD: Dr. T.Sheeba Helen**

Department : **Mathematics**

Class : **III B. Sc Mathematics**

Title of the Course : **Major Core XIII- Linear Programming**
Semester : **VI**

Course Code : **MC2064**

Course Code	L	T	P	Credits	Inst. Hours	Total Hours	Marks		
							CIA	External	Total
MC2064	5	-	-	4	5	90	25	75	100

Objectives:

1. To formulate real life problems into mathematical problems.
2. To solve life oriented and decision making problems by optimizing the objective function.
Course Outcomes

CO	upon completion of this course, the students will be able to:	PSO addressed	Cognitive level
CO – 1	understand the methods of optimization and to solve the problems	PSO - 1	K2(U)
CO – 2	explain what is an LPP	PSO - 1	K2(U)
CO – 3	define how to formulate an LPP with linear constraints	PSO - 1	K1(R)
CO – 4	maximize the profit, minimize the cost, minimize the time in transportation problem , Travelling salesman problem, Assignment problem	PSO - 3	K3(Ap)
CO – 5	identify a problem in your locality, formulate it as an LPP and solve	PSO - 4	K5(C)

Total contact hours: 90 (Including lectures, assignments, quizzes, and tests)

Unit	Section	Topics	Teaching Hours	Cognitive level	Pedagogy	Assessment/ Evaluation
I	**Formulation of L.P.P**					
	1.	Formulation of L.P.P - Mathematical Formulation of L.P.P - Solution of L.P.P	3	K2(U)	Brainstorming	Evaluation through Nearpod
	2.	Graphical method	4	K3(Ap)	Flipped Classroom	Short summary of the concept
	3.	Simplex method	4	K4(An)	Peer Teachingand Learning	MCQ
	4.	Big-M Method - Algorithm for Big-M Method	4	K3(Ap)	Lecture andproblem solving	Concept Explanation
II	**Two phase method**					
	1	Two phase method - Phase I: Solving auxiliary LPP using Simplex method	3	K2(U)	Lecture Illustration	Home Assignment
	2	Phase II: finding optimal basic feasible solution	3	K2(U)	Group discussion	Evaluation through slido
	3	Duality in L.P.P - Primal - Formation of dual L.P.P - Matrix form of primal and its dual - Fundamental theorem of duality	3	K3(Ap)	Lecture using videos, Problem solving	MCQ
	4	Dual simplex method - Dual Simplex Algorithm	4	K3(Ap)	Collaborativelearning	Simple questions
	5	Degeneracy and cycling in L.P.P	2	K4(An)	Blended classroom	Evaluation through poll

III	**Transportation problems**					
	1	Transportation problems - Mathematical formulation of Transportation Problems - Dual of a Transportation Problem	4	K2(U)	Brainstorming	Evaluation through Nearpod
	2	Solution of a Transportation Problem - North-West corner rule - Row Minima method - Column Minima method	4	K3(Ap)	Blended classroom	Slip Test using Quizziz
	3	Least Cost method - Vogel Approximation Method	4	K3(Ap)	Flipped Classroom	Short summary of the concept
	4	Degeneracy in Transportation Problems	3	K4(An)	Peer Teachingand Learning	MCQ
IV	**Assignment Problems**					
	1	Assignment Problems - Mathematical formulation	4	K2(U)	Lecture with Illustration	Slip Test
	2	Solution to Assignment Problems	4	K3(Ap)	Group discussion	Home Assignment
	3	Hungarian Algorithm for solving Assignment Problems	4	K3(Ap)	Lecture using videos, Problem solving	Quiz through slido
	4	Travelling Salesman Problem	3	K4(An)	Lecture using Chalk and talk ,Introductory session, Group Discussion	Online Quiz through quizziz

V	Sequencing of Jobs					
	1	Sequencing of Jobs-Introduction	4	K2(U)	Collaborativelearning	Evaluation through poll
	2	Processing n jobs in two machines	4	K2(U)	ProblemSolving	Concept Explanation
	3	Processing n jobs in m machines	4	K4(An)	Group Discussion	Evaluation through quizziz
	4	Processing two jobs in m machines	3	K3(Ap)	Analytic Method	Questioning

Course Focussing on Employability

Activities (Em/ En/SD): Evaluation through Concept Explanation

Assignment : Processing two jobs in m machines **(**online Assignment**)**

Sample questions

Part A

1. A feasible solution that also optimizes the objective function is called an …………solution
   (a) feasible (b) Basic
   (c) optimal (d) Basic feasible
2. The optimal solution of a linear programming problem involving ……… decision variables can be obtained by graphical method.
   (a) 2 b) 3 (c) 4 d) 5

3. State True or False

   If the primal problem is of maximization type, then the dual problem is of maximization type.

4.The number of non-basic variables in the balanced transportation problem with m rows and n columns is ________.

a) $(m+n)-mn$ b) $m-(m+n-1)$

c) $mn-(m+n-1)$ d) $mn+(m+n-1)$

5. The solving procedure of an assignment problem is known as _________

a) MODI method b) Simplex method

c) Hungarian method d) None

Part B

1. Solve by graphical method the LPP Maximize $z = 4x_1+3x_2$ subject to $2x_1-3x_2 \leq 6$, $6x_1+5x_2 \geq 30$, $x_1,x_2 \geq 0$
2. Given the cost matrix for travelling the cities A, B, C, D by a travelling salesman

	A	B	C	D
A	∞	46	16	40
B	41	∞	50	40
C	82	32	∞	60
D	40	40	36	∞

3. Explain the North West Corner Rule.
4. Explain unbalanced Assignment Problem.
5. Demonstrate Hungarian Method of Solving Assignment Problem.

Part C

1. Solve the LPP using Two phase method Maximize $z = 5x_1+8x_2$ subject to $3x_1+2x_2 \geq 3$, $x_1+4x_2 \geq 4$, $x_1+x_2 \leq 5$, $x_1,x_2 \geq 0$
2. Solve by simplex method the LPP Maximize $z = 4x_1+3x_2$ subject to $2x_1-3x_2 \leq 6$, $6x_1+5x_2 \geq 30$, $x_1,x_2 \geq 0$.
3. Solve the following L.P.P using Dual Simplex Method.

   Maximize $z = -x_1 - x_2$

   subject to $2x_1 + x_2 \geq 2$

   $-x_1 - x_2 \geq 1$

   $x_1, x_2 \geq 0$
4. For the set of data given below find the minimum total elapsed time and idle times on the two machines M_1 and M_2.

Jobs ⇒		**A**	**B**	**C**	**D**	**E**
Machines ⇒	$\mathbf{M_1}$	5	4	8	7	6
	$\mathbf{M_2}$	3	9	2	4	10

5. Solve the following Assignment problem for minimum cost.

	J1	J2	J3	J4
P1	20	13	7	5
P2	25	18	13	10
P3	31	23	18	15
P4	45	40	23	21

Head of the Department

Dr. T. Sheeba Helen

Course Instructor

Dr. A. Jancy Vini

Teaching Plan
Department: Mathematics
Class: III B.Sc
Semester: VI
Name of the Course: Astronomy
Course code: MC2065

Course Code	L	T	P	Credits	Inst. Hours	Total Hours	Marks		
							CIA	External	Total
MC2064	6	-	-	4	6	90	25	75	100

Objectives: 1. To introduce space science and to familiarize the important features of the planets, the sun, the moon, and the stellar universe.

2. To predict lunar and solar eclipses and study seasonal changes.

Course Outcome

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO – 1	define the spherical trigonometry of the celestial sphere	PSO - 1	U
CO – 2	discuss Kepler's laws	PSO - 1	U
CO – 3	calculate the motion of two particles relative to the common mass Centre	PSO - 2	Ap
CO – 4	interpret latitude and longitude and apply this to find the latitude and longitude of a particular place	PSO - 4	E
CO – 5	distinguish between Geometric Parallax and Horizontal Parallax	PSO - 4	An

Teaching Plan

Total contact hours: 90 (Including lectures, assignments, quiz, and tests)

Unit	Module	Topics	Teaching Hours	Cognitive level	Pedagogy	Assessment/ Evaluation
I	Celestial sphere					
	1.	Spherical trigonometry (only the four formulae) - Celestial sphere	3	K2(U)	Lecture Illustration	Evaluation through slip test
	2.	Four systems of coordinates	3	K3(Ap)	Lecture Illustration	Quiz through Quizizz
	3.	Diurnal motion, Sidereal Time	3	K4(An)	Lecture Illustration	Evaluationthrough Nearpod
	4.	Hour angle and Azimuth at rising	2	K2(U)	Inquiry based teaching	Class test
	5.	Morning and Evening stars	2	K3(Ap)	Lecture Illustration	Assignment
	6.	Circumpolar stars	2	K4(An)	Brainstorming	Evaluation through poll
II	The Earth					
	1.	The Earth - Zones of the earth	3	K2(U)	Flipped Classroom	Home Assignment
	2.	Perpetual Day and Perpetual night	2	K2(U)	Lecture Illustration	Evaluation through slip test
	3.	Terrestrial latitude and longitude	3	K3(Ap)	Collaborative group work	Formative Assessment
	4.	Dip of Horizon	3	K2(U)	Lecture Illustration	Quiz through Slido
	5.	Twilight, Duration of Twilight, Twilight throughout the night, Shortest Twilight.	4	K2(U)	Lecture Illustration	Home Assignment

III	Geocentric Parallax					
	1.	Geocentric parallax - Parallax - Effects of Geocentric parallax	3	K2(U)	Lecture Illustration	Slip Test
	2.	Changes in R.A and Declination of a body due to Geocentric Parallax	3	K3(Ap)	Lecture Illustration	Online quiz
	3.	Angular diameter, Equatorial horizontal Parallax	3	K3(Ap)	Illustrative Method	Online Assignment
	4.	Heliocentric Parallax, Effect of Heliocentric Parallax	3	K4(An)	Lecture with Comparative Analysis	Slip Test
	5.	To find the effect of Parallax on the Longitude and Latitude of a Star, Parsec	3	K2(U)	Lecture Illustration	Online Assignment
IV	Kepler's laws					
	1.	Kepler's laws , Eccentricity of Earth's orbit	3	K2(U)	Lecture Illustration	Slip Test
	2.	Verification of Kepler's Laws (1) and (2), Newton's deductions from Kepler's laws	3	K3(Ap)	Flipped Classroom	Home Assignment
	3.	To derive Kepler's Third Law from Newton's law of Gravitation, To find the mass of a planet	3	K3(Ap)	Interactive teaching	Simple Questions
	4.	To fix the position of a planet in its elliptic orbit, Geocentric and Heliocentric latitudes and longitudes	3	K4(An)	Lecture Illustration	Formative Test, Online Quiz

	5.	To prove that the Heliocentric longitude of the Earth and Geocentric longitude of the Sun differ by 180^o	3	K4(An)	Inquiry based teaching	Slip Test
V	Two Body Problem					
	1.	Two Body Problem – Introduction, Newton's Fundamental equation of Motion	3	K2(U)	Lecture Illustration	Class Test
	2.	Motion of one particle relative to another	3	K2(U)	Peer Teaching	Formative assessment
	3.	The motion of the common center of mass	3	K4(An)	Discussion and Lecture	Online Quiz
	4.	The motion of two particles relative to the common mass center	3	K3(Ap)	Lecture Illustration	Online Assignment
	5.	The motion of a planet with respect to the Sun	3	K4(An)	Seminar	Class test

Course Focussing on: Employability

Activities (Em/ En/SD): Quiz, Poster presentation, PPT presentations using Gamma

Assignment: The motion of the common centre of mass **(**online Assignment**)**

Sample Questions

Part – A

1. A star of declination δ is a circumpolar star at a place of latitude φ if ----------

a) $\delta \geq 90^o - \varphi$ (b) $\delta > 90^o - \varphi$ (c) $\delta < 90^o - \varphi$ (d) $\delta \leq 90^o - \varphi$

2. The secondaries to the terrestrial equator are called------------
3. State true or false: Geocentric parallax affects only near bodies
4. The angle between the standard direction and apparent direction is -------------
5. The third law of Kepler is also known as-------------

Part – B

6. Find the maximum azimuth of a star.
7. Define Dip of horizon and derive an expression for Dip.
8. Derive changes in R.A and declination of a body due to geocentric parallax.
9. Write and explain Kepler's laws of planetary motion.
10. Derive the motion of two particles relative to the common mass centre.

Part – C

11. Find the time taken by a star to rise when it is x" vertically below the horizon.
12. Trace the variations in the durations of day and night during the year for a place on the equator and at the north pole.
13. Show that the geocentric parallax of the sun is $\frac{\sin z' \sin P}{1 - \sin z' \sin P}$, where P is its horizontal parallax and z' its geocentric zenith distance.
14. Derive Newton's Deductions from Kepler's laws.
15. Derive the motion of a planet with respect to the sun.

Head of the Department

Dr. T. Sheeba Helen

Course Instructor

Dr. J.Befija Minnie