G.T.N. ARTS COLLEGE (Autonomous)

Dindigul

(Affiliated to Madurai Kamaraj University)

(Accredited with ‘B’ Grade by NAAC)

DEPARTMENT OF MATHEMATICS (PG)

SYLLABUS

Under Outcome Based Education (OBE)

(With effect from the academic year 2020-2021)

DEPARTMENT OF M.SC., MATHEMATICS

About the Department

The Department of Mathematics of G.T.N. Arts College established in the year 1964 is well-known for imparting quality education. The Post graduate and under graduate programmes (Self Supporting courses) were started in the academic year 2016-17. The Department has experienced, dedicated, committed and highly qualified faculty members with various specializations. Our staff members have written many books and published more than 100 research articles in National & International journals of repute. It has got its alumni well placed in India and abroad. The Department is consistently conducting Workshops, Seminars and other academic activities in every year. Under the able guidance and dedication of faculty members, our students have registered remarkable achievements in various academic activities.

PRINCIPAL

Dr. P. Balagurusamy,M.A., M.Phil., M.Ed., P.G.D.C.A., Ph.D.,

STAFF MEMBERS

1.	Mrs. K. Sujatha, M.Sc., M.Phil., B.Ed.,	Assistant Professor and Head
2.	Mrs. N. Sumathi, M.Sc., M.Phil.,	Assistant Professor
3.	Mrs. S. Lathamaheswari, M.Sc., M.Phil., B.Ed., CCA.,	Assistant Professor
4.	Mr. A.Mohamed Ali, M.Sc., M.Phil., PGDCA.,	Assistant Professor

Programme Outcomes

On successful completion of the M.Sc. programme, the graduates will be able to,

1. Apply the knowledge acquired in the respective disciplines and also have a multidisciplinary perspective towards the study of sciences.
2. Attain skills like analytical reasoning, critical thinking and problem solving to evince interest in higher education and research for offering solutions to societal and environmental problems.
3. Communicate articulately and effectively and interpret the results obtained from scientific studies and put forth innovative ideas to carve a niche in their domain.
4. Instill the principles and ethics learnt from the field of study and exhibit the qualities like leadership, entrepreneurship and teamwork for discharging their duties as responsible citizens.
5. Utilize the growing advancements in Information and Communication Technology and embrace digital learning to become life-long learners.

Under Choice Based Credit System (CBCS)

Post Graduate Courses

G.T.N. Arts College (Autonomous), a pioneer in higher education institution in India, strives to work towards the academic excellence. The new Outcome Based Education (OBE) system allows enhanced academic mobility and enriched employability for the students. At the same time this system preserves the identity, autonomy and uniqueness of every department and reinforces their efforts to be student centric curriculum designing and skill imparting. This new system will work concertedly to achieve and accomplish the following objectives:

1. Optimal utilization of resources both human and material for the academic flexibility leading to exemplary outcome.
2. Students experience or enjoy their choice of courses and credits for their horizontal mobility.
3. The existing curricular structure as specified by TANSCHE and other higher educational institutions facilitate the Credit- Transfer Across the Disciplines (CTAD) - a uniqueness of the Choice Based Credit System.

What is Credit System?

Weightage to a course is given in relation to the hours assigned for the course. Generally, one hour per week has one credit. For viability and conformity to the guidelines credits are awarded irrespective of the teaching hours. The following table shows the correlation between credits and hours. However, there could be some flexibility because of practical’s, field visits, tutorials and nature of the project work.

Course Pattern for M.Sc Degree

The Post Graduate degree course consists of five vital components. They are as follows:

Part III Core Courses (Theory, Electives, NME, Project).

Objectives

The Syllabus for M.Sc Degree Programme under semester system has been designed on the basis of Choice Based Credit System (CBCS), which would focus on job oriented programmes and value added education. It will come into effect from June 2020 onwards.

Eligibility

Candidates should have passed the Higher Secondary Examination, Government of Tamil Nadu or any other examination accepted by the syndicate of Madurai Kamaraj University as equivalent there to.

Duration of the Course

The students who join the M.Sc Degree Programme shall undergo a study period of two academic years – Four semesters.

SUMMARY OF HOURS AND CREDITS

<table>
<tr><th>Part</th><th>Semester</th><th>Specification</th><th>No. of Courses</th><th>Hrs</th><th>Credit</th><th>Total credits</th></tr>
<tr><td rowspan="4">III</td><td>I-IV</td><td>Core Courses</td><td>16</td><td>96</td><td>80</td><td rowspan="3">100</td></tr>
<tr><td>I-IV</td><td>Core Electives Courses</td><td>2</td><td>12</td><td>10</td></tr>
<tr><td>III</td><td>Non Major Elective Courses</td><td>1</td><td>6</td><td>5</td></tr>
<tr><td>IV</td><td>Project</td><td>1</td><td>6</td><td>5</td><td>100</td></tr>
<tr><td colspan="4">Overall Total for all Semesters</td><td>120</td><td>100</td><td></td></tr>
</table>

Programme Specific Outcomes (PSOs)

PSO1 Apply the multidisciplinary knowledge in pure, applied mathematics and non-major elective in mathematical science and capability of developing ideas based on them.

PSO2 Inculcate critical thinking to evaluate hypotheses, theories, methods and evidence within their proper contexts.

PSO3 Solve complex problems by critical understanding analysis and synthesis.

PSO4 Develop proficiency in preparing competitive examinations and empowering the students to pursue higher degrees.

PSO5 Recognize the need to engage in lifelong learning through continuing education and research critical thinking.

Course Pattern – from 2020-2021 Batch

Sem.	Part	Study Component	Course Code	Course Title	Hrs	Credit
I	III	Core Course I	20PMAC11	Algebra-I	6	5
		Core Course II	20PMAC12	Analysis-I	6	5
		Core Course III	20PMAC13	Ordinary Differential Equations	6	5
		Core Course IV	20PMAC14	Numerical Analysis	6	5
		Core Course V	20PMAC15	Integral Equations	6	5
				TOTAL	**30**	**25**
II	III	Core Course VI	20PMAC21	Algebra-II	6	5
		Core Course VII	20PMAC22	Analysis- II	6	5
		Core Course VIII	20PMAC23	Partial Differential Equations	6	5
		Core Course IX	20PMAC24	Operations Research	6	5
		Core Course X	20PMAC25	Calculus of Variations	6	5
				TOTAL	**30**	**25**
III	III	Core Course XI	20PMAC31	Linear Algebra	6	5
		Core Course XII	20PMAC32	Measure Theory	6	5
		Core Course XIII	20PMAC33	Topology	6	5
		Elective Course I	20PMAE31	Graph Theory	6	5
		Elective Course II	20PMAE32	Number Theory	6	5
		Non Major Elective Course	20PMAN31	Mathematics for Competitive Examinations		
				TOTAL	**30**	**25**
IV	III	Core Course XIV	20PMAC41	Complex Analysis	6	5
		Core Course XV	20PMAC42	Functional Analysis	6	5
		Core Course XVI	20PMAC43	Differential Geometry	6	5
		Core Course	20PMAC4P	PROJECT	6	5
		Elective Course III	20PMAE41	Probability and Statistics	6	5
		Elective Course IV	20PMAE42	Classical Mechanics		
				TOTAL	**30**	**25**

Programme	**M.Sc**	**Programme code**	**PMA**
Course Code	**20PMAC11**	**Number of Hours**	**6**
Semester	**I**	**Max. Marks**	**100**
Part	**III**	**Credit**	**5**
CORE COURSE I			
Course Title	**ALGEBRA – I**		
Cognitive level upto K5			

Preamble

This course deals with basic concepts of groups, subgroups, cyclic groups, fundamental theorem of finite Abelian groups, Sylow theorems and some special concepts of rings.

Unit – I **17 Hours**

Groups – Definition and Examples - Elementary properties of Groups –Socks – Shoes property - Finite Groups – Subgroups – Subgroup tests – Examples of subgroups - Center of a group.

Unit – II **18 Hours**

Cyclic groups – Properties of cyclic groups – Classification of Subgroups of Cyclic groups – Fundamental theorem on Cyclic groups – Isomorphisms – Definition and Examples – Cayley's Theorem – Properties of isomorphisms – Automorphisms.

Unit – III **22 Hours**

Cosets and Lagrange's Theorem - Properties of Cosets – Lagrange's Theorems and Consequences – An application of cosets to permutation groups – Orbit-Stabilizer Theorem - External Direct Products - Normal Subgroups – Group Homomorphism – Properties of Homomorphisms.

Unit – IV **15 Hours**

Fundamental theorem of finite abelian groups – Greedy Algorithm – Existence of Subgroups of Abelian Groups - Conjugacy Classes – The class equation – Sylow theorems.

Unit – V **18 Hours**

Rings - Some special classes of rings – Homomorphisms of rings - Ideal and Quotient Ring.

Pedagogy

Chalk and talk, Power point presentation, Group Discussion.

Text Books

1. Joseph A. Gallian., (2019), *Contemporary Abstract Algebra*, 9th edition, Cengage Learning, USA.
2. Herstein. I.N.,(2007) ,*Topics in Algebra*, John Wiley and Sons, United States of America.

Reference Books

1. Vijay Khanna. K.,and Bhambri.S., (1999), *A Course in Abstract Algebra*,Vikas Publication House Pvt. Limited, New Delhi.
2. Judson, (2017), *Abstract Algebra Theory and application*, PWS Publishing Edition, USA.
3. David S. Dummit and Richard M. Foote., (1999), Abstract Algebra, Wiley Student Edition.

E- Resources

- https://nptel.ac.in/courses/111/106/111106137/
- https://nptel.ac.in/courses/111/105/111105112/
- https://nptel.ac.in/courses/111/102/111102009/
- https://math.berkeley.edu/~apaulin/AbstractAlgebra.pdf
- https://youtu.be/v1czvv-7vdQ

Course Outcomes

At the end of the course, students would be able to:

CO1	Discuss the elementary properties of groups.
CO2	Define cyclic groups and use its properties.
CO3	Illustrate the lagrange's theorem and apply the cosets to permutation groups.
CO4	Define conjugacy relation, analyze the proof of Sylow's theorems.
CO5	Explain Ideals, Quotient Ring.

Mapping of Course Outcomes (COs) with Programme Specific Outcomes (PSOs)

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	**2**	**0**	**0**	**2**	**0**
CO2	**2**	**0**	**2**	**2**	**0**
CO3	**2**	**0**	**0**	**0**	**0**
CO4	**2**	**2**	**2**	**3**	**2**
CO5	**2**	**0**	**2**	**0**	**0**

1 - Low, 2 - Medium and 3 – High

Articulation Mapping - K Levels with Course Outcomes (COs)

Units	Cos	K – Level	Section A		Section B	Section C
			MCQs		Either/or Choice	Open Choice
			No. of Questions	K-Level	No. Of Questions	No. Of Questions
1	CO1	Upto K2	2	K1 & K2	2(K2&K2)	K2
2	CO2	Upto K3	2	K1 & K2	2(K2&K2)	K3
3	CO3	Upto K3	2	K1 & K2	2(K2&K2)	K3
4	CO4	Upto K4	2	K1 & K2	2(K3&K3)	K4
5	CO5	Upto K5	2	K1 & K2	2(K3&K3)	K5
No of Questions to be asked			10		10	5
No of Questions to be answered			10		5	3
Marks for each Question			1		4	10
Total Marks for each Section			10		20	30

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

Distribution of Section –wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (Either/or)	Section C (Open Choice)	Total Marks	% of Marks without choice	Consolidated (Rounded off)
K1	5			05	05	05
K2	5	24	10	39	39	39
K3		16	20	36	36	36
K4			10	10	10	10
K5			10	10	10	10
Total Marks	10	40	50	100	100	100

LESSON PLAN

UNIT	DESCRIPTION	HOURS	MODE
Unit I	a) Groups, Definition and Examples b) Elementary properties of Groups c) Finite Groups d) Subgroups, Subgroup tests, Examples of subgroups e) Center of a group	4 4 2 4 3	Chalk and talk, Power point presentation
Unit II	a) Cyclic groups, Properties of cyclic groups b) Classification of Subgroups of Cyclic groups, Fundamental theorem on Cyclic groups c) Isomorphisms, Definition and Examples d) Cayley's Theorem, Properties of isomorphisms, Automorphisms	4 5 4 5	Chalk and talk, Power point presentation
Unit III	a) Cosets and Lagrange's Theorem, Properties of Cosets b) Lagrange's Theorems and Consequences, An application of cosets to permutation groups c) Orbit-Stabilizer Theorem, External Direct Products d) Normal Subgroups, Group Homomorphism, Properties of Homomorphisms	6 6 5 5	Chalk and talk, Power point presentation
Unit IV	a) Fundamental theorem of finite abelian groups, Greedy Algorithm b) Existence of Subgroups of Abelian Groups c) Conjugacy Classes, The class equation d) Sylow theorems	4 3 3 5	Chalk and talk, Power point presentation
Unit V	a) Rings b) Some special classes of rings c) Homomorphisms of rings d) Ideal and Quotient Ring	4 5 3 6	Chalk and talk, Power point presentation, Group Discussion

Course Designed by: Mrs. N. Sumathi, Mr. A. Mohamed Ali

Programme	M.Sc	Programme code	PMA
Course Code	**20PMAC12**	**Number of Hours**	**6**
Semester	**I**	**Max. Marks**	**100**
Part	**III**	**Credit**	**5**
CORE COURSE II			
Course Title	**ANALYSIS – I**		
Cognitive level upto K4			

Preamble

This course establish with concept of metric space, continuity, differentiability and Riemann-Stieltjes Integral.

Unit I The Real Number Systems **15 Hours**

Ordered set – Fields – The Real Fields - The Extended Real Number System - Euclidean Spaces - Finite set - Countable and Uncountable set.

Unit II Basic Topology **15 Hours**

Metric spaces with examples - Neighborhood - Open sets - Closed sets - Compact sets - Perfect sets - the Cantor set - Connected sets.

Unit III Continuity **22 Hours**

Limits of Function - Continuous Functions - Continuity and Compactness - Continuity and Connectedness - Discontinuities and Monotonic Functions.

Unit IV Differentiation **18 Hours**

Derivative of a real function - Mean value theorem - Continuity of derivatives - L'Hospital's Rule - Derivatives of higher order - Taylor's theorem – Differentiation of vector-valued Functions.

Unit V The Riemann-Stieltjes Integral **20 Hours**

Definitions and existence of the Integral - Properties of the Integral - Integration and Differentiation - Integration of vector valued functions - Rectifiable curves.

Pedagogy

Chalk and talk, Power point presentation, Group Discussion.

Text Books

1. Walter Rudin, (2013), *Principles of Mathematical Analysis*, McGraw - Hill-Education Private Limited, India.

Reference Books

1. Malik S.C. and SavitaArora, (1991), *Mathematical Analysis*, Wiley Eastern Limited, New Delhi.
2. Gupta.A.L., and Gupta.N.R., (2003), *Principles of Real Analysis*, Pearson Education, (Indian print).
3. Roydon.H.L., (1988), *Real Analysis*, Macmillan, New York,Third Edition.

E - Resources

- https://www.math.stonybrook.edu/~aknapp/download/b2-realanal-inside
- https://www.jirka.org/ra/realanal.pdf
- https://www.mathcity.org/msc/real_analysis_notes_by_syed_gul_shah
- https://www.math.lsu.edu/~sengupta/4031f06/IntroRealAnalysNotes.pdf
- https://nptel.ac.in/courses/111/105/111105098/

Course Outcomes

At the end of the course, students would be able to:

CO1	Apply the domain knowledge of finite, countable and uncountable sets.
CO2	Discuss the concepts of metric spaces and illustrate with examples.
CO3	Demonstrate the concepts of continuous functions.
CO4	State mean value theorem and Taylor's theorem and discuss L'Hospital's rule.
CO5	Explain Riemann-Stieltjes Integral and compute the arc length.

Mapping of Course Outcomes (COs) with Programme Specific Outcomes (PSOs)

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	0	3	3	0
CO2	3	0	2	3	2
CO3	3	2	3	3	0
CO4	0	0	0	2	0
CO5	3	0	3	3	2

1 - Low, 2 - Medium and 3 – High

Articulation Mapping - K Levels with Course Outcomes (COs)

Units	COs	K – Level	Section A		Section B	Section C
			MCQs		Either/or Choice	Open Choice
			No. of Questions	K-Level	No. of Questions	No. of Questions
1	CO1	Up to K3	2	K1 & K2	2(K2&K2)	K3
2	CO2	Up to K3	2	K1 & K2	2(K2&K2)	K3
3	CO3	Up to K3	2	K1 & K2	2(K3&K3)	K3
4	CO4	Up to K2	2	K1 & K2	2(K1&K1)	K2
5	CO5	Up to K4	2	K1 & K2	2(K3&K3)	K4
No of Questions to be asked			10		10	5
No of Questions to be answered			10		5	3
Marks for each Question			1		4	10
Total Marks for each Section			10		20	30

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

Distribution of Section –wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (Either/or)	Section C (Open Choice)	Total Marks	% of Marks without choice	Consolidated (Rounded off)
K1	5	8		13	13	13
K2	5	16	10	31	31	31
K3		16	30	46	46	46
K4			10	10	10	10
Total Marks	10	40	50	100	100	100

LESSON PLAN

UNIT	DESCRIPTION	HOURS	MODE
I-The Real Number Systems	a) Ordered set, Fields, The Real Fields	4	Chalk and talk, Power point presentation
	b) The Extended Real Number System	4	
	c) Euclidean Spaces	2	
	d) Countable and Uncountable set	5	
II-Basic Topology	a) Metric spaces with examples	3	Chalk and talk, Power point presentation
	b) Neighborhood, Open sets, Closed sets	4	
	c) Compact sets, Perfect sets	4	
	d) Cantor set, Connected sets	4	
III-Continuity	a) Limits of Function, Continuous Functions	5	Chalk and talk, Power point presentation
	b) Continuity and Compactness	6	
	c) Continuity and Connectedness	6	
	d) Discontinuities and Monotonic Functions	5	
IV-Differentiation	a) Derivative of a real function, Mean value theorem	5	Chalk and talk, Power point presentation
	b) Continuity of derivatives, L'Hospital's Rule	5	
	c) Derivatives of higher order	4	
	d) Taylor's theorem, Differentiation of vector-valued Functions	4	
V-The Riemann-Stieltjes Integral	a) Definitions and existence of the Integral, Properties of the Integral	4	Chalk and talk, Power point presentation, Group Discussion
	b) Integration and Differentiation	6	
	c) Integration of vector valued functions	6	
	d) Rectifiable curves	4	

Course Designed by: Mrs. S. Lathamaheswari, Mr. A.Mohamed Ali

Programme	**M.Sc**	**Programme code**	**PMA**
Course Code	**20PMAC13**	**Number of Hours**	**6**
Semester	**I**	**Max. Marks**	**100**
Part	**III**	**Credit**	**5**
CORE COURSE III			
Course Title	**ORDINARY DIFFERENTIAL EQUATIONS**		
Cognitive level upto K5			

Preamble

This course provides mathematical methods to solve Picard's iterative method of successive approximation, existence and uniqueness theorem, singular solutions and homogeneous linear equations and solving method of variation of parameters and understand the concept of Sturm- Liouville's problems and solve the reality of eigen value.

Unit – I Picard's Iterative Method **16 Hours**

Introduction – Picard's method of successive approximation – Problems of existence and uniqueness – Lipschitz condition – Picard's theorem - Existence and uniqueness theorem.

Unit – II Singular Solutions **18 Hours**

Introduction – Relation between the singular solution of a differential equation and the envelope of the family of curves represented by that differential equation – C-discriminant and P-discriminant relations – Determination of singular solutions.

Unit – III Homogeneous Linear Equation **20 Hours**

Homogeneous linear equation (or Cauchy –Euler equation) – Method of solution of homogeneous linear differential equations – Equations reducible to homogeneous linear form in Legendre's linear equations.

Unit – IV Method of Variation of Parameters **18 Hours**

Method of variation of parameters for solving first order differential equations - Method of variation of parameters for solving second order differential equations - Method of variation of parameters for solving third order differential equations.

Unit – V Sturm-Liouville Problem **18 Hours**

Sturm-Liouville equations - Characteristic functions and characteristic values - Orthogonality of eigen functions - Reality of eigen values.

Pedagogy

Chalk and talk, Power point presentation, Group Discussion.

Text Books

1. Raisinghania. M.D., (2012), *Ordinary and Partial Differential equations*, S.Chand and company Ltd, New Delhi, Fourteenth Revised Edition,
2. Raisinghania. M.D., (2015), *Advanced differential equations*, S. Chand and company Ltd, New Delhi, Eighteenth Revised Edition.

Reference Books

1. Sanchez.D.A.,(1968), *Ordinary Differential Equations and Stability Theory*, W.H.Freeman& Co. San Francisc, USA.
2. Nandhakumaran.A.K.,(2017), *Ordinary Differential Equations*, Cambridge university press, United Kingdom.
3. Richard Bronson., (2017), *Differential Equations*, McGraw-Hill publications, India.

E - Resources

- https://www.cs.bgu.ac.il/~leonid/ode_bio_files/Ionascu_LectNotes.pdf
- https://math.mit.edu/~jorloff/suppnotes/suppnotes03/1803SupplementaryNotes_full.pdf
- https://nptel.ac.in/courses/111/106/111106100/#
- https://users.math.msu.edu/users/gnagy/teaching/ode.pdf
- https://www.researchgate.net/publication/228599358_Lecture_Notes_Mathematics_M544_Ordinary_differential_equations

Course Outcomes

At the end of the course, students would be able to:

CO1	Summarize the Picard's theorem and existence and uniqueness theorem.
CO2	Explain and solve of singular solutions.
CO3	Solve the homogeneous equations and the Legendre's linear equation.
CO4	Illustrate the method of variation of parameters.
CO5	Explain Sturm-Liouville's problems and orthogonality of eigen functions.

Mapping of Course Outcomes (COs) with Programme Specific Outcomes (PSOs)

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	0	2	2	2
CO2	2	0	2	3	0
CO3	3	2	3	3	0
CO4	3	2	3	3	0
CO5	3	2	3	3	0
1 - Low, 2 - Medium and 3 – High					

Articulation Mapping - K Levels with Course Outcomes (COs)

Units	COs	K – Level	Section A MCQs		Section B Either/or Choice	Section C Open Choice
			No. Of Questions	K-Level	No. Of Questions	No. Of Questions
1	CO1	Up to K2	2	K1&K2	2(K2&K2)	K2
2	CO2	Up to K3	2	K1&K2	2(K2&K2)	K3
3	CO3	Up to K3	2	K1&K2	2(K2&K2)	K3
4	CO4	Up to K4	2	K1&K2	2(K3&K3)	K4
5	CO5	Up to K5	2	K1&K2	2(K3&K3)	K5
No of Questions to be asked			10		10	5
No of Questions to be answered			10		5	3
Marks for each Question			1		4	10
Total Marks for each Section			10		20	30

K1 – Remembering and recalling facts with specific answers

K2 – Basic understanding of facts and stating main ideas with general answers

K3 – Application oriented – Solving problems

K4 – Examining, analyzing, presentation and make inferences with evidences

Distribution of Section –wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (Either/or)	Section C (Open Choice)	Total Marks	% of Marks without choice	Consolidated (Rounded off)
K1	5			05	05	05
K2	5	24	10	39	39	39
K3		16	20	36	36	36
K4			10	10	10	10
K5			10	10	10	10
Total Marks	10	40	50	100	100	100

LESSON PLAN

UNIT	DESCRIPTION	HOURS	MODE
I-Picard's Iterative Method	a) Introduction Picard's method of successive approximation b) problems of existence and uniqueness c) Lipschitz condition d) Picard's theorem - Existence and uniqueness theorem	4 4 4 4	Chalk and talk
II- Singular Solutions	a) Introduction b) Relation between the singular solution of a differential equation and the envelope of the family of curves represented by that differential equation c) C-discriminant and P-discriminant relations d) Determination of singular solutions	2 6 5 5	Chalk and talk
III-Homogeneous Linear Equation	a) Introduction b) Homogeneous linear equation (or Cauchy –Euler equation) c) Method of solution of homogeneous linear differential equations d) Equations reducible to homogeneous linear form in Legendre's linear equations	3 6 6 5	Chalk and talk, Power point presentation
IV-Method of Variation of Parameters	a) Introduction b) Method of variation of parameters for solving first order differential equations c) Method of variation of parameters for solving second order differential equations d) Method of variation of parameters for solving third order differential equations	2 4 6 6	Chalk and talk
V-Sturm-Liouville Problem	a) Sturm-Liouville equations b) Characteristic functions and characteristic values c) Orthogonality of eigen functions d) Reality of eigen values	4 5 5 4	Chalk and talk, Power point presentation

Course Designed by: Mrs. N. Sumathi, Mrs. S. Lathamaheswari

Programme	M.Sc	Programme code	PMA
Course Code	**20PMAC14**	**Number of Hours**	**6**
Semester	**I**	**Max. Marks**	**100**
Part	**III**	**Credit**	**5**
CORE COURSE IV			
Course Title	**NUMERICAL ANALYSIS**		
Cognitive level upto K5			

Preamble

This course deals with the methods of solving linear algebraic equations, evaluation of definite integral, solving ordinary differential equations with boundary conditions.

Unit – I Transcendental and Polynomial Equations **18 Hours**

Iteration methods based on second degree equation -Chebyshev method - Multipoint iteration methods - Birge-Vieta method - Bairstow method - Graeffe's root squaring method.

Unit – II System of Linear Algebraic Equations and Eigen value problems **17 Hours**

Iteration methods – Jacobi method – Guass-Seidel Method – Successive over relaxation method – Iterative method for A^{-1} – Jacobi method for symmetric matrices – Power method.

Unit – III Interpolation and Approximation **22 Hours**

Hermite interpolation - Piecewise linear interpolation – Piecewise quadratic interpolation –Piecewise cubic interpolation using Hermite Type data – Quadratic and Cubic Spline interpolation – Lagrange and orthogonalizing process - Newton's Gram-Schmidt bivariate interpolation.

Unit – IV Differentiation and Integration **18 Hours**

Methods based on interpolation - Partial Differentiation – Numerical integration: Methods Based on interpolation – Methods Based on undetermined coefficients – Guass Quadrature methods - Guass–Legendre and Guass-Chebyshev integration methods - Methods Based on Composite integration methods - Romberg Integration - Double integration.

Unit – V Ordinary Differential Equation for Initial value problem **15 Hours**

Numerical methods - Euler method – Runge-Kutta methods – Mid-Point method - Predictor-Corrector methods.

Pedagogy

Chalk and talk, Power point presentation, Group Discussion.

Text Books

1. Jain .M. K., Iyengar.S. R. K., and Jain.R. K.,(2012), *Numerical Methods for Scientific and Engineering Computation*, New Age International Publishers, New Delhi, Sixth Edition, Reprint.

Reference Books

1. Chapra. S.C., and Raymond. P.C., (2000), *Numerical Methods for Engineers*, Tata McGraw Hill, New Delhi.
2. Sastry .S.S., (1998), *Introductory Methods of Numerical Analysis*, Prentice Hall of India New-Delhi.
3. **Francis Scheid, (2008), *Numerical Analysis*, McGraw Hill Education, India.**

E - Resources

- https://nptel.ac.in/courses/111/107/111107062/
- https://nptel.ac.in/courses/111/101/111101003/
- https://www.math.ust.hk/~machas/numerical-methods.pdf
- http://www.math.iitb.ac.in/~baskar/book.pdf
- http://people.cs.uchicago.edu/~ridg/newna/nalrs.pdf

Course Outcomes

At the end of the course, students would be able to:

CO1 Recall and solve the problems by using iteration methods on second degree.

CO2 Solve the approximate solution to the given problems.

CO3 Determine and solve the interpolation.

CO4 Apply the numerical techniques to find the derivative at a point and evaluate definite integrals.

CO5 Apply and classify various method to solve the problems.

Mapping of Course Outcomes (COs) with Programme Specific Outcomes (PSOs)

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	0	3	3	0
CO2	2	3	2	2	0
CO3	0	2	2	3	0
CO4	3	3	2	3	0
CO5	3	2	2	2	0

1 - Low, 2 - Medium and 3 – High

Articulation Mapping - K Levels with Course Outcomes (COs)

Units	COs	K – Level	Section A MCQs		Section B Either/or Choice	Section C Open Choice
			No. Of Questions	K-Level	No. Of Questions	No. Of Questions
1	**CO1**	Up to K3	2	K1&K2	2(K2&K2)	K3
2	**CO2**	Up to K3	2	K1&K2	2(K2&K2)	K3
3	**CO3**	Up to K5	2	K1&K2	2(K3&K3)	K5
4	**CO4**	Up to K3	2	K1&K2	2(K2&K2)	K3
5	**CO5**	Up to K4	2	K1&K2	2(K3&K3)	K4
No of Questions to be asked			10		10	5
No of Questions to be answered			10		5	3
Marks for each Question			1		4	10
Total Marks for each Section			10		20	30

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

Distribution of Section –wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (Either/or)	Section C (Open Choice)	Total Marks	% of Marks without choice	Consolidated (Rounded off)
K1	5			05	05	05
K2	5	24		29	29	29
K3		16	30	46	46	46
K4			10	10	10	10
K5			10	10	10	10
Total Marks	10	40	50	100	100	100

LESSON PLAN

UNIT	DESCRIPTION	HOURS	MODE
I-Transcendental and Polynomial Equations	a) Iteration methods based on second degree equation. b) Chebyshev method c) Multipoint iteration methods d) Birge-Vieta method e) Bairstow method f) Graeffe's root squaring method	3 3 3 3 3 3	Chalk and talk, Power point presentation
II-System of Linear Algebraic Equations and Eigen value problems	a) Iteration methods b) Jacobi method c) Guass-Seidel Method d) Successive over relaxation method e) Iterative method for A^{-1} f) Jacobi method for symmetric matrices g) Power method	2 2 2 3 3 2 3	Chalk and talk
III-Interpolation and Approximation	a) Hermite interpolation b) Piecewise linear interpolation c) Piecewise quadratic interpolation d) Piecewise cubic interpolation using Hermite Type data e) Quadratic and Cubic Spline interpolation f) Lagrange and orthogonalizing process g) Newton's Gram-Schmidt bivariate interpolation	3 3 4 3 3 3 3	Chalk and talk, Power point presentation
IV Differentiation and Integration	a) Methods based on interpolation in differentiation b) Partial Differentiation c) Methods based on interpolation in integration d) Methods Based on undetermined coefficients e) Guass-Quadrature methods f) Guass–Legendre and Guass-Chebyshev integration methods g) Methods Based on Composite integration methods h) Romberg Integration i) Double integration	2 2 2 2 2 2 2 2 2	Chalk and talk, Power point presentation
V-Ordinary Differential Equation for Initial value problem	a) Numerical methods b) Euler method c) Runge-Kutta methods d) Mid-Point method e) Predictor-Corrector methods	2 3 4 3 3	Chalk and talk, Power point presentation

Course Designed by: Mrs. K.Sujatha, Mrs. N. Sumathi

Programme	M.Sc	Programme code	PMA
Course Code	20PMAC15	Number of Hours	6
Semester	I	Max. Marks	100
Part	III	Credit	5
CORE COURSE V			
Course Title	INTEGRAL EQUATIONS		
Cognitive level upto K5			

Preamble

This course deals with method of solving linear and non-linear integral equations, types of kind in fredholm and volterra integral equations and finding kernels.

Unit – I Linear and Non-Linear Integral Equations **18 Hours**

Integral equation – Definition – Linear and Non-linear integral equations – Fredholm integral equation of the First, Second and Third kind – Volterra integral equation of the First, Second and Third kind – Homogeneous Fredholm and Volterra integral equation of second kind - Leibnit'z rule of differentiation - special kinds of kernals.

Unit – II Initial Value Problem **18 Hours**

Introduction – Initial value problem – Method of converting an initial value problem into a Volterra integral equation – Alternative method of converting an initial value problem into a Volterra integral equation – Boundary value problem – Method of converting a boundary value problem into a Fredholm integral equation.

Unit – III Homogeneous Fredholm Integral Equation **20 Hours**

Homogeneous Fredholm integral equation of the second kind – Characteristic values – Characteristic functions - Solution of homogeneous Fredholm integral equation of the second kind with separable kernels.

Unit – IV Separable Kernels **15 Hours**

Fredholm integral equations of the second kind with separable kernels – solution of Fredholm integral equations of the second kind with degenerate kernels - Fredholm alternative theorem - An approximate method.

Unit – V Successive Approximations **19 Hours**

Method of successive approximations – Iterated kernals – Resolvant kernals - Solution of Fredholm and Volterra integral equation of the second kind by successive approximations of type I, II,III and IV – Neumann series – iterative method – Reciprocal functions.

Pedagogy

Chalk and talk, Power point presentation, Group Discussion.

Text Books

1. Raisinghania.M.D., (2010), *Integral Equations and Boundary Valued Problems*, S.Chand Publication, New Delhi.

Reference Books

1. Sharma.D.C., and Goyal. M.C., (2017), *Integral equations*, PHI learning publications, New Delhi.
2. Tricomi.F.G.,(2012), *Integral equations*, Dover publications, New York.
3. Rahman M., (2007), Integral Equations and Their Applications, WIT Press, USA.

E- Resources

- https://nptel.ac.in/courses/111/104/111104025/
- https://math.mit.edu/classes/18.086/2006/am72.pdf
- http://matematika.cuni.cz/dl/pyrih/variationProblems/variationProblems.pdf
- https://www.et.byu.edu/~vps/ET502WWW/NOTES/CH7m.pdf
- https://www.researchgate.net/publication/275518932_Handbook_of_Integral_Equations_Second_Edition

Course Outcomes

At the end of the course, students would be able to:

CO1	Demonstrate and solve the concept of Fredholm and Volterra integral equations.
CO2	Compute ordinary differential equation into integral equation and viceversa.
CO3	Solve the homogeneous Fredholm integral equations of the second kind using characteristic values and its function.
CO4	Estimate Fredholm integral equations of the second kind with separable kernels
CO5	Classify and explain to find iterated kernals and reciprocal functions.

Mapping of Course Outcomes (Cos) with Programme Specific Outcomes (PSOs)

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	0	2	2	0
CO2	2	0	2	2	0
CO3	2	0	2	2	0
CO4	2	0	2	2	0
CO5	2	0	2	2	2

1 – Low, 2 – Medium and 3 – High

Articulation Mapping – K Levels with Course Outcomes (Cos)

Units	Cos	K – Level	Section A		Section B	Section C
			MCQs		Either/or Choice	Open Choice
			No. Of Questions	K-Level	No. Of Questions	No. Of Questions
1	CO1	Up to K3	2	K1 & K2	2(K2&K2)	K3
2	CO2	Up to K3	2	K1 & K2	2(K2&K2)	K3
3	CO3	Up to K3	2	K1 & K2	2(K2&K2)	K3
4	CO4	Up to K5	2	K1 & K2	2(K3&K3)	K5
5	CO5	Up to K4	2	K1 & K2	2(K3&K3)	K4
No of Questions to be asked			10		10	5
No of Questions to be answered			10		5	3
Marks for each Question			1		4	10
Total Marks for each Section			10		20	30

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

Distribution of Section –wise Marks with K Levels

Distribution of Section –wise Marks with K Levels K Levels	Section A (No Choice)	Section B (Either/or)	Section C (Open Choice)	Total Marks	% of Marks without choice	Consolidated (Rounded off)
K1	5			05	05	05
K2	5	24		29	29	29
K3		16	30	46	46	46
K4			10	10	10	10
K5			10	10	10	10
Total Marks	10	40	50	100	100	100

LESSON PLAN

UNIT	DESCRIPTION	HOURS	MODE
I-Linear and Non-Linear Integral Equations	a) Definition, Linear and Non-linear integral equations b) Fredholm integral equation of the First, Second and Third kind c) Volterra integral equation of the First, Second and Third kind d) Homogeneous Fredholm and Volterra integral equation of second kind e) Leibnit’z rule of differentiation, special kinds of kernals	3 5 4 3 3	Chalk and talk, Power point presentation
II-Initial Value Problem	a) Introduction, Initial value problem Boundary value problem b) Method of converting an initial value problem into a Volterra integral equation c) Alternative method of converting an initial value problem into a Volterra integral equation d) Method of converting a boundary value problem into a Fredholm integral equation	3 5 5 5	Chalk and talk, Power point presentation
III-Homogeneous Fredholm Integral Equation	a) Homogeneous Fredholm integral equation of the second kind b) Characteristic values c) Characteristic functions d) Solution of homogeneous Fredholm integral equation of the second kind with separable kernels	6 4 4 6	Chalk and talk, Power point presentation
IV-Separable Kernels	a) Fredholm integral equations of the second kind with separable kernels b) Solution of Fredholm integral equations of the second kind with degenerate kernels c) Fredholm alternative theorem d) An approximate method	5 5 3 2	Chalk and talk, Power point presentation
V-Successive Approximations	a) Method of successive approximations, Iterated kernals, Resolvant kernals b) Solution of Fredholm and Volterra integral equation of the second kind by successive approximations of type I, II,III and IV c) Neumann series, iterative method d) Reciprocal functions	3 6 5 5	Chalk and talk, Power point presentation

Course Designed by: Mrs. K.Sujatha, Mrs. N. Sumathi

Programme	**M.Sc**	**Programme code**	**PMA**
Course Code	**20PMAC21**	**Number of Hours/cycle**	**6**
Semester	**II**	**Max. Marks**	**100**
Part	**III**	**Credit**	**5**
CORE COURSE VI			
Course Title	**Algebra – II**		
Cognitive level upto K4			

Preamble

This course deals with more Ideals and Quotient rings, Euclidean rings, Polynomial rings and Galois Theory.

Unit – I **17 Hours**

More Ideals and Quotient Rings - the field of Quotients of an Integral Domain - Euclidean rings - Principle ideal ring - Prime element - A particular Euclidean Ring.

Unit – II **18 Hours**

Polynomial Rings - Polynomials over the rational field - Polynomial Rings over commutative rings.

Unit – III **22 Hours**

Fields - Extension fields –Finite Extension – Algebraic Extension - Transcendence of e – Roots of a polynomials – Remainder Theorem – Factor Theorem – Splitting fields – Uniqueness of splitting fields.

Unit – IV **15 Hours**

More about roots – Finite Fields – Simple Extension.

Unit– V **18 Hours**

The Elements of Galois theory – Fixed Field – Elementary symmetric functions – Normal Extension – Galois group.

Text Books

1. Herstein. I.N., (2007), *Topics in Algebra*, John Wiley and Sons, United States of America.

Reference Books

1. Joseph Gallian., (2009), *Contemporary Abstract Algebra*, Cengage Learning, USA.
2. Vijay Khanna. K.,andBhambri.S., (1999), *A Course in Abstract Algebra*,Vikas Publication House Pvt. Limited, New Delhi.
3. Judson, (2017), *Abstract Algebra Theory and Application*, PWS Publishing Edition, USA.

E- Resources

- https://nptel.ac.in/courses/111/106/111106137/
- https://nptel.ac.in/courses/111/105/111105112/
- https://nptel.ac.in/courses/111/102/111102009/
- https://math.berkeley.edu/~apaulin/AbstractAlgebra.pdf
- https://youtu.be/v1czvv-7vdQ

Pedagogy

Chalk and talk, Power point presentation, Group Discussion.

Course Outcomes

At the end of the course, students would be able to:

CO1 Discuss the more ideals and quotient rings.
CO2 Discuss the polynomial rings.
CO3 Explain the concept of fields and compute roots of the polynomial.
CO4 Explain the finite fields and analyze simple extension.
CO5 Explain the elements of Galois theory and analysis fixed field.

Mapping of Course Outcomes (COs) with Programme Specific Outcomes (PSOs)

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**2**	**0**	**2**	**2**	**0**
CO2	**2**	**0**	**0**	**2**	**0**
CO3	**2**	**0**	**2**	**2**	**0**
CO4	**2**	**2**	**2**	**2**	**2**
CO5	**0**	**2**	**2**	**0**	**2**

1 - Low, 2 - Medium and 3 – High

Articulation Mapping - K Levels with Course Outcomes (COs)

Units	Cos	K – Level	Section A MCQs		Section B Either/or Choice	Section C Open Choice
			No. of Questions	K-Level	No. of Questions	No. of Questions
1	CO1	Up to K2	2	K1 & K2	2(K2&K2)	K2
2	CO2	Up to K2	2	K1 & K2	2(K2&K2)	K2
3	CO3	Up to K3	2	K1 & K2	2(K2&K2)	K3
4	CO4	Up to K3	2	K1 & K2	2(K3&K3)	K3
5	CO5	Up to K4	2	K1 & K2	2(K3&K3)	K4
No of Questions to be asked			10		10	5
No of Questions to be answered			10		5	3
Marks for each Question			1		4	10
Total Marks for each Section			10		20	30

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

Distribution of Section –wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (Either/or)	Section C (Open Choice)	Total Marks	% of Marks without choice	Consolidated (Rounded off)
K1	5			05	05	05
K2	5	24	20	49	49	49
K3		16	20	36	36	36
K4			10	10	10	10
Total Marks	10	40	50	100	100	100

LESSON PLAN

UNIT	DESCRIPTION	HOURS	MODE
Unit – I	a. More Ideals and Quotient Rings b. the field of Quotients of an Integral Domain, Euclidean rings c. Principle ideal ring, Prime element d. A particular Euclidean Ring	4 5 4 4	Chalk and talk, Power point presentation
Unit II	a. Polynomial Rings b. Polynomials over the rational field c. Polynomial Rings over commutative rings	5 5 8	Chalk and talk, Power point presentation
Unit III	a. Fields, Extension fields, Finite Extension b. Algebraic Extension, Transcendence of e c. Roots of a polynomials, Remainder Theorem, Factor Theorem d. Splitting fields, Uniqueness of splitting fields	5 4 5 8	Chalk and talk, Power point presentation
Unit – IV	a. More about roots b. Finite Fields c. Simple Extension	5 5 5	Chalk and talk, Power point presentation
Unit – V	a. The Elements of Galois theory, Fixed Field b. Elementary symmetric functions c. Normal Extension d. Galois group	5 5 4 4	Chalk and talk, Power point presentation

Course Designed by: Mrs. N.Sumathi, Mr. A. Mohamed Ali

Programme	M.Sc	Programme code	PMA
Course Code	20PMAC22	Number of Hours	6
Semester	II	Max.Marks	100
Part	III	Credit	5
CORE COURSE VII			
Course Title	ANALYSIS – II		
Cognitive level upto K4			

Preamble

This course deals with the concepts of integration, uniform convergence of sequence and series of functions. Uniform convergence plays a key role in finding approximate solutions to theoretical and practical problems.

Unit – I Numerical Sequences and Series **17 Hours**

Convergent sequences – Subsequences – Cauchy sequences – Upper and Lower limits – Series – Series of non-negative terms - Root and ratio tests – Absolutely convergences – Addition and Multiplication of series.

Unit – II Sequence and Series of Functions **18 Hours**

Discussion of Main Problem - Uniform Convergence - Uniform Convergence and Continuity - Uniform Convergence and Integration.

Unit – III Uniform Convergence and Differentiation **22 Hours**

Uniform Convergence and Differentiation - Equi-continuous Families of Functions - The Stone-Weierstrass Theorem.

Unit – IV Functions of Several Variables **15 Hours**

Linear Transformations – Differentiation – The Contraction principle - The inverse function Theorem.

Unit – V Functions of Several Variables **18 Hours**

Implicit function theorem – The rank theorem – Derivatives of Higher order – Differentiation of Integrals.

Pedagogy

Chalk and talk, Power point presentation, Group Discussion.

Text Book

1. Walter Rudin, (2013), *Principles of Mathematical Analysis*, McGraw Hill Education Private Limited, New Delhi.

Reference Books

1. Malik S.C. and SavitaArora, (2001), *Mathematical Analysis*, Wiley Eastern Limited, New Delhi.
2. Roydon. H.L., (2001), *Real Analysis* ,Third Edition, Macmillan, New York.
3. Karunakaran. V., (2011), *Real Analysis,* Pearson Education in South Asia.

E - Resources

- https://www.math.uni-bonn.de/ag/ana/SoSe2015/analysis2/lecture_notes/Analysis_2.pdf
- https://www.math.uni-bonn.de/ag/ana/SoSe2015/analysis2/lecture_notes/Analysis_2.pdf
- https://warwick.ac.uk/fac/sci/maths/people/staff/xue_mei_li/lecturenotes/analysis2-shorter-version.pdf
- https://nptel.ac.in/noc/courses/noc16/SEM2/noc16-me09/
- http://www.nptelvideos.in/2012/11/structural-analysis-ii.html

Course Outcomes

At the end of the course, students would be able to:

No.	Course Outcome
CO1	Explain convergence sequence, Cauchy sequence, and root and ratio tests.
CO2	Explain the uniform convergence and discuss the concept of uniform convergence of continuity and integration.
CO3	Construct the equi-continuous family of functions and discuss Stone-Weierstrass Theorem.
CO4	Explain the contraction principle and analyze inverse function theorem.
CO5	Discuss the implicit function theorem and compute the derivatives of higher order.

Mapping of Course Outcomes (COs) with Programme Specific Outcomes (PSOs)

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**2**	**2**	**2**	**2**	**0**
CO2	**3**	**2**	**2**	**3**	**2**
CO3	**3**	**2**	**3**	**3**	**2**
CO4	**3**	**0**	**3**	**3**	**2**
CO5	**3**	**0**	**2**	**3**	**0**

1 - Low, 2 - Medium and 3 – High

Articulation Mapping - K Levels with Course Outcomes (COs)

Units	Cos	K – Level	Section A		Section B	Section C
			MCQs		Either/or Choice	Open Choice
			No. of Questions	K-Level	No. of Questions	No. of Questions
1	CO1	Up to K2	2	K1 & K2	2(K2&K2)	K2
2	CO2	Up to K2	2	K1 & K2	2(K2&K2)	K2
3	CO3	Up to K3	2	K1 & K2	2(K3&K3)	K3
4	CO4	Up to K4	2	K1 & K2	2(K3&K3)	K4
5	CO5	Up to K3	2	K1 & K2	2(K2&K2)	K3
No of Questions to be asked			10		10	5
No of Questions to be answered			10		5	3
Marks for each Question			1		4	10
Total Marks for each Section			10		20	30

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

Distribution of Section –wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (Either/or)	Section C (Open Choice)	Total Marks	% of Marks without choice	Consolidated (Rounded off)
K1	5			05	05	05
K2	5	24	20	49	49	49
K3		16	20	36	36	36
K4			10	10	10	10
Total Marks	10	40	50	100	100	100

LESSON PLAN

UNIT	DESCRIPTION	HOURS	MODE
I-Numerical Sequences and Series	a. Convergent sequences b. Subsequences c. Cauchy sequences d. Upper and Lower limits e. Series of non-negative terms f. Root and ratio tests g. Absolutely convergences h. Addition and Multiplication of series	1 1 2 3 3 2 2 3	Chalk and talk, Power point presentation
II-Sequence and Series of Functions	a. Discussion of Main Problem b. Uniform Convergence c. Uniform Convergence and Continuity d. Uniform Convergence and Integration	4 5 4 5	Chalk and talk, Power point presentation
III-Uniform Convergence and Differentiation	a. Uniform Convergence and Differentiation b. Equi-continuous Families of Functions c. The Stone-Weierstrass Theorem	6 8 8	Chalk and talk, Power point presentation
IV-Functions of Several Variables	a. Linear Transformations b. Differentiation c. The Contraction principle d. The inverse function Theorem	3 4 4 4	Chalk and talk, Power point presentation
V-Functions of Several Variables	a. Implicit function theorem b. The rank theorem c. Derivatives of Higher order d. Differentiation of Integrals	4 5 5 4	Chalk and talk, Power point presentation

Course Designed by: Mrs. S.Lathamaheswari, Mr. A. Mohamed Ali

Programme	M.Sc	Programme code	PMA
Course Code	20PMAC23	Number of Hours	6
Semester	II	Max.Marks	100
Part	III	Credit	5
CORE COURSE VIII			
Course Title	PARTIAL DIFFERENTIAL EQUATIONS		
Cognitive level upto K5			

Preamble

This course deals with methods of solving linear and non-linear partial differential equations and classification of partial differential equation reductions of order one, partial differential equations reducible to equations with constant coefficients, heat and wave equation method of separation of variables and boundary value problems in Cartesian coordinates.

Unit – I Linear and Non-Linear Partial Differential Equations of Order One 17 Hours

Lagrange's equations – Complete, particular, singular and general integral – Geometrical interpretation of integrals - Compatible system of first order equations – Charpit's method.

Unit – II Classification of Partial Differential Equations Reduction to Canonical form 18 Hours

Classification of partial differential equation of second order – Classification of partial differential equations in three independent variables – Cauchy's problem of second order partial differential equations – Laplace transformation - Reduction to canonical form.

Unit – III Partial Differential Equations Reducible to Equations with Constant Coefficients 22 Hours

Introduction – Method of reducible Euler-Cauchy equation to linear partial differential equation with constant coefficients – Working rule for solving Euler-Cauchy type equations – Solved examples.

Unit – IV Heat and Wave Equations 15 Hours

Introduction – Derivation of one dimensional wave equation – Derivation of two-dimensional wave equation – Derivation of one dimensional heat equation – Laplace's equation – Boundary value problems.

Unit – V Boundary Value Problems in Cartesian Coordinates 18 Hours

Introduction – Problems based on one dimensional heat equations – General solution of one dimensional heat flow equation by the method of separation of variables.

Pedagogy

Chalk and talk, Power point presentation, Group Discussion

Text Books

1. Raisinghania.M.D.,(2012), *Ordinary and Partial Differential Equations*, S. Chand and company Ltd, New Delhi, Fourteenth Revised Edition.
2. Raisinghania. M.D., (2015), *Advanced Differential Equations*, S. Chand and company Ltd, New Delhi, Eighteenth Revised Edition.

Reference Books

1. SankarRao.K, (2005), *Introduction to Partial Differential Equations*, Prentice Hall of India, New Delhi, Second Edition.
2. Sneddon. I.N., (2008), *Elements of Partial Differential Equations*, McGraw Hill, New Delhi.
3. Walter A. Strauss, (2007), *Partial Differential Equations: An Introduction*, Wiley.

E –Resources

1. http://cyberspaceandtime.com/Y8Ud2JzWiVo.video+related
2. https://swayam.gov.in/nd2_cec20_ma08/preview
3. http://www.math.toronto.edu/ivrii/PDE-textbook/PDE-textbook.pdf
4. http://www.math.tifr.res.in/~publ/ln/tifr70.pdf
5. http://issc.uj.ac.za/downloads/problems/partial.pdf

Course Outcomes

At the end of the course, students would be able to:

CO1	Solve the linear and non-linear partial differential equations of order one.
CO2	Explain and solve the classification of partial differential equations reduction to canonical form.
CO3	Explain and solve the Partial Differential Equations Reducible to Equations with Constant Coefficients.
CO4	Illustrate the Heat, Wave Equation and Laplace's equation.
CO5	Explain and examine the boundary value problems in Cartesian coordinates.

Mapping of Course Outcomes (COs) with Programme Specific Outcomes (PSOs)

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**2**	**2**	**2**	**2**	**0**
CO2	**3**	**2**	**2**	**3**	**0**
CO3	**3**	**0**	**2**	**3**	**0**
CO4	**3**	**3**	**3**	**3**	**2**
CO5	**3**	**3**	**3**	**3**	**2**

1 - Low, 2 - Medium and 3 – High

Articulation Mapping - K Levels with Course Outcomes (COs)

Units	**COs**	**K – Level**	**Section A**		**Section B**	**Section C**
			MCQs		**Either/or Choice**	**Open Choice**
			No. of Questions	**K-Level**	**No. of Questions**	**No. of Questions**
1	CO1	Up to K3	2	K1 & K2	2(K2&K2)	K3
2	CO2	Up to K3	2	K1 & K2	2(K2&K2)	K3
3	CO3	Up to K3	2	K1 & K2	2(K2&K2)	K3
4	CO4	Up to K4	2	K1 & K2	2(K3&K3)	K4
5	CO5	Up to K5	2	K1 & K2	2(K3&K3)	K5
No of Questions to be asked			10		10	5
No of Questions to be answered			10		5	3
Marks for each Question			1		4	10
Total Marks for each Section			10		20	30

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

Distribution of Section –wise Marks with K Levels

K Levels	**Section A (No Choice)**	**Section B (Either/or)**	**Section C (Open Choice)**	**Total Marks**	**% of Marks without choice**	**Consolidated (Rounded off)**
K1	5			05	05	05
K2	5	24		29	29	29
K3		16	30	46	46	46
K4			10	10	10	10
K5			10	10	10	10
Total Marks	10	40	50	100	100	100

LESSON PLAN

UNIT	DESCRIPTION	HOURS	MODE
I –Linear and Non-Linear Partial Differential Equations of Order One	a. Lagrange's equations b. Complete, particular, singular and general integral , Geometrical interpretation of integrals c. Compatible system of first order equations d. Charpit's method	4 4 5 4	Chalk and talk, Power point presentation
II-Classification of Partial Differential Equations Reduction to Canonical form	a. Classification of partial differential equation of second order b. Classification of partial differential equations in three independent variables c. Cauchy's problem of second order partial differential equations d. Laplace transformation, Reduction to canonical form	3 5 5 5	Chalk and talk, Power point presentation
III- Partial Differential Equations Reducible to Equations with Constant Coefficient	a. Introduction b. Method of reducible Euler-Cauchy equation to linear partial differential equation with constant coefficients c. Working rule for solving Euler-Cauchy type equations d. Solved examples	2 8 6 6	Chalk and talk, Power point presentation
IV-Heat and Wave Equations	a. Introduction, Derivation of one dimensional wave equation b. Derivation of two-dimensional wave equation c. Derivation of one dimensional heat equation d. Laplace's equation – Boundary value problems	4 4 3 4	Chalk and talk, Power point presentation
V-Boundary Value Problems in Cartesian Coordinates	a. Introduction b. Problems based on one dimensional heat equations c. Problems solved d. General solution of one dimensional heat flow equation by the method of separation of variables	4 6 4 4	Chalk and talk, Power point presentation

Course Designed by: Mrs. N.Sumathi, Mr. S. Lathamaheswari

Programme	**M.Sc**	**Programme code**	**PMA**
Course Code	**20PMAC24**	**Number of Hours**	**6**
Semester	**II**	**Max.Marks**	**100**
Part	**III**	**Credit**	**5**
CORE COURSE IX			
Course Title	**OPERATIONS RESEARCH**		
Cognitive level upto K5			

Preamble

This course deals with the method of solving linear and non-linear programming in various method, quantitative techniques and decision theory.

Unit – I Integer Linear Programming **17 Hours**

Introduction – Importance of Integer programming problems – Gomory's Cutting Plane Method - Branch and Bound Method - Geometrical interpretation of Branch and Bound Method – Zero-One method.

Unit – II Goal Programming **18 Hours**

Introduction - Concept of Goal Programming – Single-Goal models - Multiple-goal models – Multiple Goals with Priorities and weights – Formulation of Goal programming models - Graphical solution of GP problems – Simplex method applied to GP problems – The GP Algorithm: Extended Simplex Algorithm – Special problems in GP.

Unit – III Quantitative Techniques **22 Hours**

Project Management by PERT - CPM - Applications of PERT/CPM Techniques - Network Diagram Representations - Rules for Drawing Network Diagram - Labelling: Fulkerson's '1-J' Rule's – Time Estimates and Critical path in Network Analysis – Optimum duration and Minimum duration cost – Definition of PERT - Uses of PERT/CPM for management – Application areas of PERT/CPM techniques – Disadvantages of Network techniques.

Unit – IV Decision Theory **15 Hours**

Introduction – Types of Decisions – Components of Decision making – Decision models – Types of Environment – Decision Making Under Uncertainty – Decision making under Conflict – Decision tree analysis - Decision making under utilities – Posterior probabilities and Bayesian analysis.

Unit – V Non-Linear Programming **18 Hours**

Classical optimization Techniques - Introduction – Unconstrained problems of Maxima and Minima - Lagrangian Method - Kuhn-Tucker Conditions - Quadratic Programming - Introduction – Kuhn-Tucker conditions: Non-negative constraints – General Quadratic programming problem Wolfe's method - Beale's Method.

Pedagogy

Chalk and talk, Power point presentation, Group Discussion.

Text Books

1. Sharma .S.D., (2009), *Operations Research*, Kedar Nath Ram Nath, Meerut, Delhi.

Reference Books

1. Kanthiswarup, Gupta.P.K., Man Mohan, (2011), *Operations Research*, Sultan Chand & Sons, New Delhi.
2. Gurusamy.S.,(2015), *Operation Research*, Vijay Nicole Imprints Private Limited Chennai.
3. Rao.S.S., (2003), *Optimization Theory and Applications*, Wiley Eastern Limited, New Delhi.

E-Resources

- http://coral.ie.lehigh.edu/~ted/files/ie316/misc/Syllabus.pdf?origin=publication_detail
- https://nptel.ac.in/courses/112/106/112106131/
- https://www.cs.toronto.edu/~stacho/public/IEOR4004-notes1.pdf
- https://www.researchgate.net/topic/Operational-Research
- https://www.scribd.com/document/251243321/OPERATION-RESEARCH-2-mark-questions-with-answers-doc-docx

Course Outcomes

At the end of the course, students would be able to:

CO1	Illustrate and solve the integer programming in various method.
CO2	Explain and compute the goal programming problems in graphical and simplex method.
CO3	Explain basic principles of optimization techniques and distinguish the shortest path problem in PERT and CPM.
CO4	Explain and solve the decision making problems.
CO5	Classify and solve the non-linear problems.

Mapping of Course Outcomes (COs) with Programme Specific Outcomes (PSOs)

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**3**	**2**	**2**	**0**	**0**
CO2	**3**	**0**	**2**	**2**	**0**
CO3	**3**	**2**	**3**	**3**	**0**
CO4	**3**	**0**	**3**	**2**	**2**
CO5	**3**	**3**	**2**	**0**	**0**

1 - Low, 2 - Medium and 3 – High

Articulation Mapping - K Levels with Course Outcomes (COs)

Units	Cos	K – Level	Section A		Section B	Section C
			MCQs		Either/or Choice	Open Choice
			No. of Questions	K-Level	No.of Questions	No. of Questions
1	CO1	Up to K3	2	K1 & K2	2(K2&K2)	K3
2	CO2	Up to K3	2	K1 & K2	2(K2&K2)	K3
3	CO3	Up to K4	2	K1 & K2	2(K3&K3)	K4
4	CO4	Up to K5	2	K1 & K2	2(K3&K3)	K5
5	CO5	Up to K3	2	K1 & K2	2(K2&K2)	K3
No of Questions to be asked			10		10	5
No of Questions to be answered			10		5	3
Marks for each Question			1		4	10
Total Marks for each Section			10		20	30

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

Distribution of Section –wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (Either/or)	Section C (Open Choice)	Total Marks	% of Marks without choice	Consolidated (Rounded off)
K1	5			05	05	05
K2	5	24		29	29	29
K3		16	30	46	46	46
K4			10	10	10	10
K5			10	10	10	10
Total Marks	10	40	50	100	100	100

LESSON PLAN

UNIT	DESCRIPTION	HOURS	MODE
I-Integer Linear Programming	a. Introduction, Importance of Integer programming problems b. Gomory's Cutting Plane Method c. Branch and Bound Method, Geometrical interpretation of Branch and Bound Method d. Zero-One method	4 4 4 5	Chalk and talk, Power point presentation
II-Goal Programming	a. Introduction Concept of Goal Programming, Single-Goal models, Multiple-goal models b. Multiple Goals with Priorities and weights, Formulation of Goal programming models c. Graphical solution of GP problems, Simplex method applied to GP problems d. The GP Algorithm: Extended Simplex Algorithm, Special problems in GP	4 5 4 5	Chalk and talk, Power point presentation, Group Discussion
III-Quantitative Techniques	a. Project Management by PERT-CPM, Applications of PERT/CPM Techniques, Optimum duration and Minimum duration cost b. Network Diagram Representations, Rules for Drawing Network Diagram c. Labelling: Fulkerson's '1-J' Rule's, Time Estimates and Critical path in Network Analysis d. Definition of PERT, Uses of PERT/CPM for management e. Application areas of PERT/CPM techniques, Disadvantages of Network techniques	5 4 4 5 4	Chalk and talk, Power point presentation
IV-Decision Theory	a. Introduction, Types of Decisions, Components of Decision making, Decision models b. Types of Environment, Decision Making Under Uncertainty, Decision making under Conflict c. Decision tree analysis, Decision making under utilities d. Posterior probabilities and Bayesian analysis	3 4 4 4	Chalk and talk, Power point presentation, Group Discussion
V-Non-Linear Programming	a. Introduction, Unconstrained problems of Maxima and Minima b. Lagrangian Method, Kuhn-Tucker Conditions c. Introduction, Kuhn-Tucker conditions: Non-negative constraints d. General Quadratic programming problem Wolfe's method, Beale's Method	3 5 5 5	Chalk and talk, Power point presentation, Group Discussion

Course Designed by: Mrs. K.Sujatha, Mr. A.Mohamed Ali

Programme	**M.Sc**	**Programme code**	**20PMA**
Course Code	**20PMAC25**	**Number of Hours**	**6**
Semester	**II**	**Max.Marks**	**100**
Part	**III**	**Credit**	**5**
CORE COURSE X			
Course Title	**CALCULUS OF VARIATIONS**		
Cognitive level upto K5			

Preamble

This course deals with the method of solving dependent and independent functional variable in Euler's equation and also finding extremal field.

Unit – I Functionals **17 Hours**

Calculus of variation - Functionals - Example of Functional - Extremal - Euler's Equation - Other Form of Euler's Equation - Solutions of Euler's Equation - Particular Cases of Euler's Equation.

Unit – II Dependent on Higher Derivatives **18 Hours**

Geodesics - Functional Dependent on Higher Derivatives - Euler- Poisson Equation - Functional for Several Dependent variable - Functionals Dependent on Several Independent Variables - Isoperimetric Problems**.**

Unit – III Transversality Conditions **22 Hours**

Introduction - Transversality Conditions - Orthogonality Conditions - Variational Problem with a Moving Boundary for a Functional Dependent on Two Functions.

Unit – IV Field of Extremal **15 Hours**

Definitions - Proper Field - Central Field - Extremal Field (Field of Extremal) Definition (Embedding in a Central Field) - Jacobi Condition - Mathematical Definition - Sufficient Condition for Extremum (Legendre Condition) - Weak and Strong Extremum - Weak Extremum - Strong Extremum.

Unit – V Rayleigh-Ritz Method **18 Hours**

Introduction - Rayleigh-Ritz Method (For Ordinary Differential Equation) - Galerkin's Method - Partial Differential Equation (By Rayleigh-Ritz Method) - Kantorovich Method.

Pedagogy

Chalk and talk, Power point presentation, Group Discussion.

Text Books

1. Mukeshkumar Singh., (2017), *Calculus of Variations*, GOEL Publishing House, Krishna's Prakashan Media (P) Limited, Meerut, Uttar Pradesh, India.

Reference Book

1. GelffandI.M. and FominS.V.,(2012), *Calculus of Variations*, Dover Publication, New York.
2. SharmaR.K.,(2017), *Calculus of Variations*, Medtech Publication, New Delhi.
3. ParsL.A.,(2010), *An Introduction to Calculus of Variations*, Dover Publication, New York.

E- Resources

- https://nptel.ac.in/courses/111/104/111104025/
- https://math.mit.edu/classes/18.086/2006/am72.pdf
- http://matematika.cuni.cz/dl/pyrih/variationProblems/variationProblems.pdf
- https://www.et.byu.edu/~vps/ET502WWW/NOTES/CH7m.pdf
- https://www.researchgate.net/publication/275518932_Handbook Of Integral_Equations_Second_Edition

Course Outcomes

At the end of the course, students would be able to:

CO1	Classify and solve theproblems by using Euler Lagrange equation.
CO2	Solve the brachistochrone and isoperimetric problem.
CO3	Explain and solve variational problems with moving boundaries dependent on two functions.
CO4	Simplify the concepts on extremal field.
CO5	Explain and solve boundary value problems of ordinary and partial differential equations on the concept of variational method.

Mapping of Course Outcomes (COs) with Programme Specific Outcomes (PSOs)

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	**2**	**0**	**2**	**2**	**0**
CO2	**2**	**0**	**3**	**3**	**0**
CO3	**2**	**0**	**3**	**2**	**0**
CO4	**2**	**0**	**3**	**2**	**2**
CO5	**0**	**0**	**2**	**2**	**2**

1 - Low, 2 - Medium and 3 - High

Articulation Mapping - K Levels with Course Outcomes (COs)

Units	Cos	K – Level	Section A		Section B	Section C
			MCQs		Either/or Choice	Open Choice
			No. Of Questions	K-Level	No. Of Questions	No. Of Questions
1	CO1	Up to K3	2	K1 & K2	2(K2&K2)	K3
2	CO2	Up to K3	2	K1 & K2	2(K2&K2)	K3
3	CO3	Up to K5	2	K1 & K2	2(K3&K3)	K5
4	CO4	Up to K4	2	K1 & K2	2(K3&K3)	K4
5	CO5	Up to K3	2	K1 & K2	2(K2&K2)	K3
No of Questions to be asked			10		10	5
No of Questions to be answered			10		5	3
Marks for each Question			1		4	10
Total Marks for each Section			10		20	30

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

Distribution of Section –wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (Either/or)	Section C (Open Choice)	Total Marks	% of Marks without choice	Consolidated (Rounded off)
K1	5			05	05	05
K2	5	24		29	29	29
K3		16	30	46	46	46
K4			10	10	10	10
K5			10	10	10	10
Total Marks	10	40	50	100	100	100

LESSON PLAN

UNIT	DESCRIPTION	HOURS	MODE
I-Functionals	a. Calculus of variation, Functionals, Example of Functional b. Extremal, Euler's Equation c. Other Form of Euler's Equation Solutions of Euler's Equation d. Particular Cases of Euler's Equation	4 3 5 5	Chalk and talk
II-Dependent on Higher Derivatives (Caption)	a. Geodesic, Functional Dependent on Higher Derivatives b. Euler-Poisson Equation c. Functional for Several Dependent variable, Functionals Dependent on Several Independent Variables d. Isoperimetric Problems	5 4 5 4	Chalk and talk, Power point presentation
III-Transversality Conditions	a. Introduction b. Transversality Conditions c. Orthogonality Conditions d. Variational Problem with a Moving Boundary for a Functional Dependent on Two Functions	1 5 8 8	Chalk and talk, Power point presentation
IV-Field of Extremal	a. Definitions, Proper Field, Central Field, Extremal Field (Field of Extremal) b. Definition (Embedding in a Central Field) , Jacobi Condition c. Mathematical Definition, Sufficient Condition for Extremum (Legendre Condition) d. Weak and Strong Extremum	3 4 4 4	Chalk and talk, Power point presentation
V-Rayleigh-Ritz Method	a. Introduction, Rayleigh-Ritz Method (For Ordinary Differential Equation) b. Galerkin's Method c. Partial Differential Equation (By Rayleigh-Ritz Method) d. Kantorovich Method	4 4 6 4	Chalk and talk, Power point presentation

Course Designed by: Mrs. N.Sumathi, Mr. S. Lathamaheswari

Programme	M.Sc	Programme Code	PMA
Course Code	**20PMAC31**	Number of Hours/Cycle	**6**
Semester	**III**	Max. Marks	**100**
Part	**III**	**Credit**	**5**
CORE COURSE XI			
Course Title	**Linear Algebra**		
Cognitive Level		**Up to K4**	

Preamble

This course deals with basic notions in linear algebra that are often used in mathematics and other sciences. It develops the basic ideas of vector spaces and provides strong background of linear transformations, Eigen values and Eigen vectors of Vector spaces and Projections.

Unit I	**Vector Spaces**	**18 Hours**
	Sub spaces – Sum of sub spaces – Quotient Spaces – Homomorphism or Linear Transformations – Linear span.	
Unit II	**Vector Spaces**	**18 Hours**
	Linear Dependence and Independence – Inner Product Spaces – Norm of a vector – Orthogonality – Orthonormal set.	
Unit III	**Linear Transformations**	**20 Hours**
	Algebra of Linear Transformations – Invertible Linear Transformations – Matrix of a Linear Transformation – Transpose of a Linear Transformation.	
Unit IV	**Eigen Values and Eigen Vectors**	**18 Hours**
	Characteristic Polynomials – Characteristic Polynomial of a Linear Operator – Minimal Polynomials – Diagonalizable Operators.	
Unit V	**Eigen Values and Eigen Vectors**	**16 Hours**
	Primary Decomposition theorem – Invariant subspaces – Cyclic subspaces – Projections.	

Pedagogy

Chalk and talk, Power point presentation, Group Discussion.

Text Book

1. Vijay K. Khanna.,Bhambri. S.K., (2013), "*A Course in Abstract Algebra*", Vikas Publication House Private Limited, Fourth Edition.

Reference Books

1. Herstein .N.,(1975), *Topics in Algebra*, Wiley Eastern Limited, New Delhi.
2. David C. Lay, (2005), *Linear Algebra and its Applications*, Pearson Education Pvt. Ltd, India, Third Edition, Fifth Indian Reprint.
3. Jacobson. N., (1980), *Basic Algebra*, Vols. I & II, Freeman , Hindustan Publishing Company, New Delhi.
4. Kenneth Hoffman and Ray Kunze, (2011), *Linear Algebra*, Prentice – Hall of India Private Limited, New Delhi, Second Edition.

E-Resources

- https://www.youtube.com/watch?v=1XlT3Y2oyAU&list=PLU6SqdYcYsfJOGZdxUpDk3w9o-w94-RoG&index=1
- https://www.youtube.com/watch?v=t5ckUuSsWe4
- https://www.youtube.com/watch?v=JcVf-My1fDg
- https://www.youtube.com/watch?v=KOZBxrAQB-o
- https://www.youtube.com/watch?v=M2n0R270yTY

Course Outcomes

After completion of this course, the students will be able to:

CO1	Apply the concepts of vector spaces and linear transformations.
CO2	Analyze the linear dependence and linear independence of vector spaces and inner product.
CO3	Analyze the algebra of linear transformations and matrix of a linear transformation.
CO4	Categorize the characteristic polynomials and minimal polynomials.
CO5	Demonstrate the Primary decomposition and Projections..

Mapping of Course Outcomes (COs) with Programme Specific Outcomes

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	2	2	3	2
CO2	0	0	0	2	0
CO3	3	2	2	0	2
CO4	3	2	2	0	2
CO5	2	0	0	0	0

3. High; 2. Moderate ; 1. Low

Articulation Mapping - K Levels with Course Outcomes (COs) (Model)

Units	**Cos**	**K-Level**	**Section A**		**Section B**	**Section C**
			MCQs		**Either/ or Choice**	**Open Choice**
			No. Of Questions	**K-Level**	**No. Of Questions**	**No.Of Questions**
1	CO1	Up to K3	2	K1& K2	2(K2& K2)	K3
2	CO2	Up to K4	2	K1& K2	2(K3&K3)	K4
3	CO3	Up to K4	2	K1& K2	2(K3&K3)	K4
4	CO4	Up to K4	2	K1& K2	2(K3& K3)	K4
5	CO5	Up to K3	2	K1& K2	2(K2&K2)	K3
No of Questions to be asked			10		10	5
No of Questions to be Answered			10		5	3
Marks for each Question			1		4	10
Total Marks for each Section			10		20	30

K1 – Remembering and recalling facts with specific answers

K2 – Basic understanding of facts and stating main ideas with general answers
K3 – Application oriented – Solving problems
K4 – Examining, analyzing, presentation and make inferences with evidences

Distribution of Section - wise Marks with K Levels (Model)

K Levels	Section A (No Choice)	Section B (Either/or)	Section C (Open Choice)	Total Marks	% of Marks without Choice	Consolidated (Rounded off)
K1	5			5	5	5
K2	5	16		21	21	21
K3		24	20	44	44	44
K4			30	30	30	30
Total Marks	10	40	50	100	100	100

Lesson Plan

Unit	Description	Hours	Mode
Unit I Vector Spaces	**Description**	**Hours**	**Mode**
	a.Sub spaces	3	Chalk and talk, Power point presentation
	b. Sum of sub spaces	3	
	c. Quotient Spaces	4	
	d.Homomorphism or Linear Transformations	4	
	e. Linear span	4	
Unit II Vector Spaces	**Description**	**Hours**	**Mode**
	a. Linear Dependence and Independence	3	Chalk and talk, Power point presentation
	b. Inner Product Spaces	3	
	c. Norm of a vector	4	
	d. Orthogonality	4	
	e. Orthonormal set	4	
Unit III Linear Transformations	**Description**	**Hours**	**Mode**
	a. Algebra of Linear Transformations	5	Chalk and talk, Power point presentation
	b. Invertible Linear Transformations	5	
	c. Matrix of a Linear Transformation	5	
	d. Transpose of a Linear Transformation	5	
Unit IV Eigen Values and Eigen vectors	**Description**	**Hours**	**Mode**
	a. Characteristic Polynomials	4	Chalk and talk, Power point presentation
	b. Characteristic Polynomial of a Linear Operator	5	
	c. Minimal Polynomials	4	
	d. Diagonalizable Operators	5	
Unit V Eigen Values and Eigen Vectors	**Description**	**Hours**	**Mode**
	a. Primary Decomposition theorem	4	Chalk and talk, Power point presentation
	b. Invariant subspaces	4	
	c. Cyclic subspaces	4	
	d. Projections	4	

Course designed by N. Sumathi and K. Sujatha

Programme	**M.Sc., Mathematics**	**Programme Code**	**PMA**
Course Code	**20PMAC32**	Number of Hours/Cycle	**6**
Semester	**III**	Max. Marks	**100**
Part		**Credit**	**5**
CORE COURSE XII			
Course Title	**Measure Theory**		
Cognitive Level		**Up to K4**	

Preamble

This course deals with basic concept of Lebesgue measure and integration and introduce Borel sets and integration of non- negative functions and know about integration with respect to measure and have knowledge on convergence in measure and understand integration in Abstract measure spaces.

Unit I	**Measures on the Real Line**	**18 Hours**
	Lebesgue outer measure - Measurable sets – Sigma algebra – Borel sets of R - Regularity.	
Unit II	**Measures on the Real Line**	**14 Hours**
	Measurable function - Borel function – Essential Supremum and Infimum - Essentially bounded – Borel and Lebesgue measurability.	
Unit III	**Integration of Functions of a Real Variable**	**22 Hours**
	Integration of non-negative functions – Simple function – Fatou's Lemma – Lebesgue's Monotone Convergence - The general integral - Integration of series.	
Unit IV	**Riemann and Lebesgue integrals**	**20 Hours**
	Riemann and Lebesgue integrals - Riemann integralable on $(-\infty,\infty)$ - Differentiation – The four derivatives - Continuous - Differentiation - The four derivatives – Continuous non-differentiable functions.	
Unit V	**Absstract Measure Spaces**	**16 Hours**
	Measures and Outer Measures – Extension of a Measure – μ^* measurable – Uniqueness of the Extension – Measure Spaces.	

Pedagogy

Chalk and talk, Power point presentation, Group Discussion.

Text Book

1. Barra.G.De., (2013), "*Measure Theory and Integration*", Willey Eastern Limited, Second Edition.

Reference Books

1. Gupta.A.L., and Gupta.N.R., (2003), "*Principles of Real Analysis*", Pearson Education.
2. Roydon.H.L., (1988), "*Real Analysis*", Macmillan, New York.
3. Walter Rudin, (1976), "*Principles of Mathematical Analysis*", McGraw Hill International, Third Edition.
4. Malik S.C., and Savita Arora, (1991), "*Mathematical Analysis*", Wiley Eastern Limited, New Delhi.

E-Resources

- https://www.youtube.com/watch?v=F65Bu_Zu_9I&t=323s
- https://www.youtube.com/watch?v=o5V7U2UZAUc
- https://www.youtube.com/watch?v=pr72maFFLmU
- https://www.youtube.com/watch?v=LV1QAnEBRyM
- https://www.youtube.com/watch?v=Ajrh6LTGyls

Course Outcomes

After completion of this course, the students will be able to:

CO1	Distinguish the relation between the class of Borel sets and the class of Lebesgue measurable sets.
CO2	Discuss the concepts of Measurable functions.
CO3	Demonstrate the concepts of Integration of Functions of a Real Variable
CO4	Explain Riemann and Lebesgue integrals
CO5	Extend the measure on a Outer measure.

Mapping of Course Outcomes (COs) with Programme Specific Outcomes

	PSO 1	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	2	2	0	2
CO2	2	2	2	2	2
CO3	3	2	2	3	2
CO4	3	2	2	0	2
CO5	2	2	2	2	2

3. High; 2. Moderate ; 1. Low

Articulation Mapping - K Levels with Course Outcomes (COs) (Model)

Units	**Cos**	**K-Level**	**Section A**		**Section B**	**Section C**
			MCQs		**Either/ or Choice**	**Open Choice**
			No. Of Questions	**K-Level**	**No. Of Questions**	**No. Of Questions**
1	CO1	Up to K4	2	K1&K2	2(K3&K3)	K4
2	CO2	Up to K2	2	K1&K2	2(K2&K2)	K2
3	CO3	Up to K3	2	K1&K2	2(K3&K3)	K3
4	CO4	Up to K4	2	K1&K2	2(K3&K3)	K4
5	CO5	Up to K2	2	K1&K2	2(K2&K2)	K2
No of Questions to be asked			10		10	5
No of Questions to be Answered			10		5	3
Marks for each Question			1		4	10
Total marks for each Section			10		20	30

K1 – Remembering and recalling facts with specific answers

K2 – Basic understanding of facts and stating main ideas with general answers

K3 – Application oriented – Solving problems
K4 – Examining, analyzing, presentation and make inferences with evidences
Distribution of Section - wise Marks with K Levels (Model)

K Levels	Section A (No Choice)	Section B (Either/or)	Section C (Open Choice)	Total Marks	% of Marks Without Choice	Consolidated (Rounded off)
K1	5			5	5	5
K2	5	16	20	41	41	41
K3		24	10	34	34	34
K4			20	20	20	20
Total Marks	10	40	50	100	100	100

Lesson Plan

Unit	Description	Hours	Mode
Unit I Measures on the Real Line	**Description**	**Hours**	**Mode**
	a. Lebesgue outer measure	3	Chalk and talk, Power point presentation
	b. Lebesgue measurable	4	
	c. Sigma algebra	3	
	d. Borel sets of R	4	
	e. Regularity	4	
Unit II Measures on the Real Line	**Description**	**Hours**	**Mode**
	a.Measurable functions	2	Chalk and talk, Power point presentation
	b. Borel function	3	
	c. Essential Supremum and Infimum	2	
	d. Essentially bounded	3	
	e. Borel and Lebesgue measurability	4	
Unit III Integration of Functions of a Real Variable	**Description**	**Hours**	**Mode**
	a. Integration of non-negative functions	4	Chalk and talk, Power point presentation
	b. Simple function	4	
	c. Fatou's Lemma	4	
	d. Lebesgue's Monotone Convergence	4	
	e. The general integral	3	
	f. Integration of series	3	
Unit IV Riemann and Lebesgue Integrals	**Description**	**Hours**	**Mode**
	a.Riemann and Lebesgue integrals	4	Chalk and talk, Power point presentation
	b. Riemann integralable on $(-\infty,\infty)$	4	
	c. Differentiation	4	
	d. The four derivatives	4	
	e. Continuous non-differentiable functions	4	
Unit V Abstract Measure Spaces	**Description**	**Hours**	**Mode**
	a.Measures and Outer Measures	3	Chalk and talk, Power point presentation
	b. Extension of a Measure	3	
	c. μ^* measurable	4	
	d. Uniqueness of the Extension	3	
	e. Measure Spaces	3	

Course designed by K. Sujatha and N. Sumathi

Course Code	**20PMAC33**	Number of Hours/Cycle	**6**
Semester	**III**	Max. Marks	**100**
Part	**III**	**Credit**	**5**
CORE COURSE XIII			
Course Title	**Topology**		
Cognitive Level		**Up to K4**	

Preamble

This course deals with the topological spaces and continuous functions, to have a clear picture of continuity and Homeomorphism and get knowledge on compact spaces and Hausdorff spaces and to learn about Countability and Separability.

Unit I	**Topological Spaces**	**18 Hours**
	Introduction - Various types of topologies - Intersection and Union of topologies - Greatest lower bound - Least upper bound of the family of topologies for a non-empty set X - Closed sets - Intersection and Union of closed sets - characterisation of a topological space in terms of closed set.	
Unit II	**Topological Spaces**	**18 Hours**
	Neighbourhood - Properties of neighbourhoods - Characterization of open in a topological space in terms of neighbourhoods - Adherent points - Limit points and derived sets in a topological space - Some theorem on derived sets - Hausdorff space (separated space or T2-space) - closure of a set.	
Unit III	**Continuity and Homeomorphism**	**20 Hours**
	Continuity - Certain Theorems giving the criteria for a continuous function - Open and Closed mappings – Certain theorem on open and closed mappings – Homeomorphism - Separated sets - Certain theorems giving the properties of Separated sets.	
Unit IV	**Compactness**	**18 Hours**
	Cover and Sub cover - Compact Spaces - Properties of Compact Space – Bounded Mapping – Compactness of Real Line.	
Unit V	**Countability and Separability**	**16 Hours**
	First Countable Space - Second Countable Space – Lindelof Space – -Space – Theorems on Space - Space – Theorems on Space.	

Pedagogy

Chalk and talk, Power point presentation, Group Discussion.

Text Book

Khanna.M.L., (2004), “*Topology*” ,Jai Prakash Nath and Company, Meerut.

Reference Books

1. George F. Simmons., (1963), “*Introduction to Topology and Modern Analysis*”, McGraw Hill Book Company.
2. James R.Munkers .,(2002), “*Topology*” Prentice-Hall of India Private Limited, New Delhi,
   Second Edition.
3. Kelley.J.L., (1995), “*General Topology*” , Van Nostrand , Reinhold Company, New York.

4. Kumaresan.S., (2011) , "*Topology of metric Spaces*", second edition, Narosa publication.
5. Gupta.K.P., (2015), "*Topology*", Pragati Edition .

E-Resources

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- https://www.youtube.com/watch?v=LQ-HegtMuOs
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- https://www.youtube.com/watch?v=rptVTb7Ebs0
- https://www.youtube.com/watch?v=w-1uqGgfiG4

Course Outcomes

After completion of this course, the students will be able to:

CO1	Provide Precise definitions and appropriate examples and counter examples of fundamental concepts in general topology.
CO2	Acquire Knowledge about various types of topological space and their properties.
CO3	Understand the concepts and properties of the continuity and Homeomorphism
CO4	Understand to construct the compactness topological spaces.
CO5	Construct the fundamentals of countability and separability of topological spaces..

Mapping of Course Outcomes (COs) with Programme Specific Outcomes

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	2	2	2	2	2
CO2	3	2	2	0	2
CO3	3	2	2	0	2
CO4	3	2	2	3	2
CO5	3	2	2	3	2

3. High; 2. Moderate ; 1. Low

Articulation Mapping - K Levels with Course Outcomes (COs) (Model)

Units	Cos	K-Level	Section A		Section B	Section C
			MCQs		Either/ or Choice	Open Choice
			No. Of Questions	K-Level	No. Of Questions	No.Of Questions
1	CO1	Up to K2	2	K1&K2	2(K2&K2)	K2
2	CO2	Up to K3	2	K1&K2	2(K3&K3)	K3
3	CO3	Up to K4	2	K1&K2	2(K3&K3)	K4
4	CO4	Up to K3	2	K1&K2	2(K2&K2)	K3
5	CO5	Up to K3	2	K1&K2	2(K2&K2)	K3
No of Questions to be Asked			10		10	5
No of Questions to be answered			10		5	3
Marks for each Question			1		4	10
Total marks for each Section			10		20	30

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

Distribution of Section - wise Marks with K Levels (Model)

K Levels	Section A (No Choice)	Section B (Either/or)	Section C (Open Choice)	Total Marks	% of Marks without Choice	Consolidated (Rounded off)
K1	5			5	5	5
K2	5	24	10	39	39	39
K3		16	30	46	46	46
K4			10	10	10	10
Total Marks	10	40	50	100	100	100

Lesson Plan

Unit I Topological Spaces	**Description**	**Hours**	**Mode**
	a.Introduction , Various types of topologies	3	Chalk and talk, Power point presentation
	b. Intersection and Union of topologies	4	
	c.Greatest lower bound, Least upper bound of the family of topologies for a non-empty set X	4	
	d. Closed sets, Intersection and Union of closed sets	3	
	e. Characterisation of a topological space in terms of closed set	4	
Unit II Topological Spaces	**Description**	**Hours**	**Mode**
	a. Neighbourhood	3	Chalk and talk, Power point presentation
	b. Properties of neighbourhoods, characterization of open in a topological space in terms of neighbourhoods	4	
	c. Adherent points	4	
	d. Limit points and derived sets in a topological space	3	
	e. Some theorem on derived sets , Hausdorff space (separated space or T2-space) - closure of a set	4	
Unit III Continuity and Homeomorphism	**Description**	**Hours**	**Mode**
	a. Continuity	4	Chalk and talk, Power point presentation
	b. Certain Theorems giving the criteria for a continuous function	4	
	c. Open and Closed mappings, Certain theorem on open and closed mappings	4	
	d.Homeomorphism	4	
	e. Separated sets, Certain theorems giving the properties of Separated sets	4	
Unit IV Compactness	**Description**	**Hours**	**Mode**
	a. Cover and Sub cover	3	Chalk and talk, Power point presentation
	b. Compact Spaces	4	
	c. Properties of compact Space	4	
	d. Bounded Mapping	3	
	e.Compactness of Real line	4	
Unit V Countability and Separability	**Description**	**Hours**	**Mode**
	a. First Countable Space	3	Chalk and talk, Power point presentation
	b. Second Countable Space	3	
	c. Lindelof Space	3	
	d. -Space – Theorems on Space	3	
	e. Space – Theorems on -Space	4	

Course designed by N. Sumathi and S. Latha Maheswari

Programme	M.Sc	Programme Code	PMA
Course Code	**20PMAE31**	Number of Hours/Cycle	**6**
Semester	**III**	Max. Marks	**100**
Part	**IV**	**Credit**	**5**
CORE ELECTIVE COURSE I			
Course Title	**Graph Theory**		
Cognitive Level		**Up to K4**	

Preamble

This course deals with graphs and its structure, to understand Trees and Connectivity and to identify Euler tours, Hamilton Cycles and Matchings and study about colourings and its characterization and explore and study more about the nature and properties of Planar graphs.

Unit I	**Graphs and Subgraphs**	**18 Hours**
	Graphs and simple graphs - Graph Isomorphism - The Incidence and Adjacency Matrices - Sub graphs - Vertex – Degrees - Paths and Connection - Cycles.	
Unit II	**Trees, Connectivity**	**16 Hours**
	Trees - Cut edges and Bonds - Cut vertices - Connectivity – Blocks.	
Unit III	**Euler Tours And Hamilton Cycles, Matchings**	**20 Hours**
	Euler Tours - Hamilton Cycles – Matchings - Matchings and Coverings in Bipartite graphs.	
Unit IV	**Edge Colourings, Vertex Colourings**	**18 Hours**
	Edge chromatic number - Vizing's theorem - Chromatic number - Brook's Theorem.	
Unit V	**Planar Graphs**	**18 Hours**
	Plane and planar graphs - Dual Graphs - Euler's formula - The five colour theorem and the four colour conjecture.	

Pedagogy

Chalk and talk, Power point presentation, Group Discussion.

Text Book

1. Bondy. J.A., and Murty.U.S.R., (1982), "*Graph Theory with Applications*", Elsevier Science Ltd.

Reference Books

1. Frank Harary, (1969), "*Graph theory*", Addition-Wesley Publishing Company , First Edition.
2. Murugan.M.,(2003), "*Topics in Graph theory and Algorithms*", Muthali Publishing House, Annanagar, Chennai.
3. Clark.J., and Holton.D.A., (1995) , "*A First look at Graph Theory*", Allied Publishers, New Delhi.
4. Wilson. R.J., (2004), "*Introduction to Graph Theory*", Pearson Education , Fourth Edition.
5. Yadav.S. K., (2010), "*Elements of graph Theory*", Ane Books Private Limited.

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- https://www.youtube.com/watch?v=N3ykpCgk3u0
- https://www.youtube.com/watch?v=FhXDhUAhHfE

- https://www.youtube.com/watch?v=FJqqHfplYEY
- https://www.youtube.com/watch?v=Fxa-Uw1CtYQ
- https://www.youtube.com/watch?v=uJUuRE3Itb0

Course Outcomes

After completion of this course, the students will be able to:

CO1	Analyze various types of graphs and identify bipartite graphs.
CO2	Examine and identify properties of trees. Find out and determine vertex and edge connectivity of all simple graphs.
CO3	Apply the analytical techniques and theoretical knowledge in solving many real life problems. To prove theorems related to Hamiltonian, Eulerian graphs and matching.
CO4	Solve and analyze the colouring problem and apply them in the Timetabling problem and the Storage Problem.
CO5	Apply Euler's formula and Solve the Four Colour Conjecture in various problems and in many practical situations and find a solution in planarity Algorithm..

Mapping of Course Outcomes (COs) with Programme Specific Outcomes

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	2	2	0	2
CO2	3	2	2	0	2
CO3	3	2	2	3	2
CO4	3	2	2	3	2
CO5	3	2	2	2	2

3. High; 2. Moderate ; 1. Low

Articulation Mapping - K Levels with Course Outcomes (COs) (Model)

Units	**Cos**	**K-Level**	**Section A**		**Section B**	**Section C**
			MCQs		**Either/ or Choice**	**Open Choice**
			No. Of Questions	**K-Level**	**No. Of Questions**	**No.Of Questions**
1	CO1	Up to K3	2	K1&K2	2(K3&K3)	K3
2	CO2	Up to K4	2	K1&K2	2(K3&K3)	K4
3	CO3	Up to K3	2	K1&K2	2(K2&K2)	K3
4	CO4	Up to K3	2	K1&K2	2(K2&K2)	K3
5	CO5	Up to K4	2	K1&K2	2(K3&K3)	K4
No of Questions to be Asked			10		10	5
No of Questions to be answered			10		5	3
Marks for each Question			1		4	10

Total marks for each Section	10		20	30

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

Distribution of Section - wise Marks with K Levels (Model)

K Levels	**Section A (No Choice)**	**Section B (Either/or)**	**Section C (Open Choice)**	**Total Marks**	**% of Marks without Choice**	**Consolidated (Rounded off)**
K1	5			5	5	5
K2	5	16		21	21	21
K3		24	30	54	54	54
K4			20	20	20	20
Total Marks	10	40	50	100	100	100

Lesson Plan

Unit I Graphs and Subgraphs Trees	**Description**	**Hours**	**Mode**
	a. Graphs and simple graphs	1	Chalk and talk, Power point presentation
	b. Graph isomorphism	2	
	c. The incidence and adjacency matrices	3	
	d. Sub graphs	3	
	e. Vertex degrees	3	
	f. Paths and connection	3	
	g. Cycles	3	
Unit II Tree,Connectivity	**Description**	**Hours**	**Mode**
	a.Trees	3	Chalk and talk, Power point presentation
	b.Cut edges and Bonds	3	
	c.Cut vertices	3	
	d.Connectivity	3	
	e. Blocks	4	
Unit III Matchings	**Description**	**Hours**	**Mode**
	a.Euler Tours	6	Chalk and talk, Power point presentation
	b. Hamilton Cycles	4	
	c. Matchings	6	
	d. Matchings and Coverings in Bipartite graphs	4	
Unit IV Edge Colourings, Independent Sets and Cliques	**Description**	**Hours**	**Mode**
	a. Edge Chromatic number	4	Chalk and talk, Power point presentation
	b. Vizing's theorem	5	
	c. Chromatic number	4	
	d. Brooks' theorem	5	
Unit V Vertex Colourings	**Description**	**Hours**	**Mode**
	a.Plane and planar graphs	4	Chalk and talk, Power point presentation
	b. Dual Graphs	5	
	c. Euler's formula	4	
	d. The five colour theorem and the four colour conjecture	5	

Course designed by Mrs. S. Latha Maheswari and Mrs. N. Sumathi

Programme	M.Sc	Programme Code	PMA
Course Code	**20PMAE32**	Number of Hours/Cycle	**6**
Semester	**III**	Max. Marks	**100**
Part	**IV**	**Credit**	**5**
CORE ELECTIVE COURSE II			
Course Title	**Number Theory**		
Cognitive Level		**Up to K4**	

Preamble

This course deals with the basic concepts of Numbers such as Divisibility, Congruences, Quadratic residues and some arithmetic functions.

Unit I	**Preliminaries**	**18 Hours**
	Introduction – Divisibility – Primes.	
Unit II	**Congruences**	**18 Hours**
	Congruences – Solutions of congruences – The Chinese remainder theorem.	
Unit III	**Quadratic reciprocity**	**20 Hours**
	Quadratic residues – Quadratic reciprocity – The Jacobian symbol.	
Unit IV	**Some functions of Number Theory**	**18 Hours**
	Greatest integer function – Arithmetic functions – The Mobius inversion formula.	
Unit V	**Diophantine equations**	**16 Hours**
	The equation ax + by = c – Simultaneous linear equation – Pythagorean triangles.	

Pedagogy

Chalk and talk, Power point presentation, Group Discussion.

Text Book

1. Ivan Niven, Herbert S. Zuckerman and Hugh L. Montgomery., (2013), *An introduction to The Theory of Numbers*, Wiley India Pvt. Ltd., Fifth Edition, Chennai.

1. David M. Burton, (2010), *Elementary Number Theory*, Tata McGraw-Hill Education Pvt. Ltd., Sixth Edition, New Delhi.
2. George E. Andrews , (1992), *Number Theory*, Hindustan Publishing Corporation, New Delhi.
3. Martin Erickson and Anthony Vazzana. (2009), *Introduction to Analytic Number Theory*, Chapman and Hall /CRC publications, New Delhi.

- https://www.maths.ed.ac.uk/~v1ranick/papers/borevich.pdf
- http://www2.math.uu.se/~astrombe/talteori2016/lindahl2002.pdf
- http://math.uga.edu/~pete/4400FULL.pdf
- https://www.youtube.com/watch?v=SCvtxjpVQms
- https://nptel.ac.in/content/storage2/courses/111103020/module1_lec1.pdf

Course Outcomes

After completion of this course, the students will be able to:

CO1	Demonstrate and apply division algorithm in integers and define factorization using primes.
CO2	Classify and solve the Chinese Reminder problem using congruences.
CO3	Determine Quadratic residues.
CO4	Explain arithmetic functions and also analyze their properties.
CO5	Recall prime factorization and solve special types of Diophantine equations.

Mapping of Course Outcomes (COs) with Programme Specific Outcomes (PSOs)

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	3	2	2	0
CO2	3	2	2	2	0
CO3	2	0	2	0	0
CO4	1	2	3	0	0
CO5	2	2	3	0	0

3. High; 2. Moderate ; 1. Low

Articulation Mapping - K Levels with Course Outcomes (COs)

<table>
<tr><th rowspan="3">Units</th><th rowspan="3">Cos</th><th rowspan="3">K – Level</th><th colspan="2">Section A</th><th>Section B</th><th>Section C</th></tr>
<tr><th colspan="2">MCQs</th><th>Either/or Choice</th><th>Open Choice</th></tr>
<tr><th>No.Of Questions</th><th>K-Level</th><th>No.Of Questions</th><th>No.Of Questions</th></tr>
<tr><td>1</td><td>CO1</td><td>Up to K3</td><td>2</td><td>K1&K2</td><td>2(K2&K2)</td><td>K3</td></tr>
<tr><td>2</td><td>CO2</td><td>Up to K3</td><td>2</td><td>K1&K2</td><td>2(K2&K2)</td><td>K3</td></tr>
<tr><td>3</td><td>CO3</td><td>Up to K3</td><td>2</td><td>K1&K2</td><td>2(K2&K2)</td><td>K3</td></tr>
<tr><td>4</td><td>CO4</td><td>Up to K4</td><td>2</td><td>K1&K2</td><td>2(K3&K3)</td><td>K4</td></tr>
<tr><td>5</td><td>CO5</td><td>Up to K3</td><td>2</td><td>K1&K2</td><td>2(K3&K3)</td><td>K3</td></tr>
<tr><td colspan="3">No of Questions to be asked</td><td>10</td><td></td><td>10</td><td>5</td></tr>
<tr><td colspan="3">No of Questions to be answered</td><td>10</td><td></td><td>5</td><td>3</td></tr>
<tr><td colspan="3">Marks for each Question</td><td>1</td><td></td><td>4</td><td>10</td></tr>
<tr><td colspan="3">Total Marks for each Section</td><td>10</td><td></td><td>20</td><td>30</td></tr>
</table>

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

Distribution of Section –wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (Either/or)	Section C (Either/or)	Total Marks	% of Marks without choice	Consolidated (Rounded off)
K1	5			05	05	05
K2	5	24		29	29	29
K3		16	40	56	56	56
K4			10	10	10	10
Total Marks	10	40	50	100	100	100

Lesson Plan

Unit	Description	Hours	Mode
Unit I Preliminaries	**Description**	**Hours**	**Mode**
	a. Introduction	6	Chalk and talk, Power Point Presentation
	b. Divisibility	6	
	C.Primes	6	
Unit II Congruences	**Description**	**Hours**	**Mode**
	a.Congruences	6	Chalk and talk and Power Point Presentation
	b. Solutions of congruences	6	
	c. The Chinese remainder theorem	6	
Unit III Quadratic reciprocity	**Description**	**Hours**	**Mode**
	a.Quadratic residues	6	Chalk and talk, Power point presentation
	b.Quadratic reciprocity	8	
	c.The Jacobian symbol	6	
Unit IV Some functions of Number Theory	**Description**	**Hours**	**Mode**
	a. Greatest integer function	6	Chalk and talk, Power point presentation
	b. Arithmetic functions	6	
	c. The Mobius inversion formula	6	
Unit V Diophantine equations	**Description**	**Hours**	**Mode**
	a. The equation ax + by = c Pythagorean triangles	6	Chalk and talk, Power point presentation
	b. Simultaneous linear equation	5	
	c. Pythagorean triangles	5	

Course designed by Mrs. N. Sumathi and Mrs. S. Lathamaheswari.

Programme	M.Sc	Programme Code	PMA
Course Code	**20PMAN31**	Number of Hours/Cycle	**6**
Semester	**III**	Max. Marks	**100**
Part	**IV**	**Credit**	**5**
Non Major Elective Course I			
Course Title	**Mathematics for competitive Examinations**		
Cognitive Level		**Up to K4**	

Preamble

This course deals with logical reasoning and problem solving , general aptitude techniques, identify business applications in Mathematics, know about various concepts in statistics, explore and study how to calculate percentage, profit and loss, ratio and proportions.

Unit I	**Logical Reasoning**	**18 Hours**
	Problems on Numbers - Problem on Ages – Average - Odd man Out & Series.	
Unit II	**Logical Reasoning**	**18 Hours**
	Time & work - Time & Distance - Pipes & cisterns.	
Unit III	**Quantitative Aptitude**	**20 Hours**
	Percentage - Profit and Loss - Ratio and Proportions	
Unit IV	**Business Applications**	**18 Hours**
	Stocks and Shares - Permutations and Combinations.	
Unit V	**Data Interpretation**	**16 Hours**
	Tabulation – Bar Graphs – Pie Charts – Line Graphs.	

Pedagogy

Chalk and talk, Power point presentation, Group Discussion.

Text Books

1. Agarwal.R.S., (2012), "*Quantitative Aptitude*", S. Chand and Company

Reference Books

1. Pratiyogita Kiran , (2019), "*Quantitative Aptitude Numerical Ability*", Think Tank of Kiran Prakashan.
2. Arun Sharma, (2019) , "*Teach Yourself Quantitative Aptitude*", McGraw Hill publication.
3. Sarvesh K. Verma, (2016), "*Quantitative Aptitude Quantum Cat*", Arihant publication.
4. P.Sivarama Krishna Das, C.Vijayakumari (2010), "Statistics", Viji's academy

E-Resources

- http// mathforum.org
- http:// ocw.mit edu/ocwweb/mathematics
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- https://digital.com/blog/profit-loss-statement/
- https://www.khanacademy.org/math/pre-algebra/pre-algebra-ratios-rates

Course Outcomes

After completion of this course, the students will be able to:

CO1	Analyze various types of problems with logical reasoning.
CO2	Solving skills in logical reasoning.
CO3	Apply the formula and perform calculations through quantitative aptitude.
CO4	Apply the analytical techniques and knowledge in business.
CO5	Analyze the various concepts in data interpretation.

Mapping of Course Outcomes (COs) with Programme Specific Outcomes (PSOs)

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	2	2	0	2
CO2	3	2	2	0	2
CO3	3	2	2	3	2
CO4	3	2	2	3	2
CO5	3	2	2	0	2

3. High; 2. Moderate ; 1. Low

Articulation Mapping - K Levels with Course Outcomes (COs) (Model)

Units	**COs**	**K-Level**	**Section A**		**Section B**	**Section C**
			MCQs		**Either/ or Choice**	**Open Choice**
			No. Of Questions	**K-Level**	**No. Of Questions**	**No. Of Questions**
1	CO1	Up to K3	2	K1&K2	2(K3&K3)	K3
2	CO2	Up to K4	2	K1&K2	2(K2&K2)	K4
3	CO3	Up to K3	2	K1&K2	2(K2&K2)	K3
4	CO4	Up to K3	2	K1&K2	2(K2&K2)	K3
5	CO5	Up to K3	2	K1&K2	2(K3&K3)	K3
No of Questions to be Asked			10		10	5
No of Questions to be answered			10		5	3
Marks for each Question			1		4	10
Total marks for each Section			10		20	30

K1 – Remembering and recalling facts with specific answers

K2 – Basic understanding of facts and stating main ideas with general answers

K3 – Application oriented – Solving problems

K4 – Examining, analyzing, presentation and make inferences with evidences

Distribution of Section - wise Marks with K Levels (Model)

K Levels	Section A (No Choice)	Section B (Either/or)	Section C (Open Choice)	Total Marks	% of Marks without Choice	Consolidated (Rounded off)
K1	5			5	5	5
K2	5	24		29	29	29
K3		16	40	56	56	56
K4			10	10	10	10
Total Marks	10	40	50	100	100	100

Lesson Plan

	Description	Hours	Mode
Unit I Logical Reasoning	**a.** Problems on Numbers	4	Chalk and talk, Power point presentation
	b. Problem on Ages	4	
	c. Average	5	
	d. Odd man Out & Series	5	
Unit II Logical Reasoning	**Description**	**Hours**	**Mode**
	a. Time & Work	6	Chalk and talk, Power point presentation
	b. Time & Distance	6	
	c. Pipes & cisterns.	6	
Unit III Quantitative Aptitude	**Description**	**Hours**	**Mode**
	a. Percentage	7	Chalk and talk, Power point presentation
	b. Profit and Loss	6	
	c. Ratio and Proportions	7	
Unit IV Business Applications	**Description**	**Hours**	**Mode**
	a. Stocks and shares	8	Chalk and talk, Power point presentation
	b. Permutations and Combinations	10	
Unit V Data Interpretation	**Description**	**Hours**	**Mode**
	a. Tabulation	4	Chalk and talk, Power point presentation
	b. Bar Graphs	4	
	c. Pie Charts	4	
	d. Line Graphs	4	

Course designed by Mrs. K. Sujatha and A. Mohamed Ali

Programme	**M.Sc**	**Programme Code**	**PMA**
Course Code	**20PMAC41**	Number of Hours/Cycle	**6**
Semester	**IV**	Max. Marks	**100**
Part	**III**	**Credit**	**5**
CORE COURSE XIV			
Course Title	**Complex Analysis**		
Cognitive Level		**Up to K4**	

Preamble

This course deals with Cauchy integral formula and local properties of analytic functions. Expose to general form of Cauchy's theorem. Understand properties of Harmonic functions on a disc and concerned results. Introduce series and product developments.

Unit I	**Analytic Functions**	**20 Hours**
	Curves in the Argand plane – Functions of a complex variable - Neighbourhood of a point – Limits and continuity – Differentiability – Analytic, holomorphic and regular functions – The necessary and sufficient conditions for f(z) to be analytic – Polar Form of Cauchy-Riemann Equations – Derivative of w = f(z) in polar form – Orthogonal system – Harmonic function – Methods of constructing A Regular function (Milne-Thomson's method).	
Unit II	**Power Series**	**16 Hours**
	Sequences – Infinite series – sequences and series of functions – Principal of uniform convergence of sequence – Cauchy's criterion for series – Power series.	
Unit III	**Complex Integration**	**20 Hours**
	Line Integrals as functions of Arcs – Cauchy's Fundamental theorem – Cauchy's Integral formula – Derivative of an analytic function – Higher order Derivatives of an analytic function – Poisson's Integral formula for a Circle – Morera's Theorem – Cauchy's Inequality.	
Unit IV	**Complex Integration**	**16 Hours**
	Integral Function – Expansion of Analytic Functions at power series – The Zeros of an Analytic function – Singularities of an Analytic function .	
Unit V	**The Calculus of Residues**	**18 Hours**
	Maximum Modulus Principle – The Excess of the Number of Zeros over the Number of Poles of the Meromorphic function (The Argument Principle) – Rouche's Theorem – Schwarz lemma – Fundamental theorem of Algebra - Residue at pole – Computation of Residue At a Finite Pole – Residue at Infinity – Computation of Residue at Infinity - Cauchy's Residue Theorem.	

Pedagogy

Chalk and talk, Power point presentation, Group Discussion.

Text Book

1. Vasishtha.A.R., (2016), "*Complex Analysis*", SatyendraRastogi "Mitra" for Krishna Prakahsan Media Private Limited.

Reference Books

1. Karunakaran.V., (2005), "*Complex Analysis*" , Narosa Publication ,Second Edition.
2. Lars V. Ahlfors, (2017), "*Complex Analysis*", McGraw Hill Education (India) Private Limited.
3. Roopkumar.R., (2015), "*Complex Analysis*", Pearson.
4. Ponnusamy.S., (2011), "*Foundation of complex Analysis*", Narosaook Distributors.
5. Singh.A.P., (2017), "*Complex Analysis*", Info study Publications.

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- https://www.youtube.com/watch?v=OQQqbV32b78
- https://www.youtube.com/watch?v=NqZUHJgitHk
- https://www.youtube.com/watch?v=jm0JLx9cT5c&t=2s

Course Outcomes

After completion of this course, the students will be able to:

CO1	Apply the concepts of analyticity, Cauchy – Riemann relations and harmonic functions are then introduced.
CO2	Analyze sequence and series of analytic functions and types of convergence and familiar of power series.
CO3	Analyze complex contour integrals and apply the Cauchy integral theorem in its various versions and the Cauchy integral formula.
CO4	Understand the ideas of complex integration for solving related problems and establishing theoretical results.
CO5	Classify singularities and poles, find residue and evaluate complex integrals using the residue theorem..

Mapping of Course Outcomes (COs) with Programme Specific Outcomes

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	2	2	3	2
CO2	3	2	2	0	2
CO3	3	2	2	3	2
CO4	3	2	2	3	2
CO5	3	2	2	0	2

3. High; 2. Moderate ; 1. Low

Articulation Mapping - K Levels with Course Outcomes (COs) (Model)

Units	Cos	K-Level	Section A		Section B	Section C
			MCQs		Either/ or Choice	Open Choice
			No. Of Questions	K-Level	No. Of Questions	No.Of Questions
1	CO1	Up to K3	2	K1&K2	2(K2&K2)	K3
2	CO2	Up to K3	2	K1&K2	2(K3&K3)	K3
3	CO3	Up to K4	2	K1&K2	2(K3&K3)	K4
4	CO4	Up to K3	2	K1&K2	2(K2&K2)	K3
5	CO5	Up to K4	2	K1&K2	2(K3&K3)	K4
No of Questions to be Asked			10		10	5
No of Questions to be Answered			10		5	3
Marks for each Question			1		4	10
Total Marks for each Section			10		20	30

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

Distribution of Section - wise Marks with K Levels (Model)

K Levels	Section A (No Choice)	Section B (Either/or)	Section C (Open Choice)	Total Marks	% of Marks without Choice	Consolidated (Rounded off)
K1	5			5	5	5
K2	5	16		21	21	21
K3		24	30	54	54	54
K4			20	20	20	20
Total Marks	10	40	50	100	100	100

Lesson Plan

	Description	Hours	Mode
Unit I Analytic Functions	**a.** Curves in the Argand plane	2	Chalk and talk, Power point presentation
	b. Functions of a complex variable	2	
	c. Neighbourhood of a point	2	
	d. Limits and continuity	2	
	e. Limits and continuity	2	
	f. Differentiability	2	
	g. Analytic, holomorphic and regular Functions	2	
	h. The necessary and sufficient conditions for f(z) to be analytic	1	
	i. Polar Form of Cauchy-Riemann Equations	1	
	j. Derivative of w = f(z) in polar form	1	
	k. Orthogonal system	1	
	l. Harmonic function	1	
	m. Methods of constructing A Regular function (Milne-Thomson's method)	1	
Unit II Power Series	**Description**	**Hours**	**Mode**
	a. Sequences , Infinite series, sequences and series of functions	3	Chalk and talk, Power point presentation
	b. Principal of uniform convergence of Sequence	4	
	c. Principal of uniform convergence of Sequence	3	
	d. Cauchy's criterion for series	3	
	e. Power series	3	
Unit III Complex Integration	**Description**	**Hours**	**Mode**
	a.Line Integrals as functions of Arcs	1	Chalk and talk, Power point presentation
	b. Cauchy's Fundamental theorem	2	
	c. Cauchy's Integral formula	2	
	d. Derivative of an analytic function	3	
	e. Higher order Derivatives of an analytic Function	3	
	f. Poisson's Integral formula for a Circle	3	
	g. Morera's Theorem	3	
	h. Cauchy's Inequality	3	
Unit IV Complex Integration	**Description**	**Hours**	**Mode**
	a.Integral Function	4	Chalk and talk, Power point presentation
	b. Expansion of Analytic Functions at power series	4	
	c. The Zeros of an Analytic function	4	
	d. Singularities of an Analytic function	4	
Unit V The Calculus of Residues	**Description**	**Hours**	**Mode**
	a.Maximum Modulus Principle	2	Chalk and talk, Power point presentation
	b. The Excess of the Number of Zeros over the Number of Poles of the Meromorphic function (The Argument Principle)	2	

	c. Rouche's Theorem	2	
	d. Schwarz lemma	2	
	e. Fundamental theorem of Algebra	2	
	f. Residue at pole, Computation of Residue At a Finite Pole	2	
	g. Residue at Infinity, Computation of Residue at Infinity	3	
	h. Cauchy's Residue Theorem	3	

Course designed by K. Sujatha and N. Sumathi

Programme	M.Sc	Programme Code	PMA
Course Code	**20PMAC42**	Number of Hours/Cycle	**6**
Semester	**IV**	Max. Marks	**100**
Part	**III**	**Credit**	**5**
CORE COURSE XV			
Course Title	**Functional Analysis**		
Cognitive Level		**Up to K4**	

Preamble

This course deals with the hard core of Functional Analysis and to have a clear picture about Banach spaces and theorems related to it and to know the ideas of Complex Banach spaces and realize deeply about Hilbert spaces and its properties and explore and study about the nature and properties of operators.

Unit I	Banach Spaces	18 Hours
	Introduction – Concept of Norm – Normed Linear Space – Banach Space – Quotient and Subspaces of Banach Spaces.	
Unit II	**Banach Spaces**	**18 Hours**
	Continuous Linear Transformations – Norm of a Continuous Linear Transformation – Equivalent Norms – Continuous Linear Functionals – Hahn Banach Theorem .	
Unit III	**Banach Spaces**	**20 Hours**
	The Open Mapping Theorem – Projections – Closed Graph Theorem – The Natural Embedding of N in N** - Uniform Bounded Principle.	
Unit IV	**Hilbert Spaces**	**16 Hours**
	Introduction – Inner Product Spaces – Hilbert Spaces – Properties of Hilbert Spaces – Orthogonality and Orthogonal Compliments – Orthogonal Set.	
Unit V	**Hilbert Spaces**	**18 Hours**
	Complete Orthonormal Set – The Gram Schmidt Orthonormalization Process – The Conjugate Space H* - Adjoint of an Operator – Self Adjoint Operator – Order Relations – Positive, Normal and Unitary Operators.	

Pedagogy

Chalk and talk, Power point presentation, Group Discussion.

Text Book

1. Dr. Sudhir K. Pundir and Dr. Rimple Pundir., (2017), " *Integration Theory and Functional Analysis*" , Pragati Prakasan Educational Publishers, Meerut.

Reference Books

1. Simmons.G.F., (2017), " *Introduction to Topology and Modern Analysis*" , McGraw Hill Education India Private Limited, New Delhi.
2. Bachman.G., and Narici.L., (1966) , "*Functional Analysis*", Academic Press, New York.
3. Somasundaram.D., (2015), "*A First course in Functional Analysis*", Narosa
4. Balmohan . V. Limaye, (2014), "*Functional Analysis*", New Age International Publication.
5. Ponnusamy.S., (2008), "*Foundation of Functional Analysis*" , Narosa Book Distributors.

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- https://www.youtube.com/watch?v=kSNk6-0coJg
- https://www.youtube.com/watch?v=2jlOAJPbwRY

Course Outcomes

After completion of this course, the students will be able to:

CO1	Learn the basic concepts of normed linear space and their properties with examples.
CO2	Identity banach spaces and Analyse their theorems with other types of spaces.
CO3	Explain the open mapping theorem and the projections ,natural embedding and uniform bounded principle.
CO4	Examine the analytical technique and theoretical knowledge in Hilbert space. Find out and determine orthogonal set.
CO5	Describe the relevance of operator theory in Hilbert space.

Mapping of Course Outcomes (COs) with Programme Specific Outcomes

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	2	2	2	2	2
CO2	3	2	2	0	2
CO3	3	2	2	0	2
CO4	3	2	2	3	2
CO5	2	2	2	2	2

3. High; 2. Moderate ; 1. Low

Articulation Mapping - K Levels with Course Outcomes (COs) (Model)

Units	**COs**	**K-Level**	**Section A**		**Section B**	**Section C**
			MCQs		**Either/ or Choice**	**Open Choice**
			No. Of Questions	**K-Level**	**No. Of Questions**	**No. Of Questions**
1	CO1	Up to K3	2	K1&K2	2(K2&K2)	K3
2	CO2	Up to K4	2	K1&K2	2(K3&K3)	K4
3	CO3	Up to K4	2	K1&K2	2(K3&K3)	K4

4	CO4	Up to K3	2	K1&K2	2(K2&K2)	K3
5	CO5	Up to K3	2	K1&K2	2(K2&K2)	K3
No of Questions to be Asked			10		10	10
No of Questions to be answered			10		5	3
Marks for each Question			1		4	10
Total marks for each Section			10		20	30

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

Distribution of Section - wise Marks with K Levels (Model)

K Levels	**Section A (No Choice)**	**Section B (Either/or)**	**Section C (Open choice)**	**Total Marks**	**% of Marks without Choice**	**Consolidated (Rounded off)**
K1	5			5	5	5
K2	5	24		29	29	29
K3		16	30	46	46	46
K4			20	20	20	20
Total Marks	10	40	50	100	100	100

Lesson Plan

Unit	**Description**	**Hours**	**Mode**
Unit I Banach Spaces	**a.** Introduction	2	Chalk and talk, Power point presentation
	b. Concept of Norm	4	
	c. Normed Linear Space	4	
	d. Banach Space	4	
	e. Quotient and Subspaces of Banach Spaces	4	
Unit II Banach Spaces	**Description**	**Hours**	**Mode**
	a. Continuous Linear Transformations	3	Chalk and talk, Power point presentation
	b. Norm of a Continuous Linear Transformation	4	
	c. Equivalent Norms	3	
	d. Continuous Linear Functionals	4	
	e. Hahn Banach Theorem	4	
Unit III Banach Spaces	**Description**	**Hours**	**Mode**
	a. The Open Mapping Theorem	4	Chalk and talk, Power point presentation
	b. Projections	3	
	c. Closed Graph Theorem	4	
	d. The Natural Embedding of N in N**	5	
	e. Uniform Bounded Principle	4	
Unit IV Hilbert Spaces	**Description**	**Hours**	**Mode**
	a. Introduction	3	Chalk and talk, Power point
	b. Inner Product Spaces	2	
	c. Hilbert Spaces	3	

	d. Properties of Hilbert Spaces	2	presentation
	e. Orthogonality and Orthogonal Compliments	3	
	f. Orthogonal Set	3	
Unit V Hilbert Spaces	**Description**	**Hours**	**Mode**
	a. Complete Orthonormal Set	2	Chalk and talk, Power point presentation
	b. The Gram Schmidt Orthonormalization Process	2	
	c. The Conjugate Space H*	2	
	d. Adjoint of an Operator	3	
	e. Self Adjoint Operator	3	
	f. Order Relations	3	
	g. Positive, Normal and Unitary Operators	3	

Course designed by N. Sumathi

Programme	**M.Sc**	**Programme Code**	**PMA**
Course Code	**20PMAC43**	Number of Hours/Cycle	**6**
Semester	**IV**	Max. Marks	**100**
Part	**III**	**Credit**	**5**
CORE COURSE XVI			
Course Title	**Differential Geometry**		
Cognitive Level		**Up to K3**	

Preamble

This course deals with space curves and the intrinsic properties of surface and derive the Fundamental theorem for space curves, knowledge about Curvature and torsion of surfaces , derive the Intrinsic equations of space curves and Differential equations for geodesic.

Unit I	**Theory of Space Curve**	**18 Hours**
	Arc length – Tangent, Normal and Binormal – Curvature and torsion of a curve given as intersection of two surfaces – Contact between curves and surfaces – Tangent surface –Involutes and Evolutes – Intrinsic equations – Fundamentals existence Theorem for space curves – Helices.	
Unit II	**The Metric: Local Intrinsic Properties of a Surface**	**18 Hours**
	Definition of a surface – Curves on a surface – Surface of revolution – Helicoids – Metric – Direction Coefficients – Famillies of Curves – Isometric correspondence – Intrinsic properties.	
Unit III	**The Metric: Local Intrinsic Properties of a Surface**	**20 Hours**
	Geodesics – Canonical Geodesic equations – Normal property of Geodesics – Existence theorems – Geodesics parallels - Geodesics Curvature.	
Unit IV	**The Second fundamental form: Local Non-Intrinsic Properties of a Surface**	**16 Hours**
	The Second Fundamental Form – Principal curvatures – Lines of curvature.	
Unit V	**The Second fundamental form: Local Non-Intrinsic Properties of a Surface**	**18 Hours**
	Developables – Developables associated with space curve – Developables associated with curves on surfaces – Minimal surfaces - Ruled surfaces – The fundamental equations of surface theory.	

Pedagogy

Chalk and talk, Power point presentation, Group Discussion.

Text Book

Willmore.T.J.,2008, *An Introduction to Differential Geometry*, Oxdord University press.

REFERENCE BOOKS

1. Weatherburn.C.E ,1930, *Differential Geometry of Three dimensions*, University Press, Cambridge.
2. Somasundaram.D ,2008, *Differential Geometry*, Narosa Book Distributors.
3. Jeffery Lee.M ,2009, *Manifolds and Differential Geometry*, Americian Mathematical Society.
4. Thorpe J.A., 1997, *Elementary topics in Differential Geometry*, Springs Verlag.
5. Mittal S.C. and Agarwall D.C., (2001), *Differential Geometry*, Krishna Prakashan Media (P) Limited.

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- https://www.youtube.com/watch?v=SgBnGBhVQec

Course Outcomes

After completion of this course, the students will be able to:

CO1	apply knowledge in space curves.
CO2	demonstrate the metric concepts in surface.
CO3	illustrate Geodesics on curves.
CO4	apply surfaces of revolution.
CO5	calculate principal curvature and line of curvature.

Mapping of Course Outcomes (COs) with Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	3	2
CO2	2	2	2	2	2
CO3	3	2	2	0	2
CO4	3	2	2	0	2
CO5	3	2	2	3	2

3. High; 2. Moderate ; 1. Low

Articulation Mapping - K Levels with Course Outcomes (COs) (Model)

Units	Cos	K-Level	Section A		Section B	Section C
			MCQs		Either/ or Choice	Open Choice
			No. Of Questions	K-Level	No. Of Questions	No. Of Questions
1	CO1	Up to K3	2	K1&K2	2(K2&K2)	K3
2	CO2	Up to K2	2	K1&K2	2(K2&K2)	K2
3	CO3	Up to K3	2	K1&K2	2(K2&K2)	K3
4	CO4	Up to K3	2	K1&K2	2(K2&K2)	K3
5	CO5	Up to K3	2	K1&K2	2(K3&K3)	K3
No of Questions to be Asked			10		10	5
No of Questions to be Answered			10		5	3
Marks for each Question			1		4	10
Total Marks for each Section			10		20	30

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

Distribution of Section - wise Marks with K Levels (Model)

K Levels	Section A (No Choice)	Section B (Either/or)	Section C (Open choice)	Total Marks	% of Marks without Choice	Consolidated (Rounded off)
K1	5			5	5	5
K2	5	32	10	47	55	55
K3		8	40	48	30	30
Total Marks	10	40	50	100	100	100

Lesson Plan

Unit	Description	Hours	Mode
I **Theory of Space Curve**	**a.** Arc length, Tangent, Normal and Binormal	**4**	Chalk and talk, Power point presentation
	b. Curvature and torsion of a curve given as intersection of two surfaces, Contact between curves and surfaces	**5**	
	c. Tangent surface, Involutes and Evolutes Intrinsic equations	**5**	
	d. Fundamentals existence Theorem for space curves, Helices.	**4**	
Unit	**Description**	**Hours**	**Mode**
II **The Metric: Local Intrinsic Properties of a Surface**	**a.** Definition of a surface, Curves on a surface, Surface of revolution	**5**	Chalk and talk, Power point presentation
	b. Helicoids, Metric	**3**	
	c. Direction Coefficients, Famillies of Curves	**3**	
	d. Isometric correspondence	**4**	
	e. Intrinsic properties	**3**	
Unit	**Description**	**Hours**	**Mode**
III **The Metric: Local Intrinsic Properties of a Surface**	**a.**Geodesics	**3**	Chalk and talk, Power point presentation
	b. Canonical Geodesic equations	**5**	
	c. Normal property of Geodesics	**4**	
	d. Existence theorems	**4**	
	e. Geodesics parallels – Geodesics Curvature	**4**	
Unit	**Description**	**Hours**	**Mode**
IV **The Second fundamental form: Local Non-Intrinsic Properties of a Surface**	**a.** The Second Fundamental Form	**5**	Chalk and talk, Power point presentation
	b. Principal curvatures	**6**	
	c. Lines of curvature	**5**	
Unit	**Description**	**Hours**	**Mode**
V **The Second fundamental form: Local Non-Intrinsic Properties of a Surface**	**a.**Developables, Developables associated with space curve	**3**	Chalk and talk, Power point presentation
	b. Developables associated with curves on surfaces	**4**	
	c. Minimal surfaces	**3**	
	d. Ruled surfaces	**3**	
	e. The fundamental equations of surface theory	**5**	

Course designed by A. Mohamed Ali

Programme	M.Sc	Programme Code	PMA
Course Code	**20PMAE41**	Number of Hours/Cycle	**6**
Semester	**IV**	Max. Marks	**100**
Part	**IV**	**Credit**	**5**
CORE ELECTIVE COURSE III			
Course Title	**Probability and Statistics**		
Cognitive Level		**Up to K4**	

Preamble

This course deals with the significance of characteristic functions, study about various discrete and continuous type distributions, understand about special cases of limit theorems, understand more about the limit theorems pertaining to limit distribution function and learn the importance of the theory of Markov Stochastic processes.

Unit I	**Distribution of Random Variables**	**18 Hours**
	Introduction – Algebra of a Sets – Set function – The Probability Set Function – Random Variables – The Probability Density Function – The Distribution Function - Certain Probability Models - Mathematical Expectation – Some Special Mathematical Expectations.	
Unit II	**Conditional Probability and Stochastic Independence**	**18 Hours**
	Conditional Probability – marginal and Conditional Distributions – The Correlation Coefficient – Stochastic Independence.	
Unit III	**Some Special Ditributions**	**20 Hours**
	The binomial, Trinomial and multinomial Distributions – The Poisson Distributions – The Gamma and Chi square distributions.	
Unit IV	**Distributions of Functions of Random Variables**	**16 Hours**
	Transformation of Variables of the Discrete Type - Transformation of Variables of the Continuous Type.	
Unit V	**Distributions of Functions of Random Variables**	**18 Hours**
	The t and F distributions – Extensions of the Change-of-Variable Technique.	

Pedagogy

Chalk and talk, Power point presentation, Group Discussion.

Text Book

1. Kadarkarai Thangam.K., and Subas Chandra Bose.A., (1988), "*Probablity And Statistics*" Jeyalakshmi Publishers, Tuticorin.

Reference Books

1. Roger E.Kirk, (2007), "*Statistics*" , Fifth Edition.
2. Narayanan Nadar.E., (2007), " *Statistics*", Second Edition.
3. Gupta.S. C., and Kapoor.V. K.., (2014), "*Fundamentals of Mathematical Statistics*", sultan chand and sons.
4. Vijay . K. Rohatgi, (2008), "*An Introduction to Probability and Statistics*" , Wiley.

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- https://www.youtube.com/watch?v=58ObxiXbazI&list=PLuHZxhktm95Pbbd13A7oqbiwFnSDqCoN

- https://www.youtube.com/watch?v=KaRRdQB7aGA
- https://www.youtube.com/watch?v=9x4HNb8r6vk

Course Outcomes

After completion of this course, the students will be able to:

CO1	Make use of the concepts of probability, including discrete and continuous random variables, Probability distributions, conditioning,independence, expectations.
CO2	Apply the basic rules and prove the theorems in probability including Marginal and Conditional distributions.
CO3	Classified and Apply the method of some special distributions .
CO4	Apply the concepts and Solve the problems of Transformation of Variables of the Discrete and continuous type.
CO5	Apply the concepts and determine the hypothesis testing t and F distributions.

Mapping of Course Outcomes (COs) with Programme Specific Outcomes

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	2	2	1	3
CO2	3	2	2	3	2
CO3	3	2	2	3	2
CO4	3	2	2	3	2
CO5	3	2	2	3	2

3. High; 2. Moderate ; 1. Low

Articulation Mapping - K Levels with Course Outcomes (COs) (Model)

Units	**Cos**	**K-Level**	**Section A**		**Section B**	**Section C**
			MCQs		**Either/ or Choice**	**Open Choice**
			No. Of Questions	**K-Level**	**No. Of Questions**	**No. Of Questions**
1	CO1	Up to K3	2	K1&K2	2(K2&K2)	K2
2	CO2	Up to K3	2	K1&K2	2(K3&K3)	K3
3	CO3	Up to K4	2	K1&K2	2(K3&K3)	K4
4	CO4	Up to K3	2	K1&K2	2(K3&K3)	K3
5	CO5	Up to K3	2	K1&K2	2(K3&K3)	K2
No of Questions to be asked			10		10	05
No of Questions to be Answered			10		05	03
Marks for each Question			1		4	10
Total marks for each Section			10		20	30

K1 – Remembering and recalling facts with specific answers

K2 – Basic understanding of facts and stating main ideas with general answers
K3 – Application oriented – Solving problems
K4 – Examining, analyzing, presentation and make inferences with evidences

Distribution of Section - wise Marks with K Levels (Model)

K Levels	**Section A (No Choice)**	**Section B (Either/or)**	**Section C (Open choice)**	**Total Marks**	**% of Marks without Choice**	**Consolidated (Rounded off)**
K1	5			5	5	5
K2	5	08	20	33	33	33
K3		32	20	52	52	52
K4			10	10	10	10
Total Marks	10	40	50	100	100	100

Lesson Plan

Unit I Distribution of Random Variables	**Description**	**Hours**	**Mode**
	a. Introduction , Algebra of a Sets	2	Chalk and talk, Power point presentation
	b. Set function – The Probability Set Function	2	
	c. Random Variables	2	
	d. The Probability Density Function	3	
	e. The Distribution Function	3	
	f. Certain Probability Models	3	
	g. Mathematical Expectation, Some Special Mathematical Expectations	3	
Unit II Conditional Probability and Stochastic Independence	**Description**	**Hours**	**Mode**
	a. Conditional Probability	3	Chalk and talk, Power point presentation
	b. Marginal Distributions	4	
	c. Conditional Distributions	4	
	d. The Correlation Coefficient	4	
	e. Stochastic Independence	3	
Unit III Some Special Ditributions	**Description**	**Hours**	**Mode**
	a. The binomial Distributions	4	Chalk and talk, Power point presentation
	b. Trinomial Distributions	3	
	c. Multinomial Distributions	3	
	d. The Poisson Distributions	6	
	e. The Gamma and Chi square distributions	4	
Unit IV Distributions of Functions of Random Variables	**Description**	**Hours**	**Mode**
	a.Transformation of Variables of the Discrete Type	8	Chalk and talk, Power point presentation
	b. Transformation of Variables of the Continuous Type	8	
Unit V Distributions of Functions of Random Variables	**Description**	**Hours**	**Mode**
	a. The t and F distributions	8	Chalk and talk, Power point presentation
	b. Extensions of the Change-of-Variable Technique	10	

Course designed by – S. Latha Maheswari and N. Sumathi.

Programme	M.Sc	Programme Code	PMA
Course Code	**20PMAE42**	Number of Hours/Cycle	**6**
Semester	**IV**	Max. Marks	**100**
Part	**IV**	**Credit**	**5**
CORE ELECTIVE COURSE IV			
Course Title	**Classical Mechanics**		

Preamble

This course deals with Hamiltonian's Principles and Lagrange's equations, velocity dependent potentials, Hamilton's Jacobi Equation and Separability

Unit I	**Introductory Concepts**	**16 Hours**
	Mechanical system - Generalized Coordinates Constraints - Virtual Work - Energy and Momentum.	
Unit II	**Lagrange's Equations**	**18 Hours**
	Derivations of Lagrange's Equations - Examples - Integrals of Motion – Simple problems.	
Unit III	**Rayleigh's dissipation function**	**20 Hours**
	Rayleigh's dissipation function – impulsive motion – velocity dependent potentials.	
Unit IV	**Hamilton's Principle**	**18 Hours**
	Hamilton's Principle - Hamilton's equation – other variational principles.	
Unit V	**Hamilton - Jacobi Theory**	**18 Hours**
	Hamilton's Principle function - The Hamilton's Jacobi Equation - Separability – Simple problems.	

Pedagogy

Chalk and talk, Power point presentation, Group Discussion.

Text Book

1. Greenwood,D.T.,(1997), *Programmical Dynamics*, Dover Publication, New York.

Reference Books

1. Gantmacher.,(1975), *Lectures in Analytic Mechanics*, MIR Publishers, Moscow.
2. Loney,S.L.,(1979), *An Elementary Treatise on Statics*, Kalyani Publishers, New Delhi.
3. Deshmukh P.C., (2020), *Foundations of Classical Mechanics*, Cambridge University Press, United Kingdom.

E-Resources

- https://nptel.ac.in/courses/112/106/112106286/
- https://pitt.edu/~qiw4/Academic/ENGR0135/Chapter4-2.pdf
- https://www.civil.iitb.ac.in/~naresh/teaching/ce221/L1_concept%20of%20stress_v1.pdf
- http://fanclub.thewho.com/classical_dynamics_by_greenwood_pdf.pdf
- https://ocw.mit.edu/courses/mechanical-engineering/2-001-mechanics-materials-i-fall-2006/lecture-notes/

Course Outcomes

After completion of this course, the students will be able to:

CO1	Discuss the basic concepts of Mechanical System.
CO2	Explain the derivation of Lagrange's Equation for holonomic and non holonomic system and solve simple problems.
CO3	Analyze the applications of Impulsive Motion.
CO4	Describe the concept of Hamilton's principle and other variational principles.
CO5	Express the ideas of separability using Stackle's Theorem and solving problems.

Mapping of Course Outcomes (COs) with Programme Specific Outcomes (PSOs)

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**2**	**0**	**2**	**2**	**0**
CO2	**0**	**2**	**2**	**2**	**0**
CO3	**2**	**0**	**3**	**0**	**2**
CO4	**2**	**2**	**1**	**2**	**0**
CO5	**0**	**2**	**2**	**2**	**0**

3. High; 2. Moderate ; 1. Low

Articulation Mapping - K Levels with Course Outcomes (COs)

Units	**Cos**	**K – Level**	**Section A MCQs**		**Section B Either or Choice**	**Section C Open Choice**
			No. Of Questions	**K-Level**	**No. Of Questions**	**No. Of Questions**
1	CO1	Up to K2	4	K1 & K2	2(K2&K2)	K2
2	CO2	Up to K3	4	K1 & K2	2(K2&K2)	K3
3	CO3	Up to K4	4	K1 & K2	2(K3&K3)	K4
4	CO4	Up to K2	4	K1 & K2	2(K2&K2)	K2
5	CO5	Up to K3	4	K1 & K2	2(K2&K2)	K3
No of Questions to be asked			20		10	10
No of Questions to be answered			20		5	5
Marks for each Question			1		6	10
Total Marks for each Section			20		30	50

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

Distribution of Section –wise Marks with K Levels

K Levels	**Section A (No Choice)**	**Section B (Either/or)**	**Section C (Either/or)**	**Total Marks**	**% of Marks without choice**	**Consolidated (Rounded off)**
K1	05			05	05	05
K2	05	32	20	57	57	57
K3		08	20	28	28	28
K4			10	10	10	10
Total Marks	10	40	50	100	100	100

Lesson Plan

Unit	Description	Hours	Mode
Unit I Introductory Concepts	**Description**	**Hours**	**Mode**
	a. Mechanical system	**4**	Chalk and talk, Power point presentation
	b. Generalized Coordinates Constraints	**4**	
	c. Virtual Work	**4**	
	d. Energy and Momentum	**4**	
Unit II Lagrange's Equations	**Description**	**Hours**	**Mode**
	a. Derivations of Lagrange's Equations	**3**	Chalk and talk, Power point presentation
	b. Examples	**4**	
	c. Integrals of Motion	**5**	
	d. Simple problems	**6**	
Unit III Rayleigh's dissipation function	**Description**	**Hours**	**Mode**
	a. Rayleigh's dissipation function	**6**	Chalk and talk, Power point presentation
	b. Impulsive motion	**8**	
	c. Velocity dependent potentials	**6**	
Unit IV Hamilton's Principle	**Description**	**Hours**	**Mode**
	a. Hamilton's Principle	**4**	Chalk and talk, Power point presentation
	b. Hamilton's equation	**6**	
	c. other variational principles	**8**	
Unit V Hamilton - Jacobi Theory	**Description**	**Hours**	**Mode**
	a. Hamilton's Principle function	**3**	Chalk and talk, Power point presentation
	b. The Hamilton's Jacobi Equation	**4**	
	c. Separability	**6**	
	d. Simple problems	**5**	

Course designed by Mrs. K.Sujatha, Mrs. N. Sumathi

<u>As our students find the existing examination pattern very difficult we would like to replace it with the following, for approval.</u>

Examination Pattern for Core and Allied Courses to be implemented from the Academic Year 2021-2022

Two Continuous Internal Assessment (CIA) and One End Semester Examination (ESE) is conducted .The marks are distributed as follows:

Nature of Study	CIA	ESE	Total
Theory	40	60	100
Practical	40	60	100

Continuous Internal Assessment (CIA) - UG

The pattern of question paper for Continuous Internal Assessment (CIA) for UG for III and IV semesters is as follows. The duration for the Internal test is 1½ hours. Equal importance is given to all the units.

Blue Print of the Question Paper (CIA)   Maximum Marks: 30

Sections	Types of questions	No. of questions	No. of questions to be answered	Marks for each question	Total Marks
A	Multiple Choice Questions	6	6	1	6
B	Paragraph Questions (Inbuilt choice)	3	3	4	12
C	Essay Questions (Open choice)	3	2	6	12
Total					30

Continuous Internal Assessment components are:

1. Two internal assessment is conducted for 30 marks each
   (The average of the marks of two internal assessments will be taken
   ((**30 + 30 / 2)** = 30)
2. Two Assignment to be submitted for 5 marks each
   (The average of two assignments is taken for 5 marks)
3. Seminar / Quiz / Group Discussion – 5 marks
   (If Quiz is conducted, the average of two quizzes is taken for 5 marks)
4. Third test may be allowed for absentees of anyone of the two assessments for genuine reasons.

Continuous Internal Assessment (CIA) - PG

The pattern of question paper for Continuous Internal Assessment (CIA) for PG for III and IV is as follows. The duration for the assessment is 2 hours. Equal importance is given to all the units.

Blue Print of the Question Paper (CIA)   Maximum Marks: 45

Sections	Types of questions	No. of questions	No. of questions to be answered	Marks for each question	Total Marks
A	Multiple Choice Questions	6	6	1	6
B	Paragraph Questions (Inbuilt choice)	5	5	3	15
C	Essay Questions (Open choice)	5	3	8	24
Total					45

Continuous Internal Assessment components are:

1. Two internal assessment is conducted for 45 marks each
   (The marks of two internal assessments will be converted into 30 marks (**(45+45)/3)** = 30)
2. Two Quizzes is to be conducted for 5 marks each (The average of two quizzes is taken for 5 marks)
3. Seminar / Group Discussion – 5 marks
4. Third test may be allowed for absentees of anyone of the two assessments for genuine reasons.

End Semester Examinations (ESE)

Duration of the End Semester Examination is 3 Hours. Equal importance is given to all the units. The pattern of Question Paper for the End Semester Examination is as follows:

Blue Print of the Question Paper (UG & PG) Maximum Marks:60

Sections	Types of questions	No. of questions	No. of questions to be answered	Marks for each question	Total Marks
A	Multiple Choice Questions	10	10	1	10
B	Paragraph Questions (Inbuilt choice)	5	5	4	20
C	Essay type Questions (Open choice)	5	3	10	30
	Total				60

Evaluation Pattern

Under Graduate

1. Passing minimum is 35% in external examination, out of 60 i.e. 21 out of 60 will be taken as pass mark for UG students.
2. An aggregate of 40 marks for UG (sum of Continuous Internal Assessment and End Semester Examination).

Post Graduate

1. A Passing minimum of 45% in external examination out of 60 i.e. 27 out of 60 will be taken as pass mark for PG students.
2. An aggregate of 50 marks for PG (sum of Continuous Internal Assessment and End Semester Examination).

Examination Pattern for Part IV Courses

As regards Part IV courses such as Skill Based, Non Major Elective. Value Education, and Environmental Studies Two Continuous Internal Assessment (CIA) and One End Semester Examination (ESE) is conducted .The marks are distributed as follows:

Nature of Study	CIA	ESE	Total
Theory	20	30	50
Practical	20	30	50

Continuous Internal Assessment (CIA) - UG

The pattern of question paper for Continuous Internal Assessment (CIA) for UG is as follows. The duration for the internal test is 1 hour. Equal importance is given to all the units.

Blue Print of the Question Paper (CIA) **Maximum Marks: 15**

Sections	Types of questions	No. of questions	No. of questions to be answered	Marks for each question	Total Marks
A	Paragraph Questions	5	5	2	10
B	Essay type Questions (open choice)	2	1	5	5
Total					15

Continuous Internal Assessment components are:

1. Two internal tests are conducted for 15 marks each
   (The average of the marks of two internal assessments will be taken ((**15+15) / 2)** = 15)
2. One Assignment is to be submitted for 5 marks

End Semester Examinations (ESE)

Duration of the End Semester Examination is 3 Hours. Equal importance is given to all the units. The pattern of Question Paper for the End Semester Examination is as follows:

Blue Print of the Question Paper (UG) **Maximum Marks: 30**

Sections	Types of questions	No. of questions	No. of questions to be answered	Marks for each question	Total Marks
A	Paragraph Questions	5	5	3	15
B	Essay type Questions (open choice)	5	3	5	15
Total					30

Evaluation Pattern
Under Graduate

1. Passing minimum is 35% in external examination, out of 30 i.e. 11 out of 30 will be taken as pass mark for UG students.
2. An aggregate of 40 marks for UG (sum of Continuous Internal Assessment and End Semester Examination).

Examination Pattern for Value Added Courses

As regards Extra Credit Value Added Courses, the study martial will be prepared by the course teacher. One Internal Assessment will be conducted for 25 marks and the End Semester Examination will be conducted for 50 marks and the evaluation will be made by the course teacher. The marks are distributed as follows:

Nature of Study	IA	ESE	Total
Theory	20	30	50
Practical	20	30	50

Continuous Internal Assessment (IA)

The pattern of question paper for Continuous Internal Assessment (CIA) for UG is as follows. The duration for the internal test is 1 hour. Equal importance is given to all the units.

Nature of Study	CIA	ESE	Total
Theory	20	30	50
Practical	20	30	50

Continuous Internal Assessment (IA)

The pattern of question paper for Internal Assessment (IA) is as follows. The duration for the internal test is 1 hour. Equal importance is given to all the units.

Blue Print of the Question Paper (CIA) Maximum Marks: 15

Sections	Types of questions	No. of questions	No. of questions to be answered	Marks for each question	Total Marks
A	Paragraph Questions	5	5	2	10
B	Essay type Questions (open choice)	2	1	10	10
Total					20

End Semester Examinations (ESE)

Duration of the End Semester Examination is 3 Hours. Equal importance is given to all the units. The pattern of Question Paper for the End Semester Examination is as follows:

Blue Print of the Question Paper Maximum Marks: 30

Sections	Types of questions	No. of questions	No. of questions to be answered	Marks for each question	Total Marks
A	Paragraph Questions	5	5	3	15
B	Essay type Questions (open choice)	5	3	5	15
Total					30

Evaluation Pattern

Under Graduate

1. Passing minimum is 35% in external examination, out of 30 i.e. 11 out of 30 will be taken as pass mark for UG students.
2. An aggregate of 40 marks for UG (sum of Continuous Internal Assessment and End Semester Examination).