(Estd. By Govt. of Uttarakhand, vide Shri Guru Ram Rai University Act no. 3 of 2017)
PATEL NAGAR, DEHRADUN-248001, UTTARAKHAND, INDIA

SYLLABUS OF M.Sc. MATHEMATICS

Two-year PG Programme (Generic and Professional)
(CHOICE BASED CREDIT SYSTEM)
DEPARTMENT OF MATHEMATICS
SCHOOL OF BASIC AND APPLIED SCIENCES

Based on NEP 2020

(w. e. f. 2024-2025)
(Revised on 30 July 2024)

Master of Science (Mathematics):

Two Year Programme- Choice Based Credit System Admission to Master's Program in Mathematics shall be through entrance examination conducted by University/Merit of qualifying exam and the program shall be based on the choice-based credit system in which credit defines the quantum of content/ syllabus prescribed for a course system and determines the number of hours of instruction per week.

The student shall be eligible for admission to a Master's Degree Program in Mathematics after he/she has successfully completed a three-year undergraduate degree or earned prescribed number of credits through the examinations conducted by university as equivalent to an undergraduate degree with minimum 45% marks in undergraduate course.

Core courses prescribed for every Semester shall be mandatory for all students registered for the Master's Program in Mathematics and shall carry minimum 80 credits. In order to qualify for a two year master's degree, a student must acquire a minimum of 80 credits.

For 2-year PG

Curricular Components		**Two Year PG Programme Minimum Credits**			
		Course Level	**Coursework**	**Research/ Thesis/ Project/ Patent**	**Total Credits**
PG Diploma		400	40	-	40
1st Year (1st & 2nd Semester)		400 500	24 16	-	40
Students who exist at the end of 1st year shall be awarded a Postgraduate Diploma					
2nd Year (3rd & 4th Semester)	Coursework & Research	500	20	20	40

Exit Point: For those who join 2-year PG programmes, there shall only be one exit point. Students who exit at the end of 1st year shall be awarded a Postgraduate Diploma.

Programme Educational Objectives (PEOs):

The Program Educational Objectives (PEOs) for Mathematics describe accomplishments that students are expected to attain after post-graduation. The educational objectives of M.Sc. Mathematics program are:

PEO1.	Research base, Apply their knowledge to secure acceptance in high quality research oriented graduate programs in mathematics at the national and international levels.
PEO2.	Scientific base, to explore the Analytical ability and join the modern industry /Laboratories
PEO3.	Explore the ability to short out the multi-disciplinary challenges in Mathematical way
PEO4.	Teaching base, To develop teaching skills, subject knowledge in the course of their study which will help them to shine in various field of basic and higher Education.
PEO5.	To acquire the significant opportunities in various service domains at national and international levels like banking, insurance, government jobs, defense, industry, and research.

Programme Objectives (PO's):

The objectives of M.Sc. Mathematics programme's are following:

PO1.	To cover the all main areas of Mathematics like Real Analysis, Functional Analysis, Measure Theory, Complex Analysis, Abstract Algebra, Topology, Differential equations, Integral equations, Calculus of variations, Differential Geometry, Mechanics, Fluid Dynamics, Operation research, Mathematical Statistics.
PO2.	The main motive of this Master's programme is deep understanding in the fundamental mathematics (graduate Mathematics) and lead to the advanced Mathematics and research oriented things.
PO3.	Students able to understand the route in between the different areas of Mathematics and understand the connectivity in subjects
PO4.	Students able to design the Mathematical model for different type of problems in Physical science and in Engineering like as Mechanical, Civil, Chemical etc.
PO5.	Can help to solve the problems based on Industrial mathematics.
PO6	Can help to solve the problems based on space science.
PO7.	Able to apply the mathematical reasoning to solve the subjective /objective problems and research ideas
PO8.	The skills and knowledge gained in this program will be helpful for modelling and solving of real life problems in scientific manner.
PO9:	Students are motivated and prepare for research studies in mathematics and related fields.
PO10:	Should be able to apply their skills and knowledge in various fields of studies including, science, engineering, commerce and management.
PO11:	able to develop the competitive skills to clear the National level exams like as NET, GATE DRDO exam for scientific post etc.
PO12:	Have sound knowledge of mathematical modelling, and computational techniques as required for employment in industry in various government and private sector.

Programme Specific Outcome (PSO's):

On successful completion of the Master programme (M.Sc.) in Mathematics, student will

PSO1:	Have a strong foundation in core areas of Mathematics, both pure and applied.
PSO2:	Student should be able to think in a critical manner and develop problem solving skills.
PSO3:	Communicate mathematical ideas effectively, in writing as well as orally
PSO4:	Able to formulate and develop mathematical arguments in a logical manner.

DURATION OF THE PROGRAMME: 2 YEARS

STUDY & EVALUATION SCHEME
(CHOICE BASED CREDIT SYSTEM)
MASTER OF SCIENCE IN MATHEMATICS

1. First year PG with course work for those students who have done three years B.Sc. course.

SEMESTER I

S. No.	Course Category	Course Code	Course Name	Periods				Evaluation scheme		Subject Total
				L	T	P	C	Sessional (Internal)	External (ESE)	
Theory										
1	Core	MMTC101	Differential Equations	4	0	0	4	40	60	100
2	Core	MMTC102	Abstract Algebra –I	4	0	0	4	40	60	100
3	Core	MMTC103	Complex Analysis	4	0	0	4	40	60	100
4	Core	MMTC104	Linear Programming Problems	4	0	0	4	40	60	100
5	Core	MMTCL105	Foundation Course in MATLAB	0	0	2	2	40	60	100
Practical										
6	Practical	MMTP106	Presentation / Viva	0	0	0	2	40	60	100
			Total	16	0	2	20	240	360	600

SEMESTER II

S. No.	Course Category	Course Code	Course Name	Periods				Evaluation scheme		Subject Total
				L	T	P	C	Sessional (Internal)	External (ESE)	
Theory										
1	Core	MMTC201	Abstract Algebra –II	4	0	0	4	40	60	100
2	Core	MMTC202	Discrete Structures	4	0	0	4	40	60	100
3	Core	MMTC203	Non-linear Programming Problems	4	0	0	4	40	60	100
4	Core	MMTC204	Real Analysis	4	0	0	4	40	60	100
5	Core	MMTCL205	Advanced Course in MATLAB	0	0	2	2	40	60	100
Practical										
6	Practical	MMTP206	Presentation / Viva	0	0	0	2	40	60	100
			Total	16	0	2	20	240	360	600

Note: Students who exit at the end of 1st year shall be awarded a Postgraduate Diploma.

2. Second year PG with course work and Research

SEMESTER III

S. No.	Course Category	Course Code	Course Name	Periods				Evaluation scheme		Subject Total
				L	T	P	C	Sessional (Internal)	External (ESE)	
Theory										
1	Core	MMTC301	Topology	4	0	0	4	40	60	100
2	Core	MMTC302	Mechanics	4	0	0	4	40	60	100
Student will select three elective papers out of six of the following:										
3	Elective	MMTE303	Calculus of Variations	3	0	0	3	40	60	100
4	Elective	MMTE304	Mathematical Statistics	3	0	0	3	40	60	100
5	Elective	MMTE305	Differential Geometry	3	0	0	3	40	60	100
6	Elective	MMTE306	Algebraic Coding Theory	3	0	0	3	40	60	100
7	Elective	MMTE307	Linear Integral Equations	3	0	0	3	40	60	100
8	Elective	MMTE308	Hydrodynamics	3	0	0	3	40	60	100
9	Practical	MMTP309	Presentation / Viva Voce	0	0	0	3	40	60	100
			Total	17	0	0	20	240	360	600

SEMESTER IV

S. No.	Course Category	Course Code	Course Name	Periods				Evaluation scheme		Subject Total
				L	T	P	C	Sessional (Internal)	External (ESE)	
Theory										
1	Core	MMTC401	Measure and Integration	4	0	0	4	40	60	100
2	Core	MMTC402	Metric Spaces	4	0	0	4	40	60	100
2	Elective	MMTE403	**Dissertation***	0	0	0	9	60	240	300
4	Practical	MMTP404	Presentation/Viva Voce	0	0	0	3	40	60	100
			Total	8	0	0	20	180	420	600

L = Lecture, T = Tutorial, P = Practical, ESE = End Semester Examination

Note1: Marks in the Dissertation shall be awarded jointly by the external and internal examiners, after viva-voce examination.

Note2: *There shall be a seminar on dissertation work of the candidate to be evaluated by a departmental Committee chaired by H.O.D

Note3: Viva Voce: In this course evaluation will be based on the students' performance in viva voce, comprehensive test and presentation/seminar on any topic in subjects of current semester.

SEMESTER - I

COURSE NAME: DIFFERENTIAL EQUATIONS

Examination Scheme:

Components	I[st] internal Assignment	II[nd] Internal	External (ESE)
Weightage (%)	20	20	60

Course code	**: MMTC101**				
Course Name	**: DIFFERENTIAL EQUATIONS**				
Semester /Year	**: SEMESTER - I**				
		L	T	P	C
		4	0	0	4

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives:

The aims of this course is to familiarize the learner with elementary terms like as Wronskian, Ordinary points, Regular and singular points of ODE and Classification of PDE after that Picard iteration methods, Uniqueness and existence theorem of ODE, and some standard ODE: Legendre's and Bessel's differential equations, solution of some standard linear and nonlinear PDE.

Course Syllabus

Unit	Content of Unit	No. of Hours
I	Ordinary differential equations: Qualitative properties of solution, Oscillation, Wronskian, Sturm separation and comparison theorem, Picard iteration methods, Uniqueness and existence theorem.	12
II	Ordinary points, Regular and singular points, Frobenius series solution for Legendre's and Bessel's differential equations with generating functions.	12
III	Classification of PDE of 2nd order and canonical forms, Concept of separation of variable solution.	12
IV	Solution of heat diffusion, Laplace and wave equations, Non-linear partial differential equation of second order.	12

SUGGESTED READINGS:

1. Simmons, G. F.; Differential Equations with Applications and Historical Notes. 2nd edition, Tata McGraw Hill, New Delhi, 2016.
2. Evans, L. C.; Partial Differential Equations, 2nd edition, The Orient Black swan, 2014.
3. Ross, S. L.; Differential Equations. 3rd edition, Wiley India, 2007.
4. Sneddon, I. N.; Elements of Partial Differential Equations. Dover Publications, 2006.
5. Rai singhania, M. D.; Advanced Differential Equations. S. Chand & Company Ltd., New Delhi, 2001.
6. Reid, W. T.; Ordinary Differential Equations. John Wiley and Sons, New York, 1971.
7. Rai, B., Chaudhary, D.P. & Freedman, H.I.; A Course in ODE: Alpha Sci. Int. Ltd.

Course Learning Outcomes: After completion of this course the student will be able to

CO1.	Remembering elementary terms like as Wronskian, Ordinary points, Regular and singular points of ODE and all other terms related to ODE and PDE etc.
CO2.	Understand the ODE, PDE problems and Frobenius series solution for Legendre's and Bessel's differential equations with generating functions and Uniqueness and existence theorem etc.
CO3.	Classification of PDE of 2nd order and canonical forms, Concept of Method of separation of variables and other problems s related to ODEs and PDEs.
CO4.	Analysis the theory of ordinary differential equations through applications, methods of solution and numerical approximations like as Picard iteration methods.
CO5.	Determine what function or functions satisfy the differential equations.
CO6.	Develop new solutions related to PDE and ODE.

CO- PSO-PO Mapping:

Course	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	1	1	2	1	1	2	2	2	2	1	2	1	1	2	1	1
CO2	1	2	1	1	1	1	1	2	2	1	2	1	1	2	1	2
CO3	1	2	1	1	1	1	1	2	2	1	2	1	1	1	1	1
CO4	1	2	2	2	1	2	1	2	2	2	2	1	1	2	2	2
CO5	1	2	1	1	1	1	1	2	2	1	2	1	1	1	1	1
CO6	1	2	2	2	1	2	1	2	2	2	2	1	1	2	2	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

COURSE NAME: ABSTRACT ALGEBRA- I

Examination Scheme:

Components	Ist internal Assignment	IInd Internal	External (ESE)
Weightage (%)	20	20	60

Course code	: **MMTC102**				
Course Name	: **ABSTRACT ALGEBRA- I**				
Semester /Year	: **SEMESTER - I**				
		L	T	P	C
		4	0	0	4

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The aims of this course is to familiarize the learner with elementary terms of group like as Conjugacy, Normalization, Centre , Class equation and Homomorphism, Endomorphism, Automorphism, Inner automorphism, Kernel of an homomorphism; and standard results on finite group theory Cauchy's theorem, Sylow's family of theorems, and Fundamental theorem on homomorphism, Maximal, Jordan-Holder theorem, Solvable groups, Commutator subgroups, Direct products, Ideals, Polynomials ring, Division and Euclidean algorithm for polynomials, unique factorization theorem.

Course Syllabus

Unit	Content of Unit	No. of Hours
I	Groups: Introduction and examples, Abelian groups, Subgroups, Cyclic groups, Normal subgroups, Group of permutations.	12
II	Orbits, Cycles, Alternating groups, Cosets, Theorem of Lagrange, Direct products, finitely generated abelian groups.	12
III	Homomorphism, Factor groups, Simple groups, Group action on a set	12
IV	Isomorphism and its theorems, Sylow theorems, Application of Sylow theorems.	12

REFERENCE BOOKS:

1. Khanna, V.K.; and Bhambri, S.K.; Abstract Algebra, Vikash Pub. House P. Ltd.
2. Gallian Josheph A.; Contemporary Abstract Algebra, Narosa Pub.House P. Ltd.
3. Fraleigh John. B.; A First course in Abstract Algebra, Pearson Edu. Inc., 2003.
4. Herstein I. N.; Topics in Algebra, John Wiley & Sons, New York.

Course Learning Outcomes: After completion of this course the student will be able to the following

CO1.	Define all aspects of Abstract Algebra.
CO2.	Explain Homomorphism, Endomorphism, Automorphism, Inner automorphism, Kernel of a homomorphism, Fundamental theorem on homomorphism of group, Group of automorphisms , Results on group homomorphism. Maximal subgroups, Ideals, Algebra of ideals, Principal ideal ring etc.
CO3.	Use algebraic methods to solve a variety of problems involving exponential, logarithmic, polynomial, and rational functions, systems of equations and inequalities, sequences
CO4.	Analyze a given algebraic structure in detail.
CO5.	Criticize the study of certain structures called groups, rings, fields and some related structures.
CO6.	Investigate Algebraic structure by correctly completing several logical steps before arriving at a final answer.

CO- PSO-PO Mapping:

Course	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	1	1	2	1	1	1	1	1	2	1	3	1	2	2	2	2
CO2	1	1	1	1	1	1	1	1	2	1	3	1	2	2	2	2
CO3	1	1	1	1	1	1	1	1	2	1	3	1	2	2	2	2
CO4	1	1	2	1	1	1	1	1	2	1	3	1	2	2	2	2
CO5	1	1	2	1	1	1	1	1	2	1	3	1	2	2	2	2
CO6	1	1	1	1	1	1	1	1	2	1	3	1	2	2	2	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

COURSE NAME: COMPLEX ANALYSIS

Examination Scheme:

Components	Ist internal Assignment	IInd Internal	External (ESE)
Weightage (%)	20	20	60

Course code	:	**MMTC103**
Course Name	:	**COMPLEX ANALYSIS**
Semester /Year	:	**SEMESTER - I**

L	T	P	C
4	0	0	4

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The aims of this course is to familiarize the learner with analytic functions, power series (and its properties), Taylor's and Laurent's series, Singularities, Residues (Cauchy residue theorem and its applications), and finally provide a glimpse of maximum principle and Schwarz' lemma, Mittag-Leffler theorem, Rouche's theorem, Conformal mapping, Mobius transformation and related properties.

Course Syllabus

Unit	Content of Unit	No. of Hours
I	Power series of analytic functions, Convergence of power series, Radius of convergence, Taylor's and Laurent's series, Residue and poles, Singularities, Classification of singularities.	12
II	Residues, Residue at infinity, Cauchy residue theorem, Applications of residue theorem in evaluation of improper real integrals.	12
III	Conformal mapping: properties, Mobius transformation, Elementary examples.	12
IV	Maximum modulus theorem, Mittag-Leffler theorem, Rouche's theorem, Concept of entire functions with simple example, Analytic continuation.	12

SUGGESTED READINGS:

1. Brown, J.W. and Churchill, R.V.; Complex Analysis, McGraw-Hill Ed.Private Ltd.2015.
2. Zill, Dennis G.; Complex Analysis, Jones &Bartlet Learning,2016.
3. Kasana, H. S.; Complex Analysis, PHI Learning.
4. Ponnusamy S.; Foundation of Complex Analysis, Alpha Int. Sci.

Course Learning Outcomes: After completion of this course the student will be able to the following

CO1.	Recall the basic definitions of analytic function, of Zeros and poles and Singularities.Understand about the kind of singularities of meromorphic functions which helps in residue theory and contour integrations.
CO2.	Describe conformal mappings between various plane regions.
CO3.	Explain the central ideas in the solution of Taylor and Laurent series.
CO4.	Classify curves and regions in the complex plane defined by simple expressions.
CO5.	Decide when and where a given function is analytic and be able to find it series development.
CO6.	Produce and create the analytic functions and concerned results.

CO- PSO-PO Mapping:

Course	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	1	1	2	1	1	1	1	1	2	1	3	1	2	2	2	2
CO2	1	1	1	1	1	1	1	1	2	1	3	1	2	2	2	2
CO3	1	1	1	1	1	1	1	1	2	1	3	1	2	2	2	2
CO4	1	1	2	1	1	1	1	1	2	1	3	1	2	2	2	2
CO5	1	1	2	1	1	1	1	1	2	1	3	1	2	2	2	2
CO6	1	1	2	1	1	1	1	1	2	1	3	1	2	2	2	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

COURSE NAME: LINEAR PROGRAMMING PROBLEMS

Examination Scheme:

Components	I[st] internal Assignment	II[nd] Internal	External (ESE)
Weightage (%)	20	20	60

Course code	:	**MMTC104**			
Course Name	:	**Linear programming problems**			
Semester /Year	:	**SEMESTER - I**			
	L	T	P	C	
	4	0	0	4	

L - Lecture T – Tutorial P – Practical C – Credit

Objectives:

To study the Linear programming problems, Linear programming problems in Graphical Method and Simplex Method, Network models, Integer Programming, Decision Theory, Game Theory.

Course Syllabus

Unit	Content of Unit	No. of Hours
I	An introduction to operations research, Methodology of O.R., Features of O.R. problems, Different models in O.R., Opportunities and shortcomings of O.R. approach.	12
II	Dual simplex method, Revised simplex method, Sensitivity analysis.	12
III	Assignment and Transportation problems.	12
IV	Theory of games, Integer linear programming.	12

SUGGESTED READINGS:

1. KantiSwarup, Gupta, P.K. & Man Mohan; Operations Research, S. Chand, 1978.
2. Sharma, J.K.; Operations Research: Theory and Applications, Trinity Press, 2016.
3. Taha, H.A.; Operations Research, Prentice Hall of India, 2011.
4. Bronson, R.; Operations Research, Schaum's Outline Series.McGraw Hill, 1982.

Course Outcome: At the end of the course the students will able to

CO1.	Define and identify the different concept based problems of Operational Research.
CO2.	Explain and show the results based on problems of Operational Research
CO3.	Solve , Calculate and construct the different problems of Operational Research
CO4.	Analyze different situations in the industrial/ business scenario involving limited resources and finding the optimal solution within constraints.
CO5.	Measure any real life system with limited constraints and depict it in a model form.
CO6.	Express the all theories of OR and solve the related problem.

CO- PSO-PO Mapping:

Course	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	1	1	2	1	1	2	2	2	2	1	1	1	1	2	1	1
CO2	1	2	1	1	1	1	1	2	2	1	1	1	1	2	1	2
CO3	1	2	1	1	1	1	1	2	2	1	1	1	1	1	1	1
CO4	1	2	2	2	1	2	1	2	2	2	1	1	1	2	2	2
CO5	1	2	2	2	1	2	1	2	2	2	1	1	1	2	2	2
CO6	1	2	2	2	1	2	1	2	2	2	1	1	1	2	2	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

COURSE NAME: FOUNDATION COURSE IN MATLAB

Examination Scheme:

Components	I[st] internal Assignment	II[nd] Internal	External (ESE)
Weightage (%)	20	20	60

Course code	:	**MMTCL105**			
Course Name	:	**FOUNDATION COURSE IN MATLAB**			
Semester /Year	:	**SEMESTER - I**			
		L	T	P	C
		0	0	2	2

L - Lecture T – Tutorial P – Practical C – Credit

Objectives: This course aims to explore fundamental computer programming concepts such as variables, control structures, functions and many others. In this course student will learn about various data types and how to handle them in MATLAB, the powerful support MATLAB provides for working with matrices, and about file input/output.

Course Syllabus

Unit	Content of Unit
I	Starting with MATLAB, MATLAB windows, Working in the command window.
II	Arithmetic operations with scalars, Defining scalar variables, Script files
III	Crating one dimensional array, Crating two-dimensional array, Variables in MATLAB, Stings and strings as variables.
IV	Addition and subtraction, Array multiplication and division, Generation of random numbers, Examples of MATLAB applications

Course Outcome: At the end of this course, the students will able to

CO1	Define foundational terms of MATLAB.
CO2	Understand the interface and basic tools of MATLAB.
CO3.	Solve the problems based on vector and matrix operations.
CO4.	Analyze the basics of MATLAB in arithmetic.
CO5.	Evaluate and test the problems related to vectors.
CO6.	Develop the sol/proof of all problems/results of this course.

CO- PSO-PO Mapping:

Course	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	2	1	2	1	1	1	1	1	2	1	1	1	2	2	2	2
CO2	1	1	1	1	1	1	1	1	2	1	1	1	2	2	2	2
CO3	1	1	2	1	1	1	1	1	2	1	1	1	2	2	2	2
CO4	1	1	2	1	1	1	1	1	2	1	1	1	2	2	2	2
CO5	2	1	2	1	1	1	1	1	2	1	1	1	2	2	2	2
CO6	1	1	1	1	1	1	1	1	2	1	1	1	2	2	2	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

COURSE NAME: PRESENTATION / VIVA

Examination Scheme:

Components	Internal (PRESENTATION/VIVA VOCE)	External (ESE) (PRESENTATION/VIVA VOCE)
Weightage (%)	40	60

Course code	:	**MMTP 106**
Course Name	:	**PRESENTATION / VIVA**
Semester /Year	:	**SEMESTER - I**

	L	T	P	C
	0	0	0	2

L - Lecture T – Tutorial P – Practical C – Credit

Viva Voce: In this course evaluation will be based on the students' performance in viva voce, comprehensive test and presentation/seminar on any topic in subjects of current semester.

SEMESTER - II

COURSE NAME: ABSTRACT ALGEBRA- II

Examination Scheme:

Components	Ist internal Assignment	IInd Internal	External (ESE)
Weightage (%)	20	20	60

Course code	:	**MMTC201**			
Course Name	:	**ABSTRACT ALGEBRA- II**			
Semester /Year	:	**SEMESTER - II**			
		L	T	P	C
		4	0	0	4

L - Lecture T – Tutorial P – Practical C – Credit

Objectives: The aims of this course is to familiarize the learner with Embedding of rings, Ring of residue classes, Euclidean ring, Module, field extension, Roots of polynomials, Splitting field, and Galois group.

Course Syllabus

Unit	Content of Unit	No. of Hours
I	Rings and Fields, Integral domains, Fermat's and Euler's theorems, The field of quotients of an integral domain.	12
II	Ring of polynomials, Factorization of a polynomial over a field, Non commutative examples, Ordered rings and fields.	12
III	Ring homomorphism, Factor rings, Prime ideals, Maximal ideals.	12
IV	Introduction to extension fields, Vector spaces, Unique factorization domains, Euclidean domains	12

SUGGESTED READINGS:

1. Gallian, Josheph A.; Contemporary Abstract Algebra , Narosa Pub. House P. Ltd.
2. Fraleigh, John. B.; A First course in Abstract Algebra, Pearson Edu. Inc. , 2003.
3. Khanna, V.K. and Bhambri, S.K.; Abstract Algebra, Vikash Pub. House P. Ltd.
4. Herstein, I. N.; Topics in Algebra, John Wiley & Sons, New York.

Course Outcomes: At the end of this course the student will be able to

CO1.	Define all aspects of advanced Abstract Algebra.	
CO2.	Explain the different algebraic structures of advanced Abstract Algebra.	
CO3.	Solve the related problems embedding ring, field extension and module and Galois group	
CO4.	Analyze a given structure in detail and categorize.	
CO5.	Criticize the study of certain structures called Embedding of rings, Euclidean ring, Module, Extension fields Galois group and some related structures and evaluate the related problems.	
CO6.	Develop and design the Algebraic structure by correctly completing several logical steps before arriving at a final answer.	

CO- PSO-PO Mapping:

Course	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	1	1	2	1	1	1	1	1	2	1	3	1	2	2	2	2
CO2	1	1	1	1	1	1	1	1	2	1	3	1	2	2	2	2
CO3	1	1	1	1	1	1	1	1	2	1	3	1	2	2	2	2
CO4	1	1	2	1	1	1	1	1	2	1	3	1	2	2	2	2
CO5	1	1	1	1	1	1	1	1	2	1	3	1	2	2	2	2
CO6	1	1	2	1	1	1	1	1	2	1	3	1	2	2	2	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

COURSE NAME: DISCRETE STRUCTURES

Examination Scheme:

Components	Ist internal Assignment	IInd Internal	External (ESE)
Weightage (%)	20	20	60

Course code	:	**MMTC202**
Course Name	:	**DISCRETE STRUCTURES**
Semester /Year	:	**SEMESTER - II**

L	T	P	C
4	0	0	4

L - Lecture T – Tutorial P – Practical C – Credit

Objectives: This course aims to explore Recurrence relations and their solutions Posets, Lattices, Boolean Lattices, Boolean algebra, Boolean expressions, Logic gates, Karnaugh maps, Directed Graphs.

Course Syllabus

Unit	Content of Unit	No. of Hours
I	Recurrence relations, Linear homogeneous recurrence relations, Non-homogeneous recurrence relations, Solutions of recurrence relations.	12
II	Partially ordered sets, Different type of lattices, Sub-lattices, Direct product, Ideal Lattice, Modular and distributive lattices.	12
III	Boolean algebra, Ideals in Boolean algebra, Boolean rings, Boolean functions, Karnaugh maps, Application of Boolean algebra to switching theory.	12
IV	Graphs, Direct graphs, Undirected graphs, Relations and graphs, Path and circuits, Eulerian and Hamiltonian graphs, Planner graphs, Connected graphs.	12

SUGGESTED READINGS:

1. Liu, C. I.; Element of Discrete Mathematics, Mcgraw Higher Edu. ,2012.
2. Rao, H. G. S.; Discrete Mathematical Structures, Galgotia Pub. Pvt. Ltd.
3. Khanna, V. K.; Lattice and Boolean Algebra, Vikash Pub. House.
4. Johnsonbaugh, R.; Discrete Mathematics, Pearson Edu. Ltd., 2014.

Course Outcome: At the end of the course the students will able to

CO1.	Identify the basic definitions in discrete structures and related examples.
CO2.	Explain conceptual based problems of discrete structures and their solutions.
CO3.	Solve the problems of Boolean algebra, Boolean functions, canonical forms of Boolean expressions and solve Karnaugh-Maps.
CO4.	Analyze the Application of Boolean algebra to switching theory and classify the problems of Graphs
CO5.	Evaluate Recurrence relations, Directed graphs, Undirected graphs, Eulerian and Hamiltonian graphs, Planner graphs, Connected graphs and related theorems.
CO6.	Design and formulate the problems on discrete structures

CO- PSO-PO Mapping:

Course	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	1	1	2	1	1	2	2	2	2	1	1	1	1	2	1	1
CO2	1	2	1	1	1	1	1	2	2	1	1	1	1	2	1	2
CO3	1	2	1	1	1	1	1	2	2	1	1	1	1	1	1	1
CO4	1	2	2	2	1	2	1	2	2	2	1	1	1	2	2	2
CO5	1	2	2	2	1	2	1	2	2	2	1	1	1	2	2	2
CO6	1	2	1	1	1	1	1	2	2	1	1	1	1	2	1	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

COURSE NAME: NON-LINEAR PROGRAMMING PROBLEMS

Examination Scheme:

Components	I[st] internal Assignment	II[nd] Internal	External (ESE)
Weightage (%)	20	20	60

Course code	:	**MMTC203**
Course Name	:	**NON-LINEAR PROGRAMMING PROBLEMS**
Semester /Year	:	**SEMESTER - II**

L	T	P	C
4	0	0	4

L - Lecture T – Tutorial P – Practical C – Credit

Course Objective:

The objective of this course is to familiarize the students with inventory control, EOQ models, queuing theory, single served queuing model, M|M|1 queuing models, multiple server queuing model, Markov chain, application of Markov analysis, sequencing problem, dynamic programming and quadratic programming.

Course Syllabus

Unit	Content of Unit	No. of Hours
I	Inventory control, Functional role of inventory control, Classification of EOQ models with shortages and without shortages.	12
II	Queuing theory, Characteristics of Queuing system, Probability distribution in queuing system, Single served queuing model, M|M|1 queuing models and Multiple server queuing models.	12
III	Markov chain, Application of Markov analysis, State and transition probabilities, Steady state conditions, Sequencing problems, Processing n jobs through two and three machines.	12
IV	Dynamic programming, Dynamic programming under certainty, Non-linear programming methods, Quadratic programming, Kuhn-Tucker conditions.	12

SUGGESTED READINGS:

1. Kanti Swarup, Gupta, P.K. & Man Mohan; Operations Research, S. Chand, 1978.
2. Sharma, J.K.; Operations Research: Theory and Applications, Trinity Press, 2016.
3. Taha, H.A.; Operations Research, Prentice Hall, 2011.
4. Bronson, R.; Operations Research, McGraw Hill, 1982.

Course outcomes: After completion of this course the students will able to the following

CO1.	Identify the concept based problems related to advanced OR
CO2.	Understand the different model of OR and how to solve their problems.
CO3.	Solve the EOQ models, queuing models –problems and other related problems of OR,
CO4.	Analyze EOQ models, queuing theory Markov chain and its application and dynamic programming and quadratic programming.
CO5.	Evaluate sequencing problems, processing n jobs through two and three machines and other related to advanced OR.
CO6.	Design and construct the solution of problems based queuing models, Markov chain, dynamic programming and quadratic programming.

CO- PSO-PO Mapping:

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	1	2	1	1	2	2	2	2	1	1	1	1	2	1	1
CO2	1	2	1	1	1	1	1	2	2	1	1	1	1	2	1	2
CO3	1	2	1	1	1	1	1	2	2	1	1	1	1	1	1	1
CO4	1	2	2	2	1	2	1	2	2	2	1	1	1	2	2	2
CO5	1	2	2	2	1	2	1	2	2	2	1	1	1	2	2	2
CO6	1	2	2	2	1	2	1	2	2	2	1	1	1	2	2	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

COURSE NAME: REAL ANALYSIS

Examination Scheme:

Components	I[st] internal Assignment	II[nd] Internal	External (ESE)
Weightage (%)	20	20	60

Course code	:	**MMTC204**
Course Name	:	**REAL ANALYSIS**
Semester /Year	:	**SEMESTER - II**

	L	T	P	C
	4	0	0	4

L - Lecture T – Tutorial P – Practical C – Credit

Objectives:

The aims of this course is to familiarize the learner with the uniform convergence and point wise convergence of sequences/series of functions (with one special case of power series), Riemann- Stieltjes integral, Functions of several variables

Course Syllabus

Unit	Content of Unit	No. of Hours
I	The Riemann-Integral: Definition and existence of Riemann integral, Properties of integrals, Integration and differentiation, Fundamental theorem of calculus.	12
II	Sequences and series of functions, Pointwise and uniform convergence, Cauchy criterion for uniform convergence, Uniform convergence and continuity, Uniform convergence, Uniform convergence and differentiation.	12
III	Power series, Algebra of power series, Uniqueness theorem for power series, Abel's theorem, Taylor's theorem.	12
IV	Functions of several variables, Concept of functions of two variables, Continuity, Partial derivatives, Differentiability, Change of variables, The inverse function theorem, The implicit function theorem, Chain rule.	12

SUGGESTED READINGS:

1. Malik, S.C. and Arora, Savita; Mathematical Analysis, New Age Int. 1992.
2. Apostol, T.M.; Mathematical Analysis, Pearson Edu. , Taiwan Ltd., 1974.
3. Royden, H.L.; Real analysis, Pearson, 2017.
4. Tao Terence; Real Analysis, Springer.

Course Outcome: After completion of this course the student will be able to the following

CO1.	Define and identify the basic of sequences and series of functions, function of several variables.
CO2.	Understand How to check the pointwise/uniform convergence of the sequences/series of functions for the different cases and explain the Riemann-Stieltjes Integral, function of several variables.
CO3.	Explain and describe the results based on sequences and series of functions, power series, function of several variables Weierstrass approximation theorem and how to apply these results in the problems.
CO4.	Analyze the different theoretical problems in real analysis
CO5.	Evaluate and the justify the problems in The Riemann-Stieltjes Integral, sequences and series of functions, function of several variables.
CO6.	Develop and express the problems related to function of several variables, sequences and series of functions, the inverse function theorem, and implicit function theorem.

CO- PSO-PO Mapping:

Course	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	1	1	2	1	1	1	1	1	2	1	3	1	2	2	2	2
CO2	1	1	1	1	1	1	1	1	2	1	3	1	2	2	2	2
CO3	1	1	1	1	1	1	1	1	2	1	3	1	2	2	2	2
CO4	1	1	2	1	1	1	1	1	2	1	3	1	2	2	2	2
CO5	1	1	2	1	1	1	1	1	2	1	3	1	2	2	2	2
CO6	1	1	2	1	1	3	1	1	3	1	3	2	2	3	3	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

COURSE NAME: ADVANCED COURSE IN MATLAB

Examination Scheme:

Components	Ist internal Assignment	IInd Internal	External (ESE)
Weightage (%)	20	20	60

Course code	:	**MMTCL205**			
Course Name	:	**ADVANCED COURSE IN MATLAB**			
Semester /Year	:	**SEMESTER - II**			
		L	T	P	C
		0	0	2	2

L - Lecture T – Tutorial P – Practical C – Credit

Objectives: This course aims to explore computer programming concepts such as script files, function files, control structures, functions and many others. In this course student will learn about Relational and logical operators, loops, breaks in MATLAB, the powerful MATLAB provides for working with polynomials and their operations.

Course Syllabus

Unit	Content of Unit
I	MATLAB workspace and workspace window, Input to a script file, Output commands, Save and load commands.
II	Creating a function file, Structure of a function file, Using a user defined function, Comparison between script files and function files
III	Relational and logical operators, Conditional statements, the switch case statements, Loops, the break and continue commands
IV	Working with polynomials, Line plots, Mesh and surface plots, The view command, Related problems

Course Outcome: At the end of this course, the students will able to

CO1	Define workspace, scrip and function files of MATLAB.
CO2	Understand the difference between script file and function files in MATLAB.
CO3.	Solve the problems based on vector and matrix operations.
CO4.	Analyze the basics of MATLAB in logics and operators.
CO5.	Evaluate and test the problems related to polynomials.
CO6.	Develop the sol/proof of all problems/results of this course.

CO- PSO-PO Mapping:

Course	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	2	1	2	1	1	1	1	1	2	1	1	1	2	2	2	2
CO2	1	1	1	1	1	1	1	1	2	1	1	1	2	2	2	2
CO3	1	1	2	1	1	1	1	1	2	1	1	1	2	2	2	2
CO4	1	1	2	1	1	1	1	1	2	1	1	1	2	2	2	2
CO5	2	1	2	1	1	1	1	1	2	1	1	1	2	2	2	2
CO6	1	1	1	1	1	1	1	1	2	1	1	1	2	2	2	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

COURSE NAME: PRESENTATION / VIVA

Examination Scheme:

Components	Internal (PRESENTATION/VIVA VOCE)	External (ESE) (PRESENTATION/VIVA VOCE)
Weightage (%)	40	60

Course code	:	**MMTP206**			
Course Name	:	**PRESENTATION / VIVA**			
Semester /Year	:	**SEMESTER - II**			
		L	T	P	C
		0	0	0	2

L - Lecture T – Tutorial P – Practical C – Credit

Viva Voce: In this course evaluation will be based on the student's performance in viva voce, comprehensive test and presentation/seminar on any topic in subjects of current semester.

SEMESTER - III
COURSE NAME: TOPOLOGY

Examination Scheme:

Components	I[st] internal Assignment	II[nd] Internal	External (ESE)
Weightage (%)	20	20	60

Course code	:	**MMTC301**			
Course Name	:	**TOPOLOGY**			
Semester /Year	:	**SEMESTER - III**			
		L	T	P	C
		4	0	0	4

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: To introduce with the basic concepts of point set topology, basis and sub basis for a topology and order topology. Further, to study continuity, homeomorphisms, open and closed maps, product and box topologies and introduce notions of connectedness, path connectedness, local connectedness, local path connectedness, convergence, and compactness of spaces, Local compactness and countability axioms.

Course Syllabus

Unit	Content of Unit	No. of Hours
I	Definition and examples of topological spaces, Closed sets, Closure, Dense subsets, Neighborhoods, Interior, Exterior and accumulation points, Bases and sub bases, subspaces, Product spaces and relative topology.	12
II	Continuous function, Homeomorphism, Connected and disconnected sets, Components, Locally connected spaces.	12
III	Countability axioms, First and second countable spaces, Lindelof's theorem, Separable spaces, Second countable and separability, Separable axioms: T_0, T_1 , T_2 , T_3 , T_4 and their characterizations.	12
IV	Compactness, Continuity and compact sets, Basic properties of compactness, Compactness and finite intersection property,Sequentially and countably compact sets, Local compactness, Tychonoff's theorem.	12

SUGGESTED READINGS:

1. Munkres, James R. ;Topology: A First Course, Prentice Hall, Incorporated, 2000.
2. Kelly, J.L.;General Topology, Springer, 1975.
3. Simmons, G.F.; Topology and Modern Analysis, Tata McGraw-Hill.
4. Lipchitz, Seymour; General Topology, Schaum Outline Series.

Course Outcomes: After completion of this course the student will be able to the following

CO1	Identify the basic problems of general topology and its sub topics for example 1, How to determine interior, Exterior and accumulation points closure, boundary, and basis and sub basis of topological spaces. 2 check whether a collection of subsets is a basis for a given topological spaces or not, and determine the topology generated by a given basis. Same as for other topics of this course
CO2	Explain the continuous maps between two spaces and maps from a space into product space and determine common topological property of given two spaces.
	Determine the connectedness and path connectedness of the product of an arbitrary family of spaces. Understand the all other things related to this course

CO3	Solve the Hausdorff spaces problems using the concept of net in topological spaces and learn about 1st and 2nd countable spaces, separable and prove the Lindelöf theorem. Compactness and connectedness. And determine other problems related to this course
CO4	Analyze and test the problems of Compactness, connectedness and T0, T1 , T2 , T3 , T4 spaces and all others related problems of topological spaces
CO5	Test and justify the solutions of problems based on topological spaces.
CO6	Prepare and express the all major theorems/problems of this course.

CO- PSO-PO Mapping:

Course	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	1	2	1	1	1	1	1	3	3	1	1	1	1	2	1	2
CO2	1	3	2	2	1	2	1	3	3	2	1	1	1	2	2	2
CO3	1	3	3	3	1	3	2	3	3	3	1	1	1	3	3	3
CO4	1	3	3	3	1	3	2	2	2	3	1	2	1	3	2	2
CO5	1	3	2	2	1	2	1	3	3	2	1	1	1	2	2	2
CO6	1	3	3	3	1	3	2	3	3	3	1	1	1	3	3	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

COURSE NAME: MECHANICS

Examination Scheme:

Components	Ist internal Assignment	IInd Internal	External (ESE)
Weightage (%)	20	20	60

Course code	: **MMTC302**				
Course Name	: **MECHANICS**				
Semester /Year	: **SEMESTER - III**				
		L	T	P	C
		4	0	0	4

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The aims of this course is to familiarize the learner with Conservation of momentum and energy, Generalized coordinates, Lagrange's equations of motion, Hamilton's principle and principle of least action and Euler's equations of motion.

Course Syllabus

Unit	Content of Unit	No. of Hours
I	Conservation of linear and angular momentum under finite and impulsive forces, Conservation of energy.	12
II	Generalized coordinates, Lagrange's equations of motion, Small oscillations. Hamiltonian's canonical equations, Hamilton's principle and principle of least action.	12
III	Euler's equations of motion, Kinetic energy, Eulerian angles, Instantaneous axis of rotation.	12

SUGGESTED READINGS:

1. Ray and Sharma ;A Text Book on Dynamics , S. Chand Ltd., 2005.
2. Ramsey A.S.; Dynamics- Part II, Cambridge University Press, 1944.
3. Goldstein H.; Classical Mechanics, Pearson Education.
4. Loney S.L.; Dynamics of Rigid Body, Cambridge University Press.

Course Learning Outcomes: After completion of this course the student will be able to the following

CO1.	Memorize the understanding of Classical Mechanics using Lagrangian and Hamiltonian Approach
CO2.	Describe the reduction of a two-body problem to a one-body problem in a central force system
CO3.	Explain the theory of relativity for particles having relativistic speeds.
CO4.	Determine the various Four vectors: position, velocity, acceleration, momentum, Force etc.
CO5.	Compare Lagrangian and Hamiltonian formalism, Galiliean and Lorentz transformation and various reference frames.
CO6.	Apply theory of relativity to determine time dilation, length contraction and simultaneity,

CO- PSO-PO Mapping:

Course	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	1	2	2	2	2	2	1	1	2	3	1	1	2	2	3	2
CO2	1	2	2	3	2	2	2	2	2	3	1	1	2	2	3	2
CO3	1	2	2	3	2	2	2	2	2	3	1	1	2	2	3	2
CO4	1	2	2	3	2	2	2	2	2	3	1	1	2	2	3	2
CO5	1	2	2	3	2	2	3	2	2	3	2	1	2	2	3	2
CO6	2	2	3	2	2	2	2	2	3	1	1	2	2	3	2	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

COURSE NAME: CALCULUS OF VARIATIONS

Examination Scheme:

Components	I[st] internal Assignment	II[nd] Internal	External (ESE)
Weightage (%)	20	20	60

Course code	:	**MMTE303**
Course Name	:	**CALCULUS OF VARIATIONS**
Semester /Year	:	**SEMESTER - III**

L	T	P	C
3	0	0	3

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: To introduce basic concepts of variational problems, Continuity and differentiability of functional, Euler's equation, variational problems with fixed boundaries, with moving boundaries, sufficient condition for extremum and application of variational calculus in classical mechanics

Course Syllabus

Unit	Content of Unit	No. of Hours
I	Variation of functional, Continuity and differentiability of functional, Necessary condition for an extremum, Euler's equation, Variational problems in parametric form, Functional depending on higher order derivatives and variational problems with subsidiary condition.	12
II	The isoperimetric problem, Invariance of Euler's equation under Coordinate transformation, General variational of functional, Variable end point problems,Transversality condition transversal theorem, Weierstrass-Endmann corner condition.	12
III	Sufficient condition for extremum: second variation, Legendre's and Jacobi's necessary condition, Canonical transformation, Noether's theorem, The principle of least action, Conservation law, Hamilton Jacobi's equations.	12
IV	Transformation of ODE and PDE into functionals and their solutions by Ritze, Galerkin, Collocation and Kantrovitch methods.	12

SUGGESTED READINGS:

1. Gelfrand and Fomin; Calculus of Variation, Dover Pub. Inc., New York.
2. Elsgolt; Calculus of Variation, University Press of the Pacific, 2003.
3. Gupta, A.S.; Calculus of Variation, PHI Learning Pvt. Ltd., 2015.

Course Learning Outcomes: After completion of this course, student will be able to the following

CO1.	Identify the basic problems on the different types of Variational problems like as problem in which functional depends on first order derivatives, several dependent variables first order partial derivatives, based on parametric form, isoperimetric problems. Ritz, Galerkin, Collocation and Kantrovitch methods etc.
CO2.	Explain the theoretical problems of variational calculus.
CO3.	Solve the all major kind of problems of variational calculus e.g. the General variational of functional, Variable end point problems, Transversality condition and transversal theorem, Weierstrass-Endmann corner condition and all other related to this course.
CO4.	Analyze the theoretical problems of variational calculus like as Sufficient condition for extremum: second variation, Legendre's and Jacobi's necessary condition, Weierstrass function, Canonical transformation, Noether's theorem etc.
CO5.	Evaluate the all major and minor problems of calculus of variation and on application of variational calculus like as The principle of least action, Conservation law, Hamilton Jacobi's equations, and solve the related problems.
CO6.	Make the solutions and proofs of different types of Variational problems like as Transform ODE and PDE into functionals and solve by Ritz, Galerkin, Collocation and Kantrovitch methods etc.

CO- PSO-PO Mapping:

Course	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	1	1	2	1	1	1	1	1	2	1	1	1	2	2	2	2
CO2	1	1	1	1	1	1	1	1	2	1	1	1	2	2	2	2
CO3	1	1	1	1	1	1	1	1	2	1	1	1	2	2	2	2
CO4	1	1	2	1	1	1	1	1	2	1	1	1	2	2	2	2
CO5	1	1	2	1	1	1	1	1	2	1	1	1	2	2	2	2
CO6	1	1	2	1	1	1	1	1	3	1	1	1	3	2	2	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

COURSE NAME: MATHEMATICAL STATISTICS

Examination Scheme:

Components	Ist internal Assignment	IInd Internal	External (ESE)
Weightage (%)	20	20	60

Course code	:	**MMTE304**
Course Name	:	**MATHEMATICAL STATISTICS**
Semester /Year	:	**SEMESTER - III**

L	T	P	C
3	0	0	3

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: To introduce basic concepts of probability and lead to Baye's theorem and generalize in Random variables and distribution functions, Binomial, Poisson, Normal, Gamma and Beta distributions and in another route like as Correlation and Regression and test of hypothesis.

Course Syllabus

Unit	Content of Unit	No. of Hours
I	Elements of probability, Sample space, Discrete probability, Bayes' theorem, Random variables and distribution functions, Mathematical expectations and moments.	12
II	Some standard discrete and continuous univariate distributions: Binomial, Poisson, Normal, Gamma and Beta distributions.	12
III	Correlation, Rank correlation, Regression line, Multiple and partial correlation of three variables only, Data reduction techniques, Canonical correlation.	12
IV	Concepts of sampling, Stratified sampling and systematic sampling, Test of hypothesis: t,z , chi square test.	12

SUGGESTED READINGS:

1. Gupta, S.C. and Kapoor, V.K.; Fundamental of Mathematical Statistics, S. Chand.
2. Kandall, M.G.; Advanced Theory of Statistics.
3. Weatherburn, C.E.; A first Course on Mathematical Statistics, Cambridge Univ. Press, 1968.

Course Learning Outcomes: After completion of this course, student will be able to the following

CO1.	Identify the basic problems on the different types of Discrete probability, Baye's theorem, Random variables and distribution functions, Mathematical expectations and moments t, z and chi square test, Correlation, Rank correlation, Regression and solve the related problems.
CO2.	Understand theoretical problems of the Discrete probability, Random variables and distribution functions, Mathematical expectations and moments, probability distributions, t, z and chi square test, Correlation, Regression and solve the related problems.
CO3.	Solve the Correlation, Regression and all related problems to the course
CO4.	Analyze the Multiple and partial correlation of three variables only, Data reduction techniques, Canonical correlation and all related problems to the course
CO5.	Evaluate the problems on the different types of Discrete probability , probability distributions, sampling, Correlation, Regression and all other topics.
CO6.	Develop the technique to test of hypothesis and how to solve the problem based on t, z and chi square test and all other topics

CO- PSO-PO Mapping:

Course	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	1	1	2	1	1	1	1	1	2	1	3	1	2	2	2	2
CO2	1	1	1	1	1	1	1	1	2	1	3	1	2	2	2	2
CO3	1	1	1	1	1	1	1	1	2	1	3	1	2	2	2	2
CO4	1	1	2	1	1	1	1	1	2	1	3	1	2	2	2	2
CO5	1	1	2	1	1	1	1	1	2	1	3	1	2	2	2	2
CO6	1	1	2	1	1	1	1	1	2	1	3	1	2	2	2	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

SHRI GURU RAM RAI UNIVERSITY **DEPARTMENT OF MATHEMATICS**

COURSE NAME: DIFFERENTIAL GEOMETRY

Examination Scheme:

Components	Ist internal Assignment	IInd Internal	External (ESE)
Weightage (%)	20	20	60

Course code	:	**MMTE305**
Course Name	:	**DIFFERENTIAL GEOMETRY**
Semester /Year	:	**SEMESTER - III**

	L	T	P	C
	3	0	0	3

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The main objective of this course is to understand the notion of Curves in space, Behaviour of a curve in the neighbourhood of a point, Osculating, Plane, Osculating circle and osculating sphere, Helix, Bertrand curves, Concept of a surface, Fundamental forms and curvature of surfaces, Minimal surface

Course Syllabus

Unit	Content of Unit	No. of Hours
I	Curves in space; Arc length, Order of contact, Tangent, Normal, Binormal, Osculating, Plane, Serret-Frenet formulae, Curvature and torsion. Osculating circle and osculating sphere, Helix, Bertrand curves.	12
II	Behavior of a curve in the neighborhood of a point. Concept of a surface, Envelope and developable surface, Parametric curves, Family of the surfaces, Edge of regression, Ruled surfaces, Central points.	12
III	Fundamental forms and curvature of surfaces: First fundamental form. Second fundamental form of the surfaces of revolution, Weingarten's equation, Direction coefficients, Family of curves.	12
IV	Local non-intrinsic properties of a surface Normal curvature, Principal directions, Principal curvatures, Minimal surface, Lines of curvature. Rodrigues and Monge's theorem, Euler's theorem, Joachimisthal's theorem, Dupin's indicatrix, Third fundamental form.	12

SUGGESTED READINGS:

1. Willmore, T.J., Differential Geometry, Dover Pub. Inc., New York.
2. Weathrburn, C.E., Differential Geometry of Three Dimensions, Cambridge Univ. Press.
3. Millman, R.S. & Parket, G.D., Elements of Differential Geometry, Prentice Hall.
4. Goctz, A., Introduction to Differential Geometry, Addison Wesley Pub. Co., 1970.

Course Learning Outcomes: After completion of this course, student will be able to the following

O1.	Identify the basic concepts based problems of Curves in space, surface, surfaces of revolution, minimal surfaces and recall all other concepts of fundamental differential geometry.
CO2.	Understand comfortably familiar with Concept of a surface, Envelope and developable surface, Parametric curves, Family of the surfaces, Edge of regression, Ruled surfaces, and Central points. and about linear self-adjoint Weingarten map and curvature of a plane curve with applications in geometry and physics, and the all major and minor problems of differential Geometry
CO3.	Solve the numerical problems of Fundamental forms and curvature of surfaces, First fundamental form and Second fundamental form of the surfaces of revolution, surfaces with

	boundary and be able to solve various problems and the Gauss-Bonnet theorem and all other related to this course
CO4.	Analyze the major and minor problems of differential Geometry e.g. Curves in space, the basic properties of a surface Normal curvature, Principal directions, Principal curvatures, minimal surfaces, Rodrigues and Monge's theorem, Euler's theorem, Joachimisthal's theorem, Dupin's indicatrix, Third fundamental form
CO5.	Evaluate the major and minor problems of differential Geometry
CO6.	Develop solution/proof of problems of differential Geometry

CO- PSO-PO Mapping:

Course	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	1	2	1	1	1	1	1	3	3	1	1	1	1	3	1	2
CO2	1	2	2	2	1	2	1	2	2	2	1	1	1	2	2	2
CO3	1	2	3	2	1	3	1	3	2	2	1	1	1	1	1	1
CO4	1	2	2	2	1	2	1	2	2	2	1	1	1	1	1	1
CO5	1	2	2	2	1	2	1	2	2	2	1	1	1	2	2	2
CO6	1	2	3	2	1	3	1	3	2	2	1	1	1	1	1	1

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

COURSE NAME: ALGEBRAIC CODING THEORY

Examination Scheme:

Components	I[st] internal Assignment	II[nd] Internal	External (ESE)
Weightage (%)	20	20	60

Course code	:	**MMTE306**
Course Name	:	**ALGEBRAIC CODING THEORY**
Semester /Year	:	**SEMESTER - III**

	L	T	P	C
	3	0	0	3

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The aims of this course are to familiarize the learner with the coding problem, Description of linear block codes by matrices, Step-by-step decoding, Codes derived from Hadamard matrices etc.

Course Syllabus

Unit	Content of Unit	No. of Hours
I	The communication channel, The coding problem, Types of codes, Error detecting and error-correcting codes, Linear codes, Hamming metric, Description of linear block codes by matrices.	12
II	Dual codes, Standard array, Step-by-step decoding, Modular representation, Error-correction, Capabilities of linear codes, Bounds of minimum distance for block codes, Plotkin bound, Hamming sphere packing bound, Bounds for burst-error detecting and correcting codes.	12
III	Important linear block codes, Hamming codes, Golaycodes, Perfect codes, Quasiperfect codes, Reed-Muller codes, Codes derived from Hadamard matrices, Product codes, Concatenated codes.	12
IV	A double error correcting decimal code and an introduction to BCH codes, BCH bounds, Cyclic codes, Matrix representation of cyclic codes, Error detection and cyclic codes, MDS codes.	12

SUGGESTED READINGS:

1. Pless, V. and Huffman, W.C.; Fundamental of Error- Correcting Codes, Cambridge Univ. Press.
2. Hill, Ramond; A First Course in Coding Theory, Oxford Univ. Press.
3. Rhee, M.Y. ;Error Correcting Coding Theory, McGraw-Hill, 1989.
4. Berlckamp, E.R. ;Algebraic Coding Theory, World Sci. Pub. Pvt. Ltd.

Course Learning Outcomes: After completion of this course, student will be able to the following

CO1.	Identify the all types of conceptual problems of communication channel, The coding problem, Types of codes, Error detecting and error-correcting codes, Linear codes, Hamming metric, Description of linear block codes by matrices and all other related to Algebraic Coding Theory.
CO2.	Understand Dual codes, Standard array, Step-by-step decoding, Modular representation, Error-correction, Capabilities of linear codes, Bounds of minimum distance for block codes, Plotkin bound, Hamming sphere packing bound, Bounds for burst-error detecting and correcting codes and all other related to Algebraic Coding Theory.
CO3.	Solve the Important linear block codes, Hamming codes, Golaycodes, Perfect codes, Quasiperfect codes, Reed-Muller codes, Codes derived from Hadamard matrices, Product codes and Concatenated codes. and all other related to Algebraic Coding Theory
CO4.	Analyze the little problems/results A double error correcting decimal code and an introduction to BCH codes, BCH bounds, Cyclic codes, understand Matrix representation of cyclic codes, Error detection and cyclic codes, MDS codes and all other related to Algebraic Coding Theory.
CO5.	Evaluate the major and minor problems of Algebraic Coding Theory
CO6.	Develop the solution/proof of problems of Algebraic Coding Theory

CO- PSO-PO Mapping:

Course	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	1	1	2	1	1	2	2	2	2	1	1	1	1	2	1	1
CO2	1	2	1	1	1	1	1	2	2	1	1	1	1	2	1	2
CO3	1	2	1	1	1	1	1	2	2	1	1	1	1	1	1	1
CO4	1	2	2	2	1	2	1	2	2	2	1	1	1	2	2	2
CO5	1	2	2	2	1	2	1	2	2	2	1	1	1	2	2	2
CO6	1	2	1	1	1	1	1	2	2	1	1	1	1	1	1	1

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

COURSE NAME: LINEAR INTEGRAL EQUATIONS

Examination Scheme:

Components	I[st] internal Assignment	II[nd] Internal	External (ESE)
Weightage (%)	20	20	60

Course code	:	**MMTE307**
Course Name	:	**LINEAR INTEGRAL EQUATIONS**
Semester /Year	:	**SEMESTER - III**

	L	T	P	C
	3	0	0	3

L - Lecture T – Tutorial P – Practical C – Credit

Objectives: This course aims to explore basic of Integral equations (Fredholm and Volterra equations), how to solve various type of integral equations like as Fredholm Integral equations and Volterra equations Integral equations, Singular integral equations (Abel and Hilbert type)

Course Syllabus

Unit	Content of Unit	No. of Hours
I	Classification of integral equations, Relation between differential and integral Equations, Fredholm integral equations, Fredholm equations of second kind with Separable kernels, Eigen values and Eigen functions	12
II	Volterra integral equations, Resolvent kernel of Volterra equation, Convolution type kernel, Integral equations with symmetric kernel; Riesz-Fischer theorem and Hilbert-Schmidt theorem	12
III	Method of successive approximation for Fredholm and Volterra equations of the second kind.	12
IV	Classical Fredholm theory,Singular integral equations,Hilbert type integral equations,Integral equation with Green's function type kernels.	12

SUGGESTED READINGS:

1. Raisinghania, M.D. ;Integral Equations and Boundary Value Problem, S. Chand.
2. Lovit, W. V.; Linear Integral Equations, Dover Pub. Int. New York.
3. Kanwal, R.P.; Linear Integral Equations, BirkhauserBoston, 1996.
4. Chambers, L. G.; Integral Equations, International Textbook Co., 1976.

Course Outcome: At the end of this course, the students will able to

CO1	Define basic of integral equation, and Relation between differential and integral Equations, Volterra integral equations, Fredholm integral equations, Abel integral equation and all other related topics
CO2	**CO2a.** Understand the problems based on Eigen values and Eigen functions of Fredholm equations of second kind with Separable kernels. Determine the resolvent kernel and solution of Volterra integral equations with the help of resolvent kernel
	CO2b. Understand the basic of Integral equations with symmetric kernel, fundamental properties of Eigen values and Eigen functions symmetric kernel, Singular integral equations
CO3.	Solve the problems Method of successive approximation for Fredholm and Volterra equations of the second kind, Singular integral equations , Integral equation with Green's function type kernels etc
CO4.	Analyze the basic of Volterra integral equations, Fredholm integral equations, Abel integral equation and all other related topics of linear integral equations
CO5.	Evaluate and test the all problems of integral equations
CO6.	Develop the sol/proof of all problems/results of this course.

CO- PSO-PO Mapping:

Course	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	2	1	2	1	1	1	1	1	2	1	1	1	2	2	2	2
CO2	1	1	1	1	1	1	1	1	2	1	1	1	2	2	2	2
CO3	1	1	2	1	1	1	1	1	2	1	1	1	2	2	2	2
CO4	1	1	2	1	1	1	1	1	2	1	1	1	2	2	2	2
CO5	2	1	2	1	1	1	1	1	2	1	1	1	2	2	2	2
CO6	1	1	1	1	1	1	1	1	2	1	1	1	2	2	2	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

COURSE NAME: HYDRODYNAMICS

Examination Scheme:

Components	I[st] internal Assignment	II[nd] Internal	External (ESE)
Weightage (%)	20	20	60

Course code	:	**MMTE308**			
Course Name	:	**HYDRODYNAMICS**			
Semester /Year	:	**SEMESTER - III**			
	L	T	P	C	
	3	0	0	3	

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: Prepare a foundation to understand the motion of fluid and develop concept, models and techniques which enables to solve the problems of fluid flow and help in advanced studies and research in the broad area of fluid motion.

Course Syllabus

Unit	Content of Unit	No. of Hours
I	Kinematics of fluids, Lagrangian and Eulerian methods, Local and individual time rates of change, Equation of continuity, Boundary surface.	12
II	Equation of motion of inviscid fluids, Euler's equation of motion, Bernoulli's equation, Lagrange's equation, Conservative field of force, Cauchy's Integral, Helm- Holtz's equation.	12
III	Impulsive motion of a fluid, Energy equation of inviscid fluid, General theory of irrotational motion, Connectivity, Flow and circulation, Kelvin's circulation theorem, Stokes's theorem, Permanence of irrotational motions, Green's theorem, Kinetic energy of finite and infinite liquid, Kelvin's minimum energy theorem, Mean value of the velocity potential over a spherical surface.	12
IV	Motion in two dimensions, Stream function, Complex potential, Source, Sink, Doublet, Complex potential and images with respect to straight line and circle, Milne- Circle theorem, Blausius theorem.	12

SUGGESTED READINGS:

1. Yuan, S.W.; Foundation to Fluid Mechanics, Prentice Hall Pvt. Ltd., 1960.
2. Chorlton, F.; Text book of Fluid Dynamics, CBS Pub. & Dist., 2004.
3. BansiLal;Theoretical Hydro-Dynamics, Skylark Pub., 1999.
4. Ray, M. & Sharma; A text book of Fluid – Dynamics, S. Chand & Co. Ltd. 2005.

Course Outcomes: After completion of this course the student will be able to

CO1.	Identify the concepts based problems of fluid dynamics
CO2.	Understand the concepts based problems of fluid dynamics
CO3.	Solve the different kind of numerical problems of fluid dynamics like as obtain solution for non-viscous flow problem and all others
CO4	Analyze the different kind of problems of fluid dynamics
CO5.	Evaluate the related problems to Kinematics of fluids, Flow and circulation, non-viscous flow, Motion in two dimensions, Stream function, Complex potential, Source, Sink, Doublet and all related to this course
CO6.	Develop the sol/proof of all major and minor problems/theorems of this course

CO- PSO-PO Mapping:

Course	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	1	1	2	1	1	2	2	2	2	1	1	1	1	2	1	1
CO2	1	2	1	1	1	1	1	2	2	1	1	1	1	2	1	2
CO3	1	2	1	1	1	1	1	2	2	1	1	1	1	1	1	1
CO4	1	2	2	2	1	2	1	2	2	2	1	1	1	2	2	2
CO5	1	2	2	2	2	2	1	2	2	2	1	1	1	2	2	2
CO6	1	1	1	2	2	2	1	2	2	2	1	1	1	2	2	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

COURSE NAME: PRESENTATION / VIVA

Examination Scheme:

Components	Internal (PRESENTATION/VIVA VOCE)	External (ESE) (PRESENTATION/VIVA VOCE)
Weightage (%)	40	60

Course code	:	**MMTP309**			
Course Name	:	**PRESENTATION / VIVA**			
Semester /Year	:	**SEMESTER - III**			
		L	T	P	C
		0	0	0	3

L - Lecture T – Tutorial P – Practical C – Credit

Viva Voce: In this course evaluation will be based on the students' performance in viva voce, comprehensive test and presentation/seminar on any topic in subjects of current semester.

SEMESTER IV

COURSE NAME: MEASURE AND INTEGRATION

Examination Scheme:

Components	Ist internal Assignment	IInd Internal	External (ESE)
Weightage (%)	20	20	60

Course code	:	**MMTC401**			
Course Name	:	**MEASURE AND INTEGRATION**			
Semester /Year	:	**SEMESTER - IV**			
		L	T	P	C
		4	0	0	4

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The main objective of this course is to familiarize learner with the Lebesgue outer measure, Measurable sets, Measurable functions, Integration, Convergence of sequences of functions and their integrals, Functions of bounded variation.

Course Syllabus

Unit	Content of Unit	No. of Hours
I	Lebesgue outer measure, Measure of open and closed sets, Borel sets, Measurable sets, Measure of cantor's ternary set, Non-measurable sets.	12
II	Measurable functions, Algebra of measurable functions, Step functions, Characteristic function, Simple functions, Convergence in measure, Egoroff's theorem, Riesz theorem.	12
III	Lebesgue Integral and their properties, General Lebesgue integrals, Lebesgue integrals for unbounded functions, Convergence theorems, Fatou Lemma.	12
IV	Functions of bounded variations, Absolutely continuity, Variation function, Jordan-decomposition theorem, Indefinite integral and its characterizations, Differentiation of an integral, Lebesgue differentiation theorem.	12

SUGGESTED READINGS:

1. Royden, H.L.; Real Analysis, Pearson, 2017.
2. Berberian, S.K.; Measure and Integration, The Macmillan Company, 1965.
3. Jain, P.K. and Gupta, V.P. ;Lebesgue Measure and Integration, Wiley, 1986.
4. Barra,G. De.; Measure Theory and Integration, Horwood, 2003.

Course Learning Outcomes: After studying this course the student will be able to the following

CO1.	Identify the all types of conceptual problems Measurable sets , measurable functions, Lebesgue integral, functions of bounded variations etc.
CO2.	Understand the requirement and the concept of the Measurable sets , measurable functions, Lebesgue integral, Differentiation of an integral along its properties.
CO3.	Solve the problems of the measure theory and integration.
CO4.	Analyze the concepts of functions of bounded variations and the absolute continuity of functions with their relations, concept of the Measurable sets , measurable functions, Lebesgue integral, Differentiation of an integral along its properties.
CO5.	Evaluate the all major and minor problems of this course.
CO6.	Develop the sol/proof of all major and minor problems/theorems of this course

CO- PSO-PO Mapping:

Course	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	1	1	2	1	1	2	2	2	2	1	1	1	1	2	1	1
CO2	1	2	1	1	1	1	1	2	2	1	1	1	1	2	1	2
CO3	1	2	1	1	1	1	1	2	2	1	1	1	1	1	1	1
CO4	1	2	2	2	1	2	1	2	2	2	1	1	1	2	2	2
CO5	1	2	2	2	1	2	1	2	2	2	1	1	1	2	2	2
CO6	1	1	2	2	1	1	2	2	2	2	1	1	2	1	2	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

COURSE NAME: METRIC SPACES

Examination Scheme:

Components	I[st] internal Assignment	II[nd] Internal	External (ESE)
Weightage (%)	20	20	60

Course code : **MMTC402**					
course name : **METRIC SPACES**					
Semester /Year : **SEMESTER - IV**					
	L	T	P	C	
	4	0	0	4	

L - Lecture T – Tutorial P – Practical C – Credit

Objectives: The aims of this course is to familiarize the learner with the basic of metric spaces, deep knowledge of Completeness, Connectedness, Compactness, continuous mappings and uniform continuity in metric spaces.

Course Syllabus

Unit	Content of Unit	No. of Hours
I	Metric on a set, Pseudo-metrics, Equivalent metrics, Limit point, Closed sets, Adherent point, Dense subsets, Interior of a set and its properties, Subspaces, Product spaces.	12
II	Convergent sequences, Cauchy sequences, Algebra of convergent sequences, Subsequences, Continuity at a point, Continuity over a apace, Algebra of real valued continuous functions in a metric space, Homeomorphism, Isometrics, Uniform continuity.	12
III	Complete metric spaces, Completeness and continuous mappings, Cantor's intersection theorem, Contraction mapping theorem, Connectedness in metric spaces, Properties of connectedness.	12
IV	Compact spaces, Compact subsets of the real line, Compactness and continuous mappings, Sequential compactness, Countable compactness, B-W property, B-W property and boundedness, B-W property and compactness, Compactness and uniform continuity, Lebesgue covering Lemma.	12

SUGGESTED READINGS:

1. Simmons G.F.; Introduction to Topology and Modern Analysis, Tata McGraw-Hill.
2. Copson, E.T.; Metric Spaces, Cambridge University Press, 1968.
3. Kasriel, Robert H.; Topology , Dover Pub. , 2009.
4. Kumaresan, S.; Topology of Metric Spaces, Alpha Science Int. , 2011.

Course Outcome: After completion of this course the student will be able to the following

CO1.	Identify the basic of the different kind of metric spaces and problems
CO2.	Understand the concept of nbd and its related, Homeomorphism, Connectedness, completeness, Complete metric spaces and solve the related problems.
CO3.	Solve the problems based on concept of map in between metric spaces like Homeomorphism (1-1, onto, open/closed, continuous), Uniform continuity & Isometry and all others related to metric spaces
CO4.	Analyze the Bolzano-Weierstrass property, sequentially compact and compact; prove the Lebesgue covering lemma and others problems related to metric spaces
CO5	Evaluate the problems on sequences and Cauchy sequences in metric spaces how it will be Complete metric spaces. Cantor's intersection theorem, Baire Category theorem, and Banach's fixed point theorem (based on contraction mapping). Justify the answer related to completeness of metric spaces and prove the completeness of the following: real line, unitary space, Euclidean space and other problems of metric spaces.
CO6.	Make the solution of theoretical numerical problems of Connectedness in metric spaces, and others problems related to metric space.

CO- PSO-PO Mapping:

Course	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	1	1	2	1	1	2	2	2	2	1	1	1	1	2	1	1
CO2	1	2	1	1	1	1	1	2	2	1	1	1	1	2	1	2
CO3	1	2	1	1	1	1	1	2	2	1	1	1	1	1	1	1
CO4	1	2	2	2	1	2	1	2	2	2	1	1	1	2	2	2
CO5	1	2	2	2	2	2	1	2	2	2	1	1	1	2	2	2
CO6	1	1	1	2	2	2	1	2	2	2	1	1	1	2	2	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

COURSE NAME: DISSERTATION

Examination Scheme:
DISTRIBUTION OF MARKS FOR DISSERTATION
Distribution of marks for Dissertation shall be as follows:

Dissertation	(Internal)* Seminar	ESE	TOTAL
		Report and Viva voce/Presentation	
Weightage (%)	60	240	300

Course code	:	**MMTE403**
Course Name	:	**DISSERTATION**
Semester /Year	:	**SEMESTER - IV**

L	T	P	C
0	0	0	9

L - Lecture T – Tutorial P – Practical C – Credit

Note1: Marks in the Dissertation shall be awarded jointly by the external and internal examiners, after viva-voce examination of Dissertation.
Note2: *There shall be a seminar on dissertation work of the candidate to be evaluated by a departmental Committee chaired by H.O.D

COURSE NAME: PRESENTATION / VIVA

Examination Scheme:

Components	Internal (PRESENTATION/VIVA VOCE)	External (ESE) (PRESENTATION/VIVA VOCE)
Weightage (%)	40	60

Course code	:	**MMTP404**			
Course Name	:	**PRESENTATION / VIVA**			
Semester /Year	:	**SEMESTER - IV**			
		L	T	P	C
		0	0	0	3

L - Lecture T – Tutorial P – Practical C – Credit

Viva Voce: In this course evaluation will be based on the student's performance in viva voce, comprehensive test and presentation/seminar on any topic in subjects of current semester.