SCHEME OF EXAMINATION

&

DETAILED SYLLABUS

For M.Sc. (Mathematics)

(Semester System)

(W.e.f. 2021 – 2022)

KALINGA UNIVERSITY

RAIPUR

FACULTY OF SCIENCE

Kalinga University, Naya Raipur

Chhattisgarh

Name of the Program: M.Sc. (Mathematics)

Objective of the Program

The Mathematics Education route is for anyone with a research or professional interest in mathematics education at Post graduate level, wanting to undertake advanced study in a world-class setting as well as in research.

The Mathematics Education route develops students' understanding of a number of important issues in the field of mathematics education. Students learn to interpret and critically engage with ideas and debates in mathematics education research in following ways:

- Through taught sessions in mathematics education;
- Through work on course assignments under the supervision of a member of the teaching team.
- Through participation in seminars led by students on the route and in project workshops.

Specific Objective of the Program

- The designed program will help students to enhance their views about fundamental and applied mathematics, so that they can differentiate between them.
- The program enables students to develop the mathematical skills and its application process in the applied fields.
- To encourage the combined knowledges and the application of mathematics in real world system, the program will help to the students.
- Program enhance the curiosity for the mathematics in the students and help them to build up their research future.

Introduction of the Program

M.Sc. Mathematics program has semester pattern and credit system. The program consists of 88 credits. Credits of a course are specified against the title of the course. With the core courses, open elective courses are taken together so that interdisciplinary approach concept can be developed in the learner's mind. Also, 12 elective courses are available in the syllabus, so that students can choose as per their future interest. It can be seen that the designed syllabus, definitely will enhance the research interest in students, so dissertation is introduced here in the syllabus with 6 credits.

Features of the Program

1. M.Sc. Mathematics programme is of minimum 88 credits spread over four semesters. The programme emphasizes both theory and applications of Mathematics and is structured to provide knowledge and skills in depth necessary for the employability of students in industry, other organizations, as well as in academics.
2. The program has some unique features such as independent projects, a large number of elective courses, extensive computer training including standard software packages such as MATLAB, SciLab and TORA.

3. The department has the academic autonomy and it has been utilized to add the new and need based elective courses.
4. The independent project work is one of the important components of this program.
5. The syllabus of the first year (two semesters) covers most of the core courses.
6. In the third semester syllabus there are two core courses and six elective courses. In the fourth semester syllabus there are one core courses and six elective courses.
7. The syllabus has been framed to have a good balance of theory, methods and applications of Mathematics.
8. It is possible for the students to study basic courses from other disciplines such as economics, life sciences, computer science and mathematics in place of electives

Scope

Mathematics is at the heart of science, engineering and technology, as well as being an indispensable problem-solving and decision-making tool in many other areas of life. Mathematics has got a great importance in the industrial and economic development of a country.M.Sc. in Mathematicstheory course (as indicated) in the same term. Scope: Mathematics is at the heart of science, engineering and technology, as well as being an indispensable problem-solving and decision-making tool in many other areas of life. Mathematics has got a great importance in the industrial and economic development of a country. M.Sc. in Mathematicswith skills and knowledge required for jobs in fields such as finance, education, engineering, science and business, as well as mathematics and mathematical science research.

Key Learning Outcomes

- The students may get wide range of opportunities of Mathematics in industry sector.
- The students will get wide range of Mathematical skills, including problem-solving, project work and presentation; they may enable to take prominent roles in a wide spectrum of employment in academics and research.
- The fundamental and advanced concepts, principles and techniques from a range of topic areas.
- Specific knowledge and understanding will be determined by the learners, particular choice of modules, according to their particular needs and interests.
- Students can understand complex mathematical ideas and arguments.
- Students are able to develop abstract mathematical thinking.
- Credit is a kind of weightage given to the contact hours to teach the prescribed syllabus, which is in a modular form. Normally one credit is allocated to 15 contact hours.
- In each of the courses, credits will be assigned on the basis of the number of lectures / tutorialsand other forms of learning required for completing the course contents in maximum 18-week schedule.

- The instructional days as worked out by the UGC for one academic year are 180 working days i.e., 90 days per semester.

Mechanics of Credit Calculation

Here in the syllabus, 1Credit = 15 contact hours. Contact hours will include all the modes of teaching like lectures / tutorials / fieldwork or other forms which suits to that particular course.

Evaluation System

In this section the broad guidelines to be followed in evaluation system and the minimum number of credits to be completed to get a degree are defined.

- The evaluation will be on Continuous Internal Assessment (CIA), End Semester Assessment (ESA). The final results shall be declared after integration of CIA and ESA
- Weightage: 70% for End Semester Assessment (ESA) & 30% for Continuous Internal Assessment (CIA).
- The Post-graduate degree will be awarded to those students who earn the minimum number of Credits.
- The project / Dissertation will be commencing from Semester III and the final work & report will be completed during Semester IV. The marks & the credits will be allotted in semester IV.

Examination/Evaluation Rules

The evaluation of the student will be mainly on

- Continuous Internal Assessment (CIA)
- End Semester Assessment (ESA).
- The ratio of CIA and ESA is 30:70

Continuous Internal Assessment (CIA): CIA aims to assess values, skills and knowledge imbibed by students, internal assessment is to be done by the concerned faculty member, department, school or the centre. CIA will be done on a continuous basis during the semester with selected assessment components.

End Semester Assessment (ESA): This is to be carried out at the end of each semester, and will aim to assess skills and knowledge acquired by the students through classroom instruction, fieldwork, small project work and/or workshop practice. The End Semester Assessment (ESA) is based on written examination. These examinations shall be at the end of each semester.

PSO's and POs of School of Mathematics, Kalinga University

Program Specific Objectives (PSOs)

The Post Graduates will be able to:

PSO1. Get a strong knowledge in mathematical sciences which include courses from Mathematics.

PSO2. Select a successful career in the sectors such as teaching, research, banking, planning and higher education, administrative service and for the advance study.

PSO3. Exhibit professionalism, ethics, communication skills, team work in their profession and adapt to current scenario by engaging in lifelong learning for the service of the society.

Program Outcomes (POs)

On successful completion, Post graduates will be able to:

PO1. Solve problems through analytical thinking.

PO2. Apply knowledge of mathematics to solve various real-life problems.

PO3. Formulate mathematical models to interpret and analyze data for interdisciplinary research and development.

PO4. Solve various mathematical problems by using relevant mathematical and statistical software.
PO5. Exhibit strong ethical and professional responsibility.

Kalinga University
Proposed M.Sc. Mathematics Scheme Semester System Syllabus 2021-2022 Onwards
Programme Structure & Syllabus for M.Sc. Mathematics

First Year							
Semester – I							
S.NO.	**Subject Code**	**Subject Name**	**Credits**	**Hours**	**MM**	**External Marks**	**Total Marks**
1	MSMH101	Real Analysis	5	15x5=75	70	30	100
2	MSMH102	Complex Analysis	5	15x5=75	70	30	100
3	MSMH103	Advanced Abstract Algebra	5	15x5=75	70	30	100
4	MSMH104	Ordinary and Partial Differential Equation	5	15x5=75	70	30	100
5	**GE-I Elective (A/B)**		4	15X4=60	70	30	100
	MSMH105A	Research Methodology					
	MSMH105B	Science Journalism					
Total			**24**	**360**			**500**
Semester – II							
S.NO.	**Subject Code**	**Subject Name**	**Credits**	**Hours**	**MM**	**External Marks**	**Total Marks**
1	MSMH201	General Topology	5	15x5=75	70	30	100
2	MSMH202	Discrete Mathematics and Its Application	5	15x5=75	70	30	100
3	MSMH203	Operations Research	5	15x5=75	70	30	100
4	MSMH204	Functional Analysis	5	15x5=75	70	30	100
5	**GE-II Elective(A/B)**		4	15X4=60	70	30	100
	MSMH205A	Entrepreneurship					
	MSMH205B	Intellectual Property Rights					
Total			**24**	**360**			**500**

Second Year							
Semester - III							
S.NO.	**Subject Code**	**Subject Name**	**Credits**	**Hours**	**MM**	**External Marks**	**Total Marks**
1	MSMH301	Set Theory, Logic and Elementary Probability Theory	5	15x5=75	70	30	100
2	MSMH302	Fuzzy Set and Their Applications	5	15x5=75	70	30	100
3	**DSE I (A/B/C)**		5	15x5=75	70	30	100
4	MSMH303A	Differential Geometry					
	MSMH303B	Mathematical Modelling					
	MSMH303C	Fluid Mechanics					
	DSE II (A/B/C)		5	15x5=75	70	30	100
	MSMH304A	Probability & Statistics					
	MSMH304B	Measure Theory					
	MSMH304C	Number Theory & Cryptography					
Total			**20**	**300**	**280**	**240**	**400**

Second Year							
Semester - IV							
S.NO.	**Subject Code**	**Subject Name**	**Credits**	**Hours**	**MM**	**External Marks**	**Total Marks**
1	MSMH401	Integral Equation and COV	5	15X5=75	70	30	100
2	**DSEIII (A/B/C)**		5	15x5=75	70	30	100
3	MSMH402A	Advance Optimization technique and Control Theory					
	MSMH402B	Advance Coding Theory					
	MSMH402C	Fluid Dynamics					
	DSE IV (A/B/C)		5	15x5=75	70	30	100
	MSMH403A	Numerical Solutions of ODE/PDE					
	MSMH403B	Computer C++ and MATLAB					
	MSMH403C	Computer Applications- Theory & Programming					
4	MSMH404P	**Project Work/Dissertation**	5		200	100	300
Total			**20**	**300**	**410**	**190**	**600**

***Project Dissertation 75**
***Presentation 50**
***Viva Voce 50**
***Scientific Paper 25**

M.Sc.
(Mathematics)
Semester –I

MSMH101	Total Marks: 100
Semester-I	Internal Marks: 30
Paper Code: MSMH101	External Marks: 70
Real Analysis	No. of Hours: 75
Course Objective(s): To learn the concepts of basic topological objects such as open sets, closed sets, compact sets and the concept of uniform convergence and also to work comfortably with continuous, differentiable and Riemann integrable functions.	Total Credits: 05

Unit No.	Details	Nos. of Hours
1	Introduction to Real Analysis and basics, mean value theorem, Riemann sums,Definition and existence of Riemann - Stieltjes integral and its properties, Integration and differentiation, The fundamental theorem of calculus. Integration of vector valued functions, Rectifiable curves, Rearrangements of terms of a series Riemann's theorem.	**15**
2	Cauchy criterion for uniform convergence, Mntest, Weierstrass M-Test Abel's and Dirichlet's tests for uniform convergence, Uniform convergence of integration, uniform convergence of differentiation, power series and its properties, uniform convergence of power series, Abel's theorem of power series.	**15**
3	The contraction mapping principle, Inverse function theorem, the implicit function theorem, Extreme problem with constraints. Lagrange's multiplier method.	15
4	Lebesgue outer measure, Measurable sets, Regularity, Measurable functions, Borel and Lebesgue measurability, The Lebesgue integral: Riemann integral, simple function, step function, Riemann and Lebesgue integral, Lebesgue bounded convergence theorem, Properties of the Lebesgue integral for bounded measurable function, Lebesgue monotone convergence theorem.	**15**
5	Functions of bounded variation, Differentiation of an integration, Integral of the derivative, The Lp spaces, Jensen's inequality. Holder and Minkowaski inequalities, Completeness of Lp space and its duality, Uniform convergence and almost uniform convergence.	**15**

Course Outcome(s): After completing this course, the student will be able to:

CO1: Attain mastery in Riemann integrable functions, Countable and Uncountable set.
CO2: Locate Sequence and Series, point wise and uniform convergent sequences.

CO3: Enumerate the concept of differentiation and partial differentiations.
CO4: Study Briefly the Measurable sets and integration of series.
CO5: The inverse function theorem, the Stone-Weirstrass theorem and contraction maps. Express the Lp spaces and its completeness.

COURSE LEARNING OUTCOME:

UNIT NO.	COURSE LEARNING OUTCOME	TEACHING AND LEARNING ACTIVITY	ASSESSMENT TASK
I.	Gains Knowledge of Riemann integrable functions, Countable and Uncountable set	Presentation/ Lecture	Evaluation of Students on the basis of Assignment/Quiz
II.	Demonstrate an understanding of the theory of sequences and series, continuity, differentiation and integration;	Application Based learning/ Research Oriented Teaching	Evaluation of Students on the basis of Assignment/Quiz /Class test
III.	Examine the different types of differentiation and partial differentiations.	Presentation/Lecture	Evaluation of Students on the basis of Presentation/Application Oriented Question solving/ Assignment/Quiz.
IV.	Examine Measurable sets and series integration briefly.	Presentation/ Video/ Lecture / Research Study.	Evaluation of Students on the basis of Presentation/ Assignment/Quiz
V.	Apply the theory in the course to solve a variety of problems at an appropriate level of difficulty	Presentation/ Lecture / Research Study.	Evaluation of Students on the basis of Assignment/Quiz /Class test.

Text book:

1. Walter Rudin, Principles of Mathematical Analysis, McGraw Hill.

Reference books:

1. T.M. Apostal, Mathematical analysis, Narosa.
2. G. de Barra Measure and Integration, Wiley Eastern (Indian Edition)
3. H.L. Royden Real Analysis, MacMillan, Indian Edition New Delhi.

E-resources:

1. Free Real analysis Books PDF: **http://www.freebookcentre.net/Mathematics/Real-Analysis-Books.html**
2. Real Analysis-Introduction by Prof. S.H. Kulkarni (IIT Madras):**https://nptel.ac.in/courses/realanalysis**
3. The Weierstrass M-test and uniform convergence of power series by Dr. Jaikrishnan J(IIT Palakkad):**https://www.youtube.com/watch?v=M67h1pW4Oc4**
4. Charectrization of Lebesque measurable sets by Prof. Indra K Rana(IIT Bombey):https://www.youtube.com/watch?v=Ql9NzFg11qA
5. The inverse function theorem byDr. Aviv Censor:https://www.youtube.com/watch?v=5srenaRHCuo
6. Real analysis study Materials 2021-Exams Time:**https://examstime.in/real-analysis-study-materials/#Real-Analysis-Study-Materials**
7. Handwritten Notes of Real Analysis by AsimMarwat: **https://www.mathcity.org/msc/notes/handwritten-notes-real-analysis-asim_marwat**
8. Real Analysis-Riemann Integral-Upper & Lower Darboux Sum-Definition with Examples by Dr. GajendraPurohit:**https://www.youtube.com/watch?v=Gp52wuNTJpU**
9. Fundamental Theorem of Integral Calculus with Proof-Riemann Integral by Dr. VineetaNegi:**https://www.youtube.com/watch?v=Fl7S9o3ahn4**
10. Lebesgue measurable functions and basic properties (MAT) by VidyaMitra:**https://www.youtube.com/watch?v=vJQTHNFHeKU**
11. Sequence of Real Analysis(introduction) by PankajKumar :**https://unacademy.com/lesson/sequence-of-real-analysis-introduction/8DGTS4OJ**
12. Introduction to Real analysis By JiříLebl:**https://www.jirka.org/ra/realanal**
13. Mathematical sciences unacademy:**https://unacademy.com/goal/csir-ugc-net/BIZXQ/free-platform/mathematical-sciences/OAJBP**

MSMH102	Total Marks: 100
Semester-I	Internal Marks: 30
Paper Code: MSMH102	External Marks: 70
Complex Analysis	No. of Hours: 75
Course Objective(s): To study Cauchy integral formula, local properties of analytic functions, general form of Cauchy's theorem and evaluation of definite integrals and harmonic functions, Jacobian of a transformation, conformal mapping.	Total Credits: 05

Unit No.	Details	Nos. of Hours
1	Differentiation of complex valued functions, Analytical function, C-R equations (necessary and sufficient condition), Polar form of C-R equations, Harmonic function, Orthogonal families,Method of construction of analytical functions (Milne-Thomson's method).	**15**
2	Complex line integral, Simply and multiply connected region,Jordan curve, Cauchy –Goursattheorem, Cauchy integral formula for simply and multiply connected region, Different application of Cauchy integral formula, Cauchy's integral formula for higher order derivatives.	**15**
3	Cauchy's Inequality, Morera's theorem, Lioville's theorem, The fundamental theorem of algebra, Taylor series, Laurent series and its applications.	11
4	Zeros of analytical functions, Singularities and its classifications, Meromorphic function, The argument principle, Rouche's theorem, inverse function theorem, Power series,Schwartz lemma,Maximum Modulus Principle, Residues, Cauchy Residue theorem,Different application of Residue theorem, Jordan's inequality, Jordan lemma, Evaluation of the integral of the different forms.	**17**
5	Transformation and mapping, Jacobian of a transformation , Some elementary transformation, Linear transformation, Bilinear transformation ,Critical points ,Product of the two bilinear transformations , Cross ratio, Preservance of cross ratio under bilinear transformation, Preservance of the family of circles and straight line under bilinear transformation, fixed point or invariant point of a bilinear transformation, Normal form of a bilinear transformation,Some special Bilinear transformation, Conformal mapping.	**17**

Course Outcome(s): After completing this course, the student will be able to:

CO1: Analyze Analytic functions and harmonic functions.

CO2: Apply Cauchy's theorem for disk and the Integral formula.

CO3: Understand Local properties of Analytic functions.

CO4: Study Residue theorem and the argument principle.

CO5: Differentiate the Taylor's series and Laurent series.

COURSE LEARNING OUTCOME:

UNIT NO.	COURSE LEARNING OUTCOME	TEACHING AND LEARNING ACTIVITY	ASSESSMENT TASK
I.	Understand the concept of Analytic functions and harmonic functions	Presentation/ Lecture	Evaluation of Students on the basis of Assignment/Quiz
II.	Express the Cauchy's Derivative formulas and concept of Cauchy-Goursat Integral Theorem	Application Based learning/ Research Oriented Teaching	Evaluation of Students on the basis of Assignment/Quiz /Class test
III.	Gain the knowledge of simple and multiple connected domains and also Express Morera's Theorem, etc.,	Presentation/Lecture	Evaluation of Students on the basis of Presentation/Application Oriented Question solving/ Assignment/ Quiz.
IV.	Understand concepts of zeros of complex functions and Residue Theorem, classify singularities, Express the Residue Theorem.	Presentation/ Video/ Lecture / Research Study.	Evaluation of Students on the basis of Presentation/ Assignment/Quiz
V.	Able to do Transformation and mapping, Jacobian of a transformation, Some elementary transformation	Presentation/ Lecture / Research Study.	Evaluation of Students on the basis of Assignment/Quiz /Class test.

Text Books:

1. L.V. Ahlfors, Complex Analysis, McGraw - Hill, Kogakusha Ltd, (Second Edition).
2. J.B. Canvey, Function of one complex Variable (Springer - Verlag) Narosa publishing House New Delhi.
3. Complex Analysis by A.R. Vashistha, Krishna Education Publication Meerut.

Reference Books:

1. S. Ponnu swamy, Foundations of complex Analysis, Narosa publishing House.
2. H.A. Priestley, Introduction to Complex Analysis, Oxford University press.

E-resources:

1. Free Complex analysis Books PDF:http://www.freebookcentre.net/Mathematics/Complex-Analysis-Books.html
2. Complex Analysis by Dr. P.A.S. Shree Krishna(IIT Guwahati):https://nptel.ac.in/courses/complexanalysis
3. Analytic Functions, C-R EquationsbyProf. P.D. Srivastava, Dr.P. Panigrahi,Prof. Somesh Kumar,Prof.J. Kumar(IIT Kharagpur):https://www.youtube.com/watch?v=rooMFBHoF5E
4. Cauchy Integral theorem by DR. TanujaShrivastava (IIT Roorkee): https://www.youtube.com/watch?v=2kyBOVfflHw
5. Complex integration ,line integral example & Solution by Dr. GajendraPurohit(GP classes of education):https://www.youtube.com/watch?v=ywQVarOaA60
6. Mathematical sciences unacademy:https://unacademy.com/goal/csir-ugc-net/BIZXQ/free-platform/mathematical-sciences/OAJBP
7. M.Sc. Complex Analysis Maths Title. P65-Shivaji University:http://www.unishivaji.ac.in/uploads/distedu/M.%20Sc.%20I%20Maths%20MT%20203%20Complex%20Analysis%20All.PDF
8. Complex Analysis handwritten notesPDF[For Net, Set, Gate, M.Sc. etc.] :https://pkalika.files.wordpress.com/2019/12/complex-quick-revision-41pages-25.pdf
9. Complex Analysis PDF:https://www.math.ucdavis.edu/~romik/data/uploads/notes/complex-analysis.pdf
10. Complex Analysis PDF:http://mpbou.edu.in/slm/mscmath1p4.pdf
11. Complex Analysis Books and Notes :https://examupdates.in/complex-analysis-books/#Download-Complex-Analysis-PDF

MSMH103	Total Marks: 100
Semester-I	Internal Marks: 30
Paper Code: MSMH103	External Marks: 70
Advanced Abstract Algebra	No. of Hours: 75
Course Objective(s): This course objective is the basic concepts of modern algebra such as rings and Prime and maximal ideal,to understand application of modules over rings as an analogue of vector spaces over fields, the notion of lengths of chains of prime ideals in commutative Noetherian rings, and its analogue in non-commutative set up. Study the radicals i.e., Prime ideals, Jacobson radical and Nil radical and brief introduction to their possible application	Total Credits: 05

Unit No.	Details	Nos. of Hours
1	Ring, Ideal, Prime and maximal ideal, Quotient ring, Polynomial Ring and irreducible criteria. Unique factorization domain, Principal ideal domain, Euclidean domain, Field, Finite field,	**15**
2	Splitting field, Normal extension, multiple roots, Separable extension, Algebraic closed fields and algebraic closure.	**15**
3	Automorphism groups and fixed fields, Fundamental theorem of Galois Theory and example. Roots of unity and cyclotomic polynomials, cyclic extension, Solution of polynomial by radicals, Insolvability of equation of degree five by radicals.	15
4	Modules, General properties of modules, Submodule, Quotient modules, Homomorphism of modules, Simple and semi simple modules, completely reducible modules, Free modules. Noetherian and Artinian modules and ring s, Homomorphism of R- modules	**15**
5	Smith normal form over a PID and rank: Introduction, Row- modules, Column's modules and rank, Smith normal form. rational canonical form, Generated Jordan form over any field. rational canonical form, Generated Jordan form over any field.	**15**

Course Outcome(s): After completing this course, the student will be able to:

CO1 Understand the ring theory and, Express the concept of domain and fields.

CO2 Give the knowledge of extension fields and its applications.

CO3 Understand Galois Theory and concept of polynomial of radicals.

CO4 Understand application of modules over rings G.

CO5 Explain Uniqueness of DecompositionGenerated Jordan form over any field.

COURSE LEARNING OUTCOME:

UNIT NO.	COURSE LEARNING OUTCOME	TEACHING AND LEARNING ACTIVITY	ASSESSMENT TASK
I.	Explain the fundamental concepts of advanced abstract algebra and their role in modern mathematics and applied contexts.	Presentation/ Lecture	Evaluation of Students on the basis of Assignment/Quiz
II.	Knowledge of extension fields and its applications.	Application Based learning/ Research Oriented Teaching	Evaluation of Students on the basis of Assignment/Quiz /Class test
III.	Understand the concepts Galois Theory and concept of polynomial of radicals.	Presentation/Lecture	Evaluation of Students on the basis of Presentation/Application Oriented Question solving/ Assignment/ Quiz.
IV.	Able to utilize Application of modules over rings G	Presentation/ Video/ Lecture / Research Study.	Evaluation of Students on the basis of Presentation/ Assignment/Quiz
V.	Understand the connection and transition between previously studied mathematics and more advanced mathematics.	Presentation/ Lecture / Research Study.	Evaluation of Students on the basis of Assignment/Quiz /Class test.

Text Books-

1. P.B. Bhattacharya, S.K. Jain and S. R. Nagpaul, Basic Abstract Algebras Cambridge University press.
2. I.N. Herstein, Topic in Algebra wiley Eastern, New Delhi.
3. A Course in Abstract Algebra, Vijay Khanna and S K Bhambri Vikas Publishing House PVT LTD

Reference Books

1. .N. Jacobs, Basic Algebra Vol I, II, & III Hindustan Publishing Company.
2. S. Lang, Algebra Addision - Wisley.
3 .S. Luther & IBS Passi, AlgebmBol, I, II ,& III Narosa pub. House , New Delhi

E-resources:

1. Free Advanced Abstract Algebra Books PDF: https://www.freebookcentre.net/maths-books-download/Advance-Abstract-Algebra.html
2. Advanced Abstract Algebra PDF (GURU JAMBHESHWAR UNIVERSITY OF SCIENCE & TECHNOLOGY) :

http://www.ddegjust.ac.in/studymaterial/msc-math/mal-521.pdf
3. Mathematics Advanced Abstract Algebra Notes PDF –NPTEL (IIT Delhi): https://nptel.ac.in/courses/advancedabstractalgebra
4. Advanced Abstract Algebra by Bhagwan Singh Vishwakarma : https://www.youtube.com/watch?v=VsNqpExmohw
5. Advanced Algebra-Stony Book Mathematics: https://www.math.stonybrook.edu/~aknapp/download/a2-alg-inside.pdf
6. Advanced Algebra-Word Press.com: https://pkalika.files.wordpress.com/2021/05/abstract-1-group-theory-250pages79.pdf
7. Fundamental theorem of Galois Theory and example By HarpreetBedi: https://www.youtube.com/watch?v=Bo3Vw9ZotFE
8. Basic Advanced Algebra PDF: http://www.mdudde.net/pdf/study_material_DDE/M.Sc.MAthematics/BASIC%20ABSTRACT%20ALGEBRA.pdf
9. Fundamental theorem of Galois Theory and example-Wolfram Math world: https://mathworld.wolfram.com/FundamentalTheoremofGaloisTheory.html

MSMH	Total Marks: 100
Semester-I	Internal Marks: 30
PaperCode: MSMH104	External Marks: 70
Ordinary and partial Differential Equations	No. of Hours: 75
Course Objective(s): To study Linear Equations with Regular, Linear Equations with Variable Co-efficient, Ordinary Differential Equations in more than two variables, Partial Differential Equations of the First order, Partial Differential Equations of the second order.	Total Credits: 05

Unit No.	Details	Nos. of Hours
1	Existence and uniqueness of solutions of initial value problems for first order ordinary differential equations, Qualitative properties of ordinary differential equations of order two: Sturm separation theorem, normal form and standard form.	**15**
2	General theory of homogeneous and nonhomogeneous linear ODEs, variation of parameters, Sturm –Liouville boundary value problem,Green's functions.	**15**
3	Power series solutions: Series solutions of first order equations and second order linear equations, ordinary points, regular singular points, identical equations, Gausses' Hyper geometric equation.	15
4	Introduction of PDE, Charpit's method, Jacobi's method, quasi linear equations, nonlinear first order PDE.	**15**
5	Classification of second order PDEs, One dimensional heat and wave equation, Laplace equation, Boundary value problem, the Cauchy problem, Classification of PDE in the case of n variables.	**15**

Course Outcome(s): After completing this course, the student will be able to:

CO1 Obtain solutions of the Homogeneous equation with constant co-efficient and Homogeneous equation with analytic co-efficient.
CO2 Comprehend the Euler equations, the Bessel equation and Regular singular points at infinity.
CO3 Study surfaces and curves in three-dimension space.
CO4 Analyze the origin of first order partial differential equations and solving them using Charpit'smethod.
CO5 Identify the second order equations and solve them using separation of variable method.

COURSE LEARNING OUTCOME:

UNIT NO.	COURSE LEARNING OUTCOME	TEACHING AND LEARNING ACTIVITY	ASSESSMENT TASK
I.	Students will have a working knowledge of important mathematical concepts in Ordinary and Differential Equations	Presentation/ Lecture	Evaluation of Students on the basis of Assignment/Quiz
II.	Comprehend the Euler equations, the Bessel equation and Regular singular points at Infinity	Application Based learning/ Research Oriented Teaching	Evaluation of Students on the basis of Assignment/Quiz /Class test
III.	Understand the concepts of surfaces and curves in three-dimension space.	Presentation/Lecture	Evaluation of Students on the basis of Presentation/Application Oriented Question solving/ Assignment/ Quiz.
IV.	Understand how to Analyze the origin of first order partial differential equations and solving them using Charpit'smethod	Presentation/ Video/ Lecture / Research Study.	Evaluation of Students on the basis of Presentation/ Assignment/Quiz
V.	Gain the knowledge of separation of variable method	Presentation/ Lecture / Research Study.	Evaluation of Students on the basis of Assignment/Quiz /Class test.

Text Books:

1. T. Amarnath: An Elementary Course in Partial Differential Equations (2nd edition) (NarosaPublishing House).
2. G.F. Simmons: Differential equations with applications and Historical Notes second edition(Mc-Graw Hill).

E-resources:

1. Free Ordinary-and-Partial Differential-Equations Books PDF:
2. https://www.freebookcentre.net/maths-books-download/Introduction-to-Ordinary-and-Partial-Differential-Equations.html
3. Ordinary-and-Partial Differential-NPTEL-by Prof. N.P.Agrawal and Dr. D.N.Pandey (IIT Roorkee):https://nptel.ac.in/courses/Ordinay
4. Existence and uniqueness of solutions of initial value problems for first order ordinary differential equations PDF: https://faculty.math.illinois.edu/~tyson/existence.pdf
5. Sturm –Liouville boundary value problem-NPTEL-by Prof.TanujaShrivastava(IIT Roorkee):https://www.youtube.com/watch?v=HkhQ0Q2kqtc
6. Green's functions and its applications-NPTEL-by Prof. Dr. D.N.Pandey(IIT Roorkee):https://www.youtube.com/watch?v=5OTw6sBAYB8

7. Gausses' Hyper geometric equation by Prasant G.Patel(Shanti –Peace for Mathematics): https://www.youtube.com/watch?v=BfKcg_zp7Ro
8. Boundary value problem based on Laplace equations by ThichNhathanh(Shanti –Peace for Mathematics): https://www.youtube.com/watch?v=HuyEXKgJbYs
9. Ordinary-and-Partial DifferentialEquation: -Virginia: https://www.people.vcu.edu/~clarson/cain-reynolds-odes.pdf
10. Ordinary Differential Equation: https://old.mu.ac.in/wp-content/uploads/2020/12/Paper-IV-Ordinary-Diffrential-Equation.pdf
11. Lecture notes on Ordinary Differential Equations Annual Foundation School, IIT Kanpur by S. Sivaji Ganesh(IIT Bombay):http://www.math.iitb.ac.in/~siva/afs07.pdf

KALINGA UNIVERSITY

FACULTY OF SCIENCE

COURSE: M.SC (ELECTIVE) CREDITS: 4 TEACHING HOURS: 60Hrs

SUBJECT: RESEARCH METHODOLOGY CODE: MSMH105A

Objectives:

1. Understand some basic concepts of research and its methodologies
2. Identify appropriate research topics
3. Select and define appropriate research problem and parameters
4. Prepare a project proposal (to undertake a project)
5. Organize and conduct research (advanced project) in a more appropriate manner

Unit I

Foundations of Research: Meaning, Objectives, Motivation, Utility. Concept of theory, empiricism, deductive and inductive theory. Characteristics of scientific method – Understanding the language of research – Concept, Construct, Definition, Variable. Research Process

Unit II

Problem Identification & Formulation – Research Question – Investigation Question – Measurement Issues – Hypothesis – Qualities of a good Hypothesis –Null Hypothesis & Alternative Hypothesis. Hypothesis Testing – Logic & Importance , Research Design: Concept and Importance in Research – Features of a good research design – Exploratory Research Design – concept, types and uses, Descriptive Research Designs – concept, types and uses. Experimental Design: Concept of Independent & Dependent variables.

Unit III

Qualitative and Quantitative Research: Qualitative research – Quantitative research – Concept of measurement, causality, generalization, replication. Merging the two approaches. Measurement: Concept of measurement– what is measured? Problems in measurement in research – Validity and Reliability. Levels of measurement – Nominal, Ordinal, Interval, Ratio. Sampling: Concepts of Statistical Population, Sample, Sampling Frame, Sampling Error, Sample Size, Non Response. Characteristics of a good sample. Probability Sample – Simple Random Sample, Systematic Sample, Stratified Random Sample & Multi-stage sampling. Determining size of the sample – Practical considerations in sampling and sample size.

Unit IV

Data Analysis: Data Preparation – Univariate analysis (frequency tables, bar charts, pie charts, percentages), Bivariate analysis – Cross tabulations and Chi-square test including testing hypothesis of association. Interpretation of Data and Paper Writing – Layout of a Research Paper, Journals in Computer Science, Impact factor of Journals, When and where to publish ? Ethical issues related to publishing, Plagiarism and Self-Plagiarism.

Unit V

Use of Encyclopedias, Research Guides, Handbook etc., Academic Databases for Computer Science Discipline. Use of tools / techniques for Research: methods to search required information effectively, Reference Management Software like Zotero/Mendeley, Software for paper formatting like LaTeX/MS Office, Software for detection of Plagiarism

Learning Outcomes:

1. Students will understand a general definition of research design.
2. Students will know why educational research is undertaken, and the audiences that profit from research studies.
3. Students will be able to identify the overall process of designing a research study from its inception to its report.
4. Students will be familiar with ethical issues in educational research, including those issues that arise in using quantitative and qualitative research

Assessment Tools:

Written examinations, Case study discussions, Viva examinations.

Books Recommended:-

1. Business Research Methods – Donald Cooper & Pamela Schindler, TMGH, 9th edition
2. Business Research Methods – Alan Bryman & Emma Bell, Oxford University Press.
3. Research Methodology – C.R.Kothari

KALINGA UNIVERSITY

FACULTY OF SCIENCE

COURSE: M.SC (ELECTIVE) **CREDITS: 4** **TEACHING HOURS: 60Hrs**

SUBJECT: SCIENCE JOURNILISM **CODE: MSMH105B**

Objectives

- Students will learn the mechanics of science writing, including research, sourcing, and generating story ideas; interviewing, note-taking, and organization; fact-checking, editing, writing for story, structure, and formatting.
- Students will practice writing for multiple public, academic, and professional audiences and contexts using writing strategies, conventions, genres, technologies, and formats to communicate effectively.

UNIT 1 Science communication at the end of the Enlightenment and the importance of notions of the public in the origin of modern science - development of new audiences for science in the Nineteenth century and the emergence of new science communication media (e.g. mechanics' institutes, science journalism, public museums and zoos) - advent of the figure of the scientist as public expert and the debate about 'Two Cultures' – difference between science journalism and science communication

UNIT 2 Introduction of Western science in India through missionaries, travelers, army and civilian army of the East India Company– science in the 18th and 19th century –emergence of Indian pioneer scientists – science teaching–– developments during post-Independence period – emerging areas of science and technology – convergence in study of science

UNIT 3 Institutions of science in India - the role of the Asiatic Society – Bose Institute – Indian Institute of Science - Council of Scientific and Industrial Research (CSIR) – Indian Space Research Organization (ISRO) – Indian Science Congress organizations for popularization of science – NCSTC and Vigyan Prasar – noted science societies at state level – Science and Technology Academies – awards for science communication and popularization.

UNIT 4 The boom in new media during the twentieth century and their impact on science journalism - role of a science page editor – popular science magazines in the west – science magazines in India – the ideal science reporter - scope of science journalism on radio & television in developing countries – science serials on radio and television – Bharat ki Chaap on Doordarshan – Science serials on All India Radio - tech news - understanding present market trends.

UNIT 5 Science as an essential element in political, corporate and community news – major issues in science journalism – environmental pollution – genetically modified crops – research for disease prevention and eradication – nuclear power – disaster mitigation – scientific knowledge for effective governance – the North-South divide in science research and scientific development.

Learning Outcomes

- They will appreciate the digital landscape within which science journalism exists today by learning: blogging in science journalism (honing your craft, developing a voice); how to get work (pitching and staying relevant); the value of social networks for science journalism (sharing stories, finding stories, joining discussions and finding sources); digital strategies employed by major news organizations (data visualization, multimedia, community building).
- Students will analyze and learn about the structure of several types of data including numbers, texts and documents. Students will learn the skills to examine, evaluate, and critique those data, extract patterns, summarize features, create visualizations, and provide insights, while learning to be sensitive to ethical concerns associated

Assessment Tools: Written examinations, Case study discussions, Viva examinations.

Reference Book:

1. Mass Communication: A Critical analysis, Keval J Kumar
2. Professional Journalism, M V Kamat
3. Theory and Practice of Journalism, B N Ahuja
4. Professional Journalist, John Hohenberg
5. Understanding Media, Marshall McLuhan 6. Journalism in India,Nadig Krishnamurthy, Mysore University Press
6. Barbara Gastel, Presenting Science to the Public.
7. Blum, Deborah, Knudson, Mary & Marantz Henig, Robin. A Field Guide for Science Writers: The Official Guide of the National Association of Science Writers. (2005)
8. D. Perlman, Science and the Mass Media.
9. Elise Hancock, Ideas into Words: Mastering the Craft of Science Writing. Baltimore and London: Johns Hopkins, 2003.
10. N Corcoran (Ed.). Communicating health: strategies for health promotion. Sage. (2013).
11. O.P. Jaggi, A Concise History of Science including Science in India.
12. R. Sundara, Popular Science in Mass Media.
13. Renata Schiavo, Health Communication: From Theory to Practice. John Wiley & Sons. 2013
14. Sharon, M. Friedman, Sharon, Woody, Carlol, L. Rogers (Ed) : Scientists and Journalists, Reporting Science as News.
15. Warren Burkett, News Reporting : Science Medicine and High Technology

M.Sc.
(Mathematics)
Semester –II

MSMH		Total Marks: 100
SEMESTER-II		Internal Marks: 30
Paper Code: MSMH201		External Marks: 70
General Topology		No. of Hours: 75
Course Objective(s): To study topological spaces, continuous functions, connectedness, compactness, countability and separation axioms.		Total Credits: 05
Unit No.	**Details**	**Nos. of Hours**
1	Infinite sets, Cardinal numbers and its arithmetic, axiom of choice, Schroeder- Bernstein theorem, Zorn's lemma, well ordering theorem. Definition and examples of topological spaces, Closed sets, Neighborhoods, interior, Exterior and boundary, Accumulation points and derived sets. Dense subsets.	**15**
2	Bases and sub - bases, subspaces and relative topology. Alternate methods of defining a topology in terms of kuratowski closure operator and neighbor heed system, Continuous functions and homomorphism, First and second countable spaces, Lindelof's theorems.	**15**
3	Separation axioms T0, T1, T2, T3, T1/2 & T4 their characteristics and properties. Urysohn lemma Tietze extension theorem, Compactness, Basic properties of compactness, continuous functions and compact sets, Compactness and finite intersection property. Sequentially and countably compact, compact sets. Lindelof's theorems, Compactification, One point compactification, The stone-Cechcompactification.	15
4	Countable compactness and sequential compactness in metric spaces. Connected spaces. Connectedness on the line. Components Locally connected spaces. Embedding and metrization. Embedding lemma and Tychonoff embedding theorem The Urysohnmetrization theorem. Tychonoff product topology in terms of standard sub base and its characterizations.	**15**
5	Projection maps. Separation axioms and product spaces. Connectedness and product spaces. Compactness and product spaces (Tychonoff's theorem) Countability and product spaces. Net and filters. Topology and convergence of nets Hausdorffness and nets. Compactness and nets. Filters and their convergence. Canonical way of converting nets to filters and vice- versa Ultra filters and compactness.	**15**

Course Outcome(s): After completing this course, the student will be able to:
CO1: Understand Open bases and open sub bases, Weak topologies, the function algebras C (X, R) and C (X, C).
CO2: Discuss Tychonoff's theorem, locally compact spaces, Compactness of metric spaces andAscoli's theorem.
CO3: Distinguish Urysohn's lemma and the Tietze extension theorem.
CO4: Discuss connected spaces, the components of a space and totally disconnected spaces.
CO5: Study Stone-Weierstrass theorems and its applications.

COURSE LEARNING OUTCOME:

UNIT NO.	COURSE LEARNING OUTCOME	TEACHING AND LEARNING ACTIVITY	ASSESSMENT TASK
I.	Understand Open bases and open sub bases, Weak topologies, the function algebras C (X, R) and C (X, C).	Presentation/ Lecture	Evaluation of Students on the basis of Assignment/Quiz
II.	Gains the knowledge of Tychonoff's theorem and its applications	Application Based learning/ Research Oriented Teaching	Evaluation of Students on the basis of Assignment/Quiz /Class test
III.	Distinguish Urysohn's lemma and the Tietze extension theorem	Presentation/Lecture	Evaluation of Students on the basis of Presentation/Application Oriented Question solving/ Assignment/ Quiz.
IV.	Discuss connected spaces, the components of a space and totally disconnected spaces	Presentation/ Video/ Lecture / Research Study.	Evaluation of Students on the basis of Presentation/ Assignment/Quiz
V.	Study the Projection maps. Separation axioms and product spaces and Stone-Weierstrass theorems and its applications	Presentation/ Lecture / Research Study.	Evaluation of Students on the basis of Assignment/Quiz /Class test.

Text Books:

1. James R. Munkres, Topology, A first course, prentice Hall of India Pvt. Ltd. New Delhi.
2. J.N. Sharma and J.P. Chauhan Krishna Educational Publication Meerut.

Reference Books:

1.G.F. Simmons, Introduction to Topology and Modern Analysis, McGraw Hill Book Company.
2. K. D Joshi Introduction to general Topology Wiley Eastern.
3. J.L. Kelley General Topology Van Nostrand.

E-resources:

1. Free Topology Books PDF: http://www.freebookcentre.net/Mathematics/Topology-Books-Download.html
2. M.Sc. I Maths MT202 General Topology All PDF: https://www.scribd.com/document/433959798/M-Sc-I-Maths-MT-202-General-Topology-All-1-PDF
3. A handwritten notes of Topology by Mr. Raheel Ahmad-Math city.org: https://www.mathcity.org/msc/notes/general-topolgy-raheel-ahmad
4. Topology PDF-NPTEL: https://nptel.ac.in/content/storage2/courses/111106054/Topology%20complete%20course.pdf
5. On Separation Axioms (T0, T1, T2, T3, , T4, AND T5) and Relationship among them-COLLEGE OF EDUCATION FOR PURE SCIENCE-UNIVERSITY OF ANBAR: https://www.uoanbar.edu.iq/EPSCollege/catalog/res1(1).pdf

MSMH	Internal Marks: 30
Semester-II	External Marks: 70
Paper Code: MSMH202	No. of Hours: 75
Discrete Mathematics and Its Application	Total Marks: 100
Course Objective(s): To study Relation, Lattices, Grammar, Boolean algebra and graph theory with the various applications.	Total Credits: 05

Unit No.	Details	Nos. of Hours
1	Congruence relation and quotient semigroups. Sub semigroup and sub monoids. Direct products Basic homomorphism theorem. Lattices: lattices as partially ordered sets. Their properties. Lattices as Algebraic systems. Sub lattices such as complete, Complemented and Distributive Lattices.	**15**
2	Non - deterministic finite automata and equivalence of its power to that of deterministic finite automata. Moore and mealy machines. Turing machine and partial recursive functions. Grammars and Languages Phrase Structure grammars. Rewriting rules Derivations. Sentential forms. Language generated by a grammar.	**15**
3	Boolean algebra as lattices Various Boolean identities. The switching algebra examples sub algebras. Direct products and homomorphism's join irreducible elements atoms and minterms. Boolean forms and their equivalence, minterms. Boolean forms, Sum of products canonical forms minimization of Boolean functions. Applications of Boolean algebra to switching theory (using AND, OR, NOT gates) The Karnaugh map method.	**15**
4	Graph theory definition of graphs, paths, circuits, cycles & sub graphs into sub graphs, degree of a vertex connectivity. Planer graphs and their property, Trees, Euler's formula for connected planer graphs. Complete bipartite graph, Kuratowski's theorem (Statement only) Minimal spanning trees and Kruskal's algorithm. Matrix representation of graphs.	**15**
5	Directed graphs, in degree and out degree of vertex (theorems) Weighted undirected graphs. Dijkstra's algorithm, Eulerian and Hamiltonian graphs, Dijkrtra's algorithm, strong connectivity and War shall algorithm directed trees search trees, tree traversals, Introductory computability theory finite state machines machine, Homomorphism Finite automata, Acceptors.	**15**

Course Outcome(s): After completing this course, the student will be able to:

CO1: Study Congruence relation and quotient semigroups, Lattices.
CO2: Understand the finite automata, Moore and mealy machines.
CO3: Express the Boolean algebra as lattices and its applications.
CO4: Understand the Graph and its types.
CO5: Discuss the various algorithms for shortest route.

COURSE LEARNING OUTCOME:

UNIT NO.	COURSE LEARNING OUTCOME	TEACHING AND LEARNING ACTIVITY	ASSESSMENT TASK
I.	Study Congruence relation and quotient semigroups, Lattices	Presentation/ Lecture	Evaluation of Students on the basis of Assignment/Quiz
II.	Understand the concepts finite automata, Moore and mealy machines	Application Based learning/ Research Oriented Teaching	Evaluation of Students on the basis of Assignment/Quiz /Class test
III.	Gain the knowledge of Boolean algebra as lattices and its applications	Presentation/Lecture	Evaluation of Students on the basis of Presentation/Application Oriented Question solving/ Assignment/ Quiz.
IV.	Gain the knowledge the Graph and its types.	Presentation/ Video/ Lecture / Research Study.	Evaluation of Students on the basis of Presentation/ Assignment/Quiz
V.	Discuss the various algorithms for shortest route	Presentation/ Lecture / Research Study.	Evaluation of Students on the basis of Assignment/Quiz /Class test.

Text Books:

1. J.P. Tremblay & R. Manohar, discrete Mathematical Structures, McGraw Hill New Delhi.
2. NarsinghDeo Graph Theory with applications prentice Hall New Delhi.
3. A text book of Discrete Mathematics by Swapan Kumar SarkarS.Chand Publication New Delhi.

Reference Books:

1. C.L. Liu Elements of Discrete Mathematics McGraw Hill New Delhi.
2. J.L. Gresting Mathematical Structures for computer science computer science press New York.
3. Discrete Mathematics by Seymour Lipschurtz&Marck Lipson. The McGraw Hill New Delhi.

E-resources:

1. Free Discrete Mathematics Books PDF: **http://www.freebookcentre.net/Mathematics/Discrete-Mathematics-Books.html**
2. Advanced Discrete Mathematics-MaharshiDayanand University ROHTAK:http://mdudde.net/books/MA/MA-maths/2nd/Advanced%20Discrete%20Mathematics-final.pdf
3. Graph Theory Notes-University of Warwick: https://homepages.warwick.ac.uk/~masgax/Graph-Theory-notes.pdf
4. Graph Theory by Prof. SoumenMaity(IISER Pune)-NPTEL:https://nptel.ac.in/courses/Graphtheory
5. Automata Theory-Tutorialspoint:https://www.tutorialspoint.com/automata_theory/automata_theory_tutorial.pdf
6. Deterministic Finite Automate(DFA) by Prof. SouravMukhopadhay(IIT Kharagpur)-NPTEL:https://www.youtube.com/watch?v=CwihAY_fgRE
7. Graph theory by Mr. Muhammad Iftikhar-Mathcity.org: https://www.mathcity.org/msc/notes/groups-theory-m-iftikhar

MSMH	Total Marks: 100
Semester-II	Internal Marks: 30
Paper Code: MSMH203	External Marks: 70
Operations Research	No. of Hours: 75
Course Objective(s): In this course basic concepts of Operations Research such as Linear Programming Problem, Duality in Linear Programming, Transportation Problem, Assignment Problem and Queuing Theory are introduced.	Total Credits: 05

Unit No.	Details	Nos. of Hours
1	Linear Programming- Introduction of general LPP, Simplex method, duality, Dual simplex method, Two-Phase simplex method, Big-M method. Degeneracy in Linear programming.	**15**
2	Transportation problem-initial basic feasible solution, Solution by Matrix minima method and Vogel's approximation method, Optimal solution, degeneracy in transportation problems. Assignment Problems: Hungarian Method for solution. Traveling-Salesman problems.	**15**
3	Games Theory: two people zero sum game, game with mixed strategies. Principle of dominance, rectangular game. Graphical Solution By linear programming. Queuing Theory: Poison queuing system, non-Poison queuing system, Different queuing models: Model(M/M/1) :(∞/FIFO), (M/M/1)) :(N/FIFO), (M/M/C) :(∞/FIFO).	**15**
4	Integer Programming: Pure and Mixed Integer programming, Gomory's All – I.P.P. Method, Fractional Cut method- All Integer LPP, Branch and Bound method (its application), Goal programming, Dynamic programming.	**15**
5	Non-Linear Programming: Kuhn-Tucker Condition with non –negative constraints, Wolfe's Modified Simplex method, Geometric Programming.	**15**

Course Outcome(s): After completing this course, the student will be able to:

CO1 Apply and solve the problems - Games Theory and Queuing Theory: Poison queuing system.

CO2 Understand the concept of LPP by Simplex method, dual simplex method, Big M method and

its different applications.

CO3 Analyze Transportation problem and Assignment Problems: Hungarian Method for solution. Traveling- Salesman problems and different application in real life.

CO4 Understand Integer Programming, Goal Programming, Dynamic Programming and its importance in optimization process.

CO5 Discuss the Non-Linear Programming and its applications.

COURSE LEARNING OUTCOME:

UNIT NO.	COURSE LEARNING OUTCOME	TEACHING AND LEARNING ACTIVITY	ASSESSMENT TASK
VI.	Understand the concept of LPP by Simplex method, dual simplex method, Big M method and its different applications	Presentation/ Lecture	Evaluation of Students on the basis of Assignment/Quiz
VII.	Understand how to Analyze Transportation problem and Assignment Problems: Hungarian Method for solution. Traveling- Salesman problems and different application in real life	Application Based learning/ Research Oriented Teaching	Evaluation of Students on the basis of Assignment/Quiz /Class test
VIII.	Gains knowledge to solve the problems - Games Theory and Queuing Theory: Poison queuing system.	Presentation/Lecture	Evaluation of Students on the basis of Presentation/Application Oriented Question solving/ Assignment/ Quiz.
IX.	Understand Integer Programming, Goal Programming, Dynamic Programming and its importance in optimization process.	Presentation/ Video/ Lecture / Research Study.	Evaluation of Students on the basis of Presentation/ Assignment/Quiz
X.	Discuss the Non-Linear Programming and its applications.	Presentation/ Lecture / Research Study.	Evaluation of Students on the basis of Assignment/Quiz /Class test.

Text Books:

1. H.A Taha, Operations Research-An Introduction, Macmillan Publishing INC., New York.
2. KantiSwarup, P.K. Gupta & Man Mohan, Operations Research, Sultan Chand & sons, New Delhi.

Reference Books:

1. F.S. Hillier & G.J. Lieberman, Introduction to Operations Research, (Sixth-edition) McGraw Hill International Edition.
2. S.D. Sharma Operations Research, KedarNath Ram Sons & Co. Publisher Meerut (thirteenth-edition).

E-resources:

1. NOC-Operation Research (video) by Prof. Kusum Deep(IIT Roorkee):https://nptel.ac.in/courses/operationresearch
2. Operation Research applications PDF by (IIT Madras)-NPTEL: https://nptel.ac.in/courses/operationresearch
3. Linear Programming: Theory and Applications by Catherine Lewis: https://www.whitman.edu/Documents/Academics/Mathematics/lewis.pdf
4. Transportation Problem and Assignment problem: https://www.acsce.edu.in/acsce/wp-content/uploads/2020/03/1585041316993_Module-4.pdf
5. Operation Research handwritten notes-Mathcity.org: https://www.mathcity.org/msc/notes/operation_research
6. Operation Research handwritten notes by sir Haidar Ali-Mathcity.org: https://www.mathcity.org/msc/notes/operation-research-haidar-ali
7. Handwritten Operation Research Lecture notes PDF-TutorialsDunia:https://www.tutorialsduniya.com/notes/operational-research-notes/
8. Introduction to Operation Research by Yong Wang:https://www.youtube.com/watch?v=4EUAnzLkHFU

MSMH	Total Marks: 100
Semester-II	Internal Marks: 30
Paper Code: MSMH204	External Marks: 70
Functional Analysis	No. of Hours: 75
Course Objective(s): To study Normed linear spaces, Banach spaces, Hilbert Spaces, and operators on these spaces.	Total Credits: 05

Unit No.	Details	Nos. of Hours
1	Normed linear spaces, Banach spaces and examples, Quotient space ofnormed linear space and its completeness, equivalent norms, Riesz Lemma, basic properties of finite dimensional normed linear spaces and compactness.	**15**
2	Weak convergence and bounded linear transformations, normed linearspaces of bounded linear transformations, dual spaces with examples and reflexive spaces.	**15**
3	Uniform boundedness theorem and some of its consequences. Open mapping and closed graph theorems, Hahn-Banach theorem for real linear spaces and complex linear spaces. Inner product spaces: Hilbert spaces, Orthonormal Sets,	**15**
4	Bessel's inequality.Complete Orthonormal sets and Parseval's identity, Structure of Hilbert spaces, Reflexivity of Hilbert spaces, Projection theorem, Riesz representation theorem, Adjoint of an operator on a Hilbert space, Self-Adjoint operators, Positive, compact operators, normal and unitary operators.	**15**
5	General measures Examples Semi finite& Sigma-finite measure. Measurable functions. Signed measure Hahn Decomposition theorem, mutually singular measures. Jordon Decomposition theorem.Radon-Nikodym theorem.	**15**

Course Outcome(s): After completing this course, the student will be able to:

CO1 Study Continuous linear transformations and the Hahn-Banach theorem.
CO2 Understand the, normed linearspaces of bounded linear transformations.
CO3 Obtain Orthogonal complements, Orthonormal sets and conjugate space.
CO4 Understand the Complete Orthonormal sets and Parseval's identity, Structure of Hilbert spaces.

CO5 Discuss Measurable functions.

COURSE LEARNING OUTCOME:

UNIT NO.	COURSE LEARNING OUTCOME	TEACHING AND LEARNING ACTIVITY	ASSESSMENT TASK
I.	Gain the knowledge of Continuous linear transformations and the Hahn-Banach theorem	Presentation/ Lecture	Evaluation of Students on the basis of Assignment/Quiz
II.	Understand the, normed linear spaces of bounded linear transformations	Application Based learning/ Research Oriented Teaching	Evaluation of Students on the basis of Assignment/Quiz /Class test
III.	Understand the Orthogonal complements, Orthonormal sets and conjugate space	Presentation/Lecture	Evaluation of Students on the basis of Presentation/Application Oriented Question solving/ Assignment/ Quiz.
IV.	Understand the Complete Orthonormal sets and Parseval's identity, Structure of Hilbert spaces	Presentation/ Video/ Lecture / Research Study.	Evaluation of Students on the basis of Presentation/ Assignment/Quiz
V.	Understand the concepts of Jordon Decomposition theorem its applications	Presentation/ Lecture / Research Study.	Evaluation of Students on the basis of Assignment/Quiz /Class test.

Text Books:

1. B. Choudhary and Sudarsan Nanda, Functional Analysis with applications, Wiley Eastern Ltd.
2. G.F. Simmons, Introduction to Topology & Modern Analysis, McGraw Hill, New York, 1963.
3. E. Kreyszig, Introductory Functional Analysis with applications, John Wiley & Sons, New York, 1978.

Reference Books:

1. Walter Rudin, Functional analysis, TMH Edition, 1974.
2. A.E. Taylor-Introduction to Functional Analysis, John Wiley & Sons, New Your, 1978.
3. A.H. Siddiqui, Functional Analysis with applications, TMH Publication company Ltd. New Delhi.
4. B.K. Lahiri, Elements of functional Analysis, The World Press, Calcutta,
5. P.R. Halmos, Measure theory, Bon-Nostrance.
6. L.K. Rana,Introduction to measure & integration, Narosa Publishing House, New Delhi

E-resources:

1. Functional Analysis by Prof. P.D.Shrivastava (IIT Kharagpur)-NPTEL:https://nptel.ac.in/courses/functionalanalysis
2. Functional Analysis by Prof.S. Kesavan-NPTEL:https://nptel.ac.in/courses/functionalanalysis
3. Functional Analysis handwritten notes by Mr. TahirHussainJaffery – MathCity.org:https://www.mathcity.org/msc/notes/functional_analysis
4. Functional Analysis handwritten notes by Prof. Mumtaz Ahmad– MathCity.org:https://www.mathcity.org/msc/notes/functional-analysis-by-prof-mumtaz-ahmad
5. Functional Analysis Notes and Books PDF:https://examupdates.in/functional-analysis-book/#MSc-Functional-Analysis-Books
6. Lecture notes in Functional Analysis –MIMUW:https://www.mimuw.edu.pl/~aswiercz/AnalizaF/lecture.pdf

KALINGA UNIVERSITY

FACULTY OF SCIENCE

COURSE: M.SC (ELECTIVE) CREDITS: 4 TEACHING HOURS: 60Hrs

SUBJECT: ENTERPRENEURSHIP CODE: MSMH205A

Course Overview The goals of this programme are to inspire students and help them imbibe an entrepreneurial mind-set. The students will learn what entrepreneurship is and how it has impacted the world and their country. They will be introduced to key traits and the DNA of an entrepreneur, and be given an opportunity to assess their own strengths and identify gaps that need to be addressed to become a successful entrepreneur. The programme comprises several short courses, each focusing on a specific entrepreneurial knowledge or skill requirement such as creative thinking, communication, risk taking, and resilience and helping them become career ready, whether it is entrepreneurship or any other career.

Course Contents:

Unit I **Contact Hours: 12**

Entrepreneurship: Concept of Entrepreneur, Entrepreneurship and Manager, Difference between Entrepreneur and Entrepreneur, Entrepreneurship, Attributes and Characteristics of successful entrepreneurs. Functions of an Entrepreneurs Function of an Entrepreneur, Classification of Entrepreneurs, Role of Entrepreneur in Indian Economy, Developing Entrepreneurial culture, Factors influencing Entrepreneurship Growth – Economic, Non-Economic Factors, For profit or Not for profit entrepreneurs, Constraints for the Growth of Entrepreneurial Culture, Entrepreneurship as a career, Entrepreneurship as a style of management, Emerging Models of Corporate Entrepreneurship, India's start up revolution-Trends, Imperatives, benefits: the players involved in the ecosystem, Business Incubators-Rural Entrepreneurship, social entrepreneurship, women entrepreneurs, Cases of Tata, Birlas, Kirloskar and new generation entrepreneurs in India.Case study on related topics.

Unit II **Contact Hours: 12**

Theories of entrepreneurship: Innovation Theory by Schumpeter & Imitating, Theory of High Achievement by McClelland, X-Efficiency Theory by Leibenstein, Theory of Profit by Knight, Theory of Social change by Everett Hagen.Case study on related topics.

Unit III **Contact Hours: 12**

Entrepreneurship development: Entrepreneurial Competencies, Developing competencies, concept of entrepreneurship development, Entrepreneur Training and developing, Role of Entrepreneur development Programs (EDP), Role of DIC, EDII, NIESBUD, NEDB, EDP – Objectives – contents – methods – execution, Mudra Yojna: Shishu, Kishore and Tarun Scheme. Role of Mentors. Innovation and Entrepreneurship, Design Thinking Process, Role of consultancy organizations in promoting Entrepreneurs, Problems and difficulties of Entrepreneurs – Marketing Finance, Human Resource, Production; Research – external problems, Mobility of Entrepreneurs,Entrepreneurial change, occupational mobility – factors in mobility.Case study on related topics.

Unit IV **Contact Hours: 12**

Role of Central government and State Government in promoting Entrepreneurship:Introduction to various incentives, subsidies and grants, Export Oriented Units, Fiscal and Tax concessions available, Women Entrepreneurs – Role, Problems and Prospects, Reasons for low women Entrepreneurs, Assistance Programme for Small Scale Units – Institutional Framework – Role of SSI Sector in the Economy – SSI Units – Failure, Causes and Preventive Measures – Turnaround Strategies. Future of Entrepreneurship Development and Government, Start Up India, Make in India.Case study on related topics.

Unit V **Contact Hours: 12**

Enterprise Promotion: Creating Entrepreneurial Venture, Entrepreneurship Development Cycle, Business Planning Process The business plan as an entrepreneurial tool, Elements of Business Plan, Objectives, Market Analysis, Development of product/ idea –Resources, Capabilities, and strategies, identifying attributes of strategic resources, Opportunity Analysis, innovator or imitator, SWOT analysis, Internal and External Environment Analysis, Industry Analysis, Embryonic Companies and Spin off's, Porter's five forces model, Identifying the right Business Model Canvas, Seven Domains of John Mullins, Opportunities in Emerging/Transition/Decline industries, Opportunities at the bottom of the pyramid, Opportunities in social sector, Opportunities arising out of digitization, Marketing, Finance, Organization & Management, Ownership – Franchising, networking and alliances, Buying an existing business, Critical risk contingencies of the proposal, Scheduling and milestones.Case study on related topics.

Text Books:

1. Vasant Desai (2011), Dynamics of Entrepreneurship Development, Himalaya Publishing House.
2. David H. Holt, (1991) Entrepreneurship: New Venture Creation, Prentice Hall.
3. K. Nagarajan, (2017) Project Management, New Age International Pvt Ltd.

Reference book:

1. The Culture of Entrepreneurship, Brigitte Berger.
2. Entrepreneurship: Strategies and Resources, Marc J, Dollinger.

KALINGA UNIVERSITY

FACULTY OF SCIENCE

COURSE: M.SC (ELECTIVE) **CREDITS: 4** **TEACHING HOURS: 60Hrs**

SUBJECT: INTELLECTUAL PROPERTY RIGHTS **CODE: MSMH205A**

Objectives

1. To introduce fundamental aspects of Intellectual property Rights to students who are going to play a major role in development and management of innovative projects in industries and Research.
2. To disseminate knowledge on patents, patent regime in India and abroad and registration aspects
3. To disseminate knowledge on copyrights and its related rights and registration aspects
4. To disseminate knowledge on trademarks and registration aspects
5. To disseminate knowledge on Design, Geographical Indication (GI), Plant Variety and Layout Design Protection and their registration aspects
6. To aware about current trends in IPR and Govt. steps in fostering IPR and case studies.

Unit-1	**Overview and Introduction of Intellectual Property**
8-Hrs.	Introduction and the need for intellectual property right (IPR) - Kinds of Intellectual Property Rights: Patent, Copyright, Trade Mark, Design, Geographical Indication, Plant Varieties and Layout Design – Genetic Resources and Traditional Knowledge – Trade Secret - IPR in India : Genesis and development – IPR in abroad - Major International Instruments concerning Intellectual Property Rights: Paris Convention, 1883, the Berne Convention, 1886, the Universal Copyright Convention, 1952, the WIPO Convention, 1967,the Patent Co-operation Treaty, 1970, the TRIPS Agreement, 1994, Phonograms or Geneva Convention, History of IPR.
Unit-2	**Patents and Drafting**
10-Hrs.	Patents - Elements of Patentability: Novelty,Non-Obviousness (Inventive Steps), Industrial Application - Non - Patentable Subject Matter - Registration Procedure, Rights and Duties of Patentee, Assignment and license, Restoration of lapsed Patents, Surrender and Revocation of Patents, Infringement, Remedies & Penalties - Patent office and Appellate Board, Patent Filing and Drafting Case studies, Patent Agents role in India.

Unit-3	**Copyrights in IPR**
8-Hrs	Nature of Copyright - Subject matter of copyright: original literary, dramatic, musical, artistic works; cinematograph films and sound recordings - Registration Procedure, Term of protection, Ownership of copyright, Assignment and license of copyright - Infringement, Remedies & Penalties – Related Rights - Distinction between related rights and copyrights, Filing and Drafting the Copyrights.
Unit-4	**Trademarks and Trading licenses**
8-Hrs	Concept of Trademarks - Different kinds of marks (brand names, logos, signatures, symbols, well known marks, certification marks and service marks) - Non-Registrable Trademarks - Registration of Trademarks - Rights of holder and assignment and licensing of marks - Infringement, Remedies & Penalties - Trademark's registry and appellate board, Trading license importance of exports and imports in trading.
Unit-5	**IP transactions; Enforcement of IP, Commercialisation**
15Hrs	Implications of Intellectual Property Rights in promoting innovations and their commercialization; technology transfer, Due diligence in patent transactions. Working of patents in India Compulsory license and its implications; Enforcement of Patents against infringer. **Industrial Designs Registrations:** Classification, Protection and Enforcement of Industrial Designs in Indian. Registration and protection of design in India and abroad. **Geographical Indications**: Concept of Geographical Indications and GI registration in India; Global scenario of GI. Protection of Traditional Knowledge and development of balanced benefit sharing models; management of GI to enhance the economic returns from GIs. Enforcement of GI. GI registrations process in India Case studies.
10 –HRS	**Case Studies and Discussions related to IPR**

Learning Outcomes

1. The students once they complete their academic projects, shall get an adequate knowledge on patent and copyright for their innovative research works during their research career, information in patent documents provide useful insight on novelty of their idea from state-of-the art search.

2. This course provides further way for developing their idea or innovations.

3. To Pave the way for the students to catch up Intellectual Property (IP) as a career option a. R&D IP Counsel b. Government Jobs – Patent Examiner c. Private Jobs d. Patent agent and Trademark agent e. Entrepreneur

Assessment Tools: Written examinations, Case study discussions, Viva examinations.

REFERENCE BOOKS

1. Rimmer, M. (2008). *Intellectual property and biotechnology: biological inventions*. Edward Elgar Publishing.

2. Singh, H. B., Jha, A., &Keswani, C. (Eds.). (2016). *Intellectual property issues in biotechnology*. CABI.

3. Nithyananda, K V. (2019). Intellectual Property Rights: Protection and Management. India, IN: Cengage Learning India Private Limited.

4. Neeraj, P., &Khusdeep, D. (2014). Intellectual Property Rights. India, IN: PHI learning Private Limited.

E-resources:

1. Subramanian, N., &Sundararaman, M. (2018). Intellectual Property Rights – An Overview. Retrieved from http://www.bdu.ac.in/cells/ipr/docs/ipr-eng-ebook.pdf

2. 2. World Intellectual Property Organisation. (2004). WIPO Intellectual property Handbook. Retrieved from https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub_489.pdf

Reference Journal: 1. Journal of Intellectual Property Rights (JIPR): NISCAIR: http://nopr.niscair.res.in/handle/123456789/45 (Case Studies)

Useful Websites:

1. Cell for IPR Promotion and Management (http://cipam.gov.in/)
2. World Intellectual Property Organisation (https://www.wipo.int/about-ip/en/)
3. Office of the Controller General of Patents, Designs & Trademarks (http://www.ipindia.nic.in/)

M.Sc.
(Mathematics)
Semester –III

MSMH	Total Marks: 100
Semester-III	Internal Marks: 30
Paper Code: MSMH301	External Marks: 70
Set theory, Logic and probability Theory	No. of Hours: 75
Course Objective(s): To get the knowledge and applications of mathematical logic, advance set theory, permutations and pigeon hole principle.	Total Credits: 05

Unit No.	Details	Nos. of Hours
1	Statements, Propositions and Theorems, Truth value, Logical connectives and Truth tables, Conditional statements, Logical inferences, Methods of proof, examples.	**15**
2	Basic Set theory: Union , intersection and complement, indexed sets, the algebra of sets, power set, Cartesian product, relations, equivalence relations, partitions, discussion of the example congruence modulo-m relation on the set of integers, Functions, composition of functions, surjections, injections, bijections, inverse functions, Cardinality Finite and infinite sets, Comparing sets, Cardinality , $\|A\| < \|P(A)\|$, Schroeder-Bernstein theorem , Countable sets, Uncountable sets, Cardinalities of N , $N \times N$, Q, R, $R \times R$.	**15**
3	Order relations, order types, partial order, Total order, well ordered sets, Principle of Mathematical Induction, Russel's paradox, introduction to axiomatic set theory, Statements of the Axiom of Choice, the Well Ordering Theorem, Zorn's lemma, applications of Zorn's lemma to maximal ideals and to bases of vector spaces.	**15**
4	Permutations, decomposition into cycles, product of permutations, permutations and geometric symmetry, computing the order of a permutation, even and odd permutations.	**15**
5	Pigeon-hole principle, generalized pigeon-hole principle and its applications, ErdosSzekers theorem on monotone subsequences.	**15**

Course Outcome(s): After completing this course, the student will be able to:

CO1: Study Propositions and Theorems, Methods of proof.
CO2: Understand theadvance set theory.
CO3: Express the Principle of Mathematical Induction, maximal ideals and to bases of vector spaces.
CO4: Understand the Permutations and its applications.
CO5: Discuss the Pigeon-hole principle in advance.

COURSE LEARNING OUTCOME:

UNIT NO.	COURSE LEARNING OUTCOME	TEACHING AND LEARNING ACTIVITY	ASSESSMENT TASK
I.	Understand the concepts of Propositions and Theorems, Methods of proof	Presentation/ Lecture	Evaluation of Students on the basis of Assignment/Quiz
II.	Gain knowledge of advance set theory	Application Based learning/ Research Oriented Teaching	Evaluation of Students on the basis of Assignment/Quiz /Class test
III.	Express the Principle of Mathematical Induction, maximal ideals and to bases of vector spaces	Presentation/Lecture	Evaluation of Students on the basis of Presentation/Application Oriented Question solving/ Assignment/ Quiz.
IV.	Understand the Permutations and its applications	Presentation/ Video/ Lecture / Research Study.	Evaluation of Students on the basis of Presentation/ Assignment/Quiz
V.	Explain the Pigeon-hole principle in advance	Presentation/ Lecture / Research Study.	Evaluation of Students on the basis of Assignment/Quiz /Class test.

Text Books:

1. Larry J. Gerstein: Introduction to mathematical structures and proofs, Springer.
2. Joel L. Mott, Abraham Kandel, Theodore P. Baker: Discrete mathematics for computer scientists and mathematicians, Prentice-Hall India.

Reference Books:

1. Robert R. Stoll: Set theory and logic, Freeman & Co.
2. Robert Wolf: Proof, logic and conjecture, the mathematician's toolbox, W.H.Freemon.
3. James Munkres: Topology, Prentice-Hall India.

E-resources:

1. Logic and Set Theory Based on lectures by I. B. Leader:https://dec41.user.srcf.net/notes/II_L/logic_and_set_theory_trim.pdf

2. A Book of Set Theory by Charles C. Pinter:http://matematicas.uis.edu.co/adrialba/sites/default/files/SetTheoryDover-%20Charles%20C%20Pinter.pdf
3. Free Set Theory Books PDF: http://www.freebookcentre.net/Mathematics/Set-Theory-Books.html
4. Prepositional Logic-Stanford University: http://stanford.edu/~dntse/classes/cs70_fall09/70-2-notes1.pdf
5. Pigeon-hole principle: https://www.cs.purdue.edu/homes/hmaji/teaching/Spring%202016/lectures/01.pdf

MSMH	Total Marks: 100
Semester-III	Internal Marks: 30
Paper Code: MSMH302	External Marks: 70
Fuzzy Set and their Application	No. of Hours: 75
Course Objective(s): To get the basic knowledge of Fuzzy Set and the applications and also the operations, norm of it is expressed.	Total Credits: 05

Unit No.	Details	Nos. of Hours
1	Fuzzy sets-Basic definitions, α-level sets, convex fuzzy set, Basic operations on fuzzy sets. Types of fuzzy sets. Cartesian products, Algebraic products. Bounded sum and difference, t-norms and t-conorms.	**15**
2	The Extension Principle- The Zadeh's extension principle. Image and inverse image of fuzzy sets. Fuzzy numbers. Elements of fuzzy arithmetic.	**15**
3	Fuzzy Relations on Fuzzy sets, Composition of Fuzzy relations. Minmax composition and its properties.	**15**
4	Fuzzy equivalence relations. Fuzzy compatibility relations. Fuzzy relation equations. Fuzzy graphs, Similarity relation.	**15**
5	Possibility Theory-Fuzzy measures. Evidence theory. Necessity measure. Possibility measure. Possibility distribution. Possibility theory and fuzzy sets. Possibility theory versus probability theory.	**15**

Course Outcome(s): After completing this course, the student will be able to:

CO1: Understand the concept of Fuzzy sets.
CO2: Express operations on fuzzy sets.
CO3: Apply Relation between fuzzy sets and its compositions.
CO4: State Fuzzy graphs.
CO5: Express the Fuzzy measures.

COURSE LEARNING OUTCOME:

UNIT NO.	COURSE LEARNING OUTCOME	TEACHING AND LEARNING ACTIVITY	ASSESSMENT TASK
I.	Understand the basic knowledge of concept of Fuzzy sets	Presentation/ Lecture	Evaluation of Students on the basis of Assignment/Quiz
II.	Express operations on fuzzy sets	Application Based learning/ Research Oriented Teaching	Evaluation of Students on the basis of Assignment/Quiz /Class test
III.	Apply Relation between fuzzy sets and its compositions	Presentation/Lecture	Evaluation of Students on the basis of Presentation/Application Oriented Question solving/ Assignment/ Quiz.
IV.	Gain the knowledge of Fuzzy graphs	Presentation/ Video/ Lecture / Research Study.	Evaluation of Students on the basis of Presentation/ Assignment/Quiz
V.	Express the Fuzzy measures	Presentation/ Lecture / Research Study.	Evaluation of Students on the basis of Assignment/Quiz /Class test.

REFERENCES:

1. H.J. Zimmermann, Fuzzy set theory and its Applications, Allied Publishers Ltd. New Delhi, 1991.
2. G.J. Klir and B. Yuan- Fuzzy sets and fuzzy logic, Prentice-Hall of India, New Delhi, 1995.

E-resources:

1. Fuzzy sets Arithmetic & Logic by Prof. Niladri Chatterjee (IIT Delhi)-NPTEL:https://nptel.ac.in/courses/fuzzysets
2. Fuzzy set Theory and its applications, Fourth edition: https://cours.etsmtl.ca/sys843/REFS/Books/ZimmermannFuzzySetTheory2001.pdf
3. Fuzzy set Theory Lecture notes by R.C.Chakraborty: https://www.myreaders.info/06-Fuzzy_Set_Theory.pdf
4. Fuzzy Arithmetic and the Extension principle –Islamic Azad University Central Tehran Branch:http://faculty.iauctb.ac.ir/faculty/Files//Content/Fuzzy12-Fuzzy%20Aritmetic%20and%20the%20extension%20principle.pdf

MSMH	Total Marks: 100
Semester-III	Internal Marks: 30
Paper Code:MSMH303A	External Marks: 70
Differential Geometry	No. of Hours: 75
Course Objective(s): In this course the student will learn about tangent spaces, Surfaces, Gauss map, Geodesics on surfaces and curvature of plane curves.	Total Credits: 05

Unit No.	Details	Nos. of Hours
1	Curves in space, 3 R parameterized curves, regular curves, helices, arc length, reparameterization (by arc length), tangent, principal normal, binomial, osculating plane, normal plane, rectifying plane, curvature and torsion of smooth curves, FrenetSerret formulae, Frenet approximation of a space curve. .	**15**
2	Osculating circle, osculating sphere, spherical indicatrices, involutes and evolutes, intrinsic equations of space curves, isometries of, 3 R fundamental theorem of space curves, surfaces in, 3 R regular surfaces, co-ordinate neighborhoods, parameterized surfaces, change of parameters, level sets of smooth functions on, 3 R surfaces of revolution, tangent vectors, tangent plane, differential of a map.	**15**
3	Normal fields and orientability of surfaces, angle between two intersecting curves on a surface, Gauss map and its properties, Weingarten map, second and third fundamental forms, classification of points on a surface.	**15**
4	Curvature of curves on surfaces, normal curvature, Meusnier theorem, principal curvatures, geometric interpretation of principal curvatures, Euler theorem, mean curvature, lines of curvature, umbilical points, minimal surfaces, definition and examples, Gaussian curvature, intrinsic formulae for the Gaussian curvature, isometries of surfaces, Gauss Theorem Egregium (statement only).	**15**
5	Christoffel symbols, Gauss formulae, Weingarten formulae, Gauss equations, Codazzi-Mainardi equations, curvature tensor, geodesics, geodesics on a surface of revolution, geodesic curvature of a curve, Gauss-Bonnet Theorem (statement only).	**15**

Course Outcome(s): After completing this course, the student will be able to:

CO1: Understand Curves in space and arc length, reparameterization.
CO2: Analyzeinvolutes and evolutes, 3 R surfaces of revolution.
CO3: Understand Normal fields and orientability of surfaces.
CO4: Apply the concept of curvature.
CO5: Study the concept of geodesics on a surface of revolution**.**

COURSE LEARNING OUTCOME:

UNIT NO.	COURSE LEARNING OUTCOME	TEACHING AND LEARNING ACTIVITY	ASSESSMENT TASK
I.	Understand Curves in space and arc length, reparameterization	Presentation/ Lecture	Evaluation of Students on the basis of Assignment/Quiz
II.	Able to understand how Analyze involutes and evolutes, 3 R surfaces of revolution	Application Based learning/ Research Oriented Teaching	Evaluation of Students on the basis of Assignment/Quiz /Class test
III.	Understand Normal fields and orientability of surfaces	Presentation/Lecture	Evaluation of Students on the basis of Presentation/Application Oriented Question solving/ Assignment/ Quiz.
IV.	Apply the concept of curvature	Presentation/ Video/ Lecture / Research Study.	Evaluation of Students on the basis of Presentation/ Assignment/Quiz
V.	Gain knowledge of geodesics on a surface of revolution its applications	Presentation/ Lecture / Research Study.	Evaluation of Students on the basis of Assignment/Quiz /Class test.

Books Recommended:

1. M. P. Do Carmo, Differential Geometry of Curves and Surfaces, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1976.
2. B. O' Neill, Elementary Differential Geometry, Academic Press, 1997.
3. A. Gray, Differential Geometry of Curves and Surfaces, CRC Press, 1998.
4. A. Pressley, Elementary Differential Geometry, Springer (Undergraduate Mathematics Series), 2001.
5. A. Thorpe, Elementary Topics in Differential Geometry, Springer (Undergraduate Texts in Mathematics), 1979.
6. D. Somasundaram, Differential Geometry, A First Course, Narosa Publishing House, New Delhi, 2002.
7. L. P. Eisenhart, A Treatise on the Differential Geometry of Curves and Surfaces, Ginn and Company, Boston, 1909.

E-resources:

1. Notes on Differential Geometry by Noel J. Hicks:**http://www.wisdom.weizmann.ac.il/~yakov/scanlib/hicks.pdf**
2. Lectures on Differential Geometry WulfRossmann:https://mysite.science.uottawa.ca/rossmann/Differential%20Geometry%20book_files/Diffgeo.pdf
3. Curve and surfaces by Prof. SudiptaDutta (IIT Kanpur):https://nptel.ac.in/courses/curves
4. Free Differential Geometry Books PDF:http://www.freebookcentre.net/maths-books-download/Differential-Geometry-Lecture-Notes.html
5. Differential Geometry: Handwritten Notes by Prof. (Rtd) Muhammad Saleem:https://www.mathcity.org/msc/differential_geometry_notes

MSMH	Total Marks: 100
Semester-III	Internal Marks: 30
Paper Code: MSMH303B	External Marks: 70
Mathematical Modelling	No. of Hours: 75
Course Objective(s): This course gives the basic concept of Mathematical modelling, so that students from various fields like Engineering, Economics, Biology, Epidemiology etc. can apply its concept.	Total Credits: 05

Unit No.	Details	Nos. of Hours
1	Concepts of mathematical modelling, open and closed systems, Simple situations requiring mathematical modelling, techniques of mathematical modelling, Classifications, areas of applications, Characteristics and limitations of mathematical models.	**15**
2	Linear Growth and Decay model, Nonlinear Growth and Decay model, Mathematical Modelling in dynamics through ordinary differential equation of first order, Mathematical Modelling in population dynamics, Mathematical Modelling of Epidemics through system of differential equation of first order.	**15**
3	The need for Mathematical modelling through difference equations, Basic theory of linear difference equations with constant coefficients, Mathematical modelling through difference equations in economics and finance, Mathematical modelling through difference equations in population dynamics and genetics. Mathematical Modelling through difference equations in probability theory.	**15**
4	Continuous Models Using Ordinary Differential Equations: Introduction and formation of various continuous models, Carbon dating, Growth and Decay of Current in an L-R Circuit, Bifurcations. Spatial Models Using Partial Differential Equations: Wave Equation, Traffic Flow, Theory of Car-Following, Crimes Model.	**15**
5	Environment that can be modelled through Graphs, Mathematical Modelling in terms of Directed Graphs, Signed Graphs, weighted Diagraphs, Non-oriented Graphs.	**15**

Course Outcomes: After completing this course, the student will be able to:

CO1: Discuss the basic features of mathematical modelling.
CO2: Apply the mathematical modeling using ODE of first order.
CO3: Explain the discrete model and its applications.

CO4: Get the application of continuous and spatial models.
CO5: Use the modelling using graph theory**.**

COURSE LEARNING OUTCOME:

UNIT NO.	COURSE LEARNING OUTCOME	TEACHING AND LEARNING ACTIVITY	ASSESSMENT TASK
I.	Understand the basic knowledge of features of mathematical modelling.	Presentation/ Lecture	Evaluation of Students on the basis of Assignment/Quiz
II.	Apply the mathematical modeling using ODE of first order	Application Based learning/ Research Oriented Teaching	Evaluation of Students on the basis of Assignment/Quiz /Class test
III.	Explain the discrete model and its applications	Presentation/Lecture	Evaluation of Students on the basis of Presentation/Application Oriented Question solving/ Assignment/ Quiz.
IV.	Get the application of continuous and spatial models	Presentation/ Video/ Lecture / Research Study.	Evaluation of Students on the basis of Presentation/ Assignment/Quiz
V.	Gain the knowledge of modeling using graph theory	Presentation/ Lecture / Research Study.	Evaluation of Students on the basis of Assignment/Quiz /Class test.

References:

1. Kapur J. N., Mathematical Modelling, New Age International, 1988.
2. Rutherford, A. Mathematical Modelling Techniques. Courier Corporation, 2012.
3. Bender, E. A. An Introduction to Mathematical Modelling. Courier Corporation, 2000.
4. Clive, L. D. Principles of Mathematical Modelling. Elsevier, 2004.
5. Meerschaert, M. M. Mathematical Modelling. Academic Press, 2013.
6. Sandip Banerjee, MATHEMATICAL MODELING Models, Analysis and Applications, CRC Press.

E-resources:

1. Mathematical Modelling : Analysis and Applications by Dr. Ameeya Kumar Nayak(IIT Roorkee): https://nptel.ac.in/courses/mathematicalmodelling
2. An introduction to Mathematical Modelling by Michael Alder:

http://mtm.ufsc.br/~daniel/matap/IntMatMod.pd
3. Lecture Notes on Mathematical Modelling in Applied Sciences by Nicola Bellomo, Elena De Angelis, and Marcello Delitala:
https://staff.polito.it/marcello.delitala/dwd/mechanic_Simai.pdf
4. Introduction to Mathematical Modelling by Andrea Doeschl-Wilson:
https://jvanderw.une.edu.au/Lecture1_IntroToMathModelling.pdf

MSMH	Total Marks: 100
Semester-III	Internal Marks: 30
Paper Code: MSMH303C	External Marks: 70
Fluid Dynamics	No. of Hours: 75
Course Objective(s): To develop the knowledge of dynamic and mechanics concept for different types of fluid.	Total Credits: 05

Unit No.	Details	Nos. of Hours
1	Kinematics — Lagrangian and Eulerian methods. Equation of continuity. Boundary surface. Stream lines. Path lines and streak lines. Velocity potential. Irrotational and rotational motions. Vortex lines. Equations of Motion— Lagrange's and Euler's equations of motion. Bernoulli's theorem. Equation of motion byflux method. Equations referred to moving axes Impulsive actions. Stream function.	**15**
2	Irrotational motion in two-dimensions. Complex velocity potential. Sources, sinks, doublets and their images. Conformal mapping, Milne-Thomson circle theorem. Two-dimensional irrotational motion produced by motion of circular, co-axial and elliptic cylinders in an infinite mass of liquid. Kinetic energy of liquid. Theorem of Blasius. Motion of a sphere through a liquid at rest at infinity. Liquid streaming past a fixed sphere. Equation of motion of a sphere. Stoke's stream function.	**15**
3	Vortex motion and its elementary properties. Kelvin's proof of permanence. Motions due to circular and rectilinear vertices. Wave motion in a gas. Speed of Sound. Equation of motion of a gas. Subsonic, sonic and supersonic flows of a gas. Isentropic gas flows. Flow through a nozzle. Normal and oblique shocks.	**15**
4	Stress components in a real fluid. Relations between rectangular components of stress. Connection between stresses and gradients of velocity. Navier-Stoke's equations of motion. Plane Poiseuille and Couette flows between two parallel plates. Theory of Lubrication. Flow through tubes of uniform cross section in form of circle, annulus, ellipse and equilateral triangle under constant pressure gradient. Unsteady flow over a flat plate.	**15**
5	Dynamical similarity. Buckingham p-theorem. Reynolds number. Prandt's boundary layer. Boundary layer equations in two dimensions. Blasius solution. Boundary-layer thickness. Displacement thickness. Karman integral conditions. Separations of boundary layer flow.	**15**

Course Outcome(s): After completing this course, the student will be able to:

CO1: Understand Kinematics and its applications.
CO2: Analyze motion in two-dimensions, Equation of motion of a sphere.
CO3: Understand Vortex motion and its elementary properties.

CO4: Apply Relations between rectangular components of stress.
CO5: Study the concept of Boundary layer equations, Separations of boundary layer flow**.**

COURSE LEARNING OUTCOME:

UNIT NO.	COURSE LEARNING OUTCOME	TEACHING AND LEARNING ACTIVITY	ASSESSMENT TASK
I.	Understand the basic concepts of Kinematics and its applications	Presentation/ Lecture	Evaluation of Students on the basis of Assignment/Quiz
II.	Analyze motion in two-dimensions, Equation of motion of a sphere	Application Based learning/ Research Oriented Teaching	Evaluation of Students on the basis of Assignment/Quiz /Class test
III.	Understand Vortex motion and its elementary properties	Presentation/Lecture	Evaluation of Students on the basis of Presentation/Application Oriented Question solving/ Assignment/ Quiz.
IV.	Apply Relations between rectangular components of stress	Presentation/ Video/ Lecture / Research Study.	Evaluation of Students on the basis of Presentation/ Assignment/Quiz
V.	Explain the concept of Boundary layer equations, Separations of boundary layer flow	Presentation/ Lecture / Research Study.	Evaluation of Students on the basis of Assignment/Quiz /Class test.

Text Books:

1**.** P.K. Kundu and I.M. Cohen, Fluid Mechanics, Academic Press, 2002.
2**.** F. Chorlton: Text Book of Fluid Dynamics, CBS, 2004.

E-Resources:

1. FLUID DYNAMICS- MaharshiDayanand University (ROHTAK): http://mdudde.net/pdf/study_material_DDE/M.Sc.MAthematics/Fluid_Dynamics_final.pdf
2. Notes on Fluid Dynamics by Rodolfo Repetto: http://www3.dicca.unige.it/rrepetto/linked-files/fluid-dynamics-lecture-notes.pdf
3. Fluid Dynamics 1by DrEvyKersal´- School of Mathematics, University of Leeds: http://www1.maths.leeds.ac.uk/~kersale/2620/Notes/m2620.pdf
4. Fluid Dynamics (North Campus-Section A,B,C,D; South Campus)-University of Delhi:http://maths.du.ac.in/Covid/study-material.html

MSMH	Total Marks: 100
Semester-III	Internal Marks: 30
Paper Code: MSMH304A	External Marks: 70
Probability and statistics	No. of Hours: 75
Course Objective(s): To study probability density function, Mathematical Expectation, Marginal and Conditional distributions, Some Special Distributions and The Central Limit Theorem.	Total Credits: 05

Unit No.	Details	Nos. of Hours
1	Descriptive statistics, exploratory data analysis, sample space, discrete probability, independent events, Bayes theorem.	**15**
2	Random variables and distribution function (univariate and multivariate); expectation and moments. Independent random variables, marginal and conditional distribution, characteristics function. Probability inequalities (Chebyshev, Markov, Jensen), Central limit theorems.	**15**
3	Standard discrete and continuous univariate distributions, sampling distributions, standard errors and asymptotic distributions, distribution of order statistics and range, methods of estimation, properties of estimators, confidence interval.	**15**
4	Tests of hypothesis: most powerful and uniformly most powerful tests, likelihood ratio tests, Analysis of discrete data and chi-square test of goodness of fit. Large sample tests. Sample nonparametric tests for one and two sample problems.	**15**
5	Gauss- Markov models, best linear unbiased estimators, analysis of variance and covariance, simple and multiple linear regression, Multivariate normal distribution, partial and multiple correlation coefficients and related tests.	**15**

Course Outcome(s): After completing this course, the student will be able to:

CO1: Understand Descriptive statistics and discrete probability.
CO2: Study Random variables and distribution function and applications.
CO3: Apply the standard discrete and continuous univariate distribution.
CO4: Study the Tests of hypothesis, Analysis of discrete data and chi-square test.
CO5: Understand Multivariate normal distribution, partial and multiple correlation coefficients and related tests

COURSE LEARNING OUTCOME:

UNIT NO.	COURSE LEARNING OUTCOME	TEACHING AND LEARNING ACTIVITY	ASSESSMENT TASK
I.	Understand Descriptive statistics and discrete	Presentation/ Lecture	Evaluation of Students on the basis of

	probability		Assignment/Quiz
II.	Study Random variables and distribution function and applications	Application Based learning/ Research Oriented Teaching	Evaluation of Students on the basis of Assignment/Quiz /Class test
III.	Apply the standard discrete and continuous univariate distribution	Presentation/Lecture	Evaluation of Students on the basis of Presentation/Application Oriented Question solving/ Assignment/ Quiz.
IV.	Study the Tests of hypothesis, Analysis of discrete data and chi-square test	Presentation/ Video/ Lecture / Research Study.	Evaluation of Students on the basis of Presentation/ Assignment/Quiz
V.	Understand Multivariate normal distribution, partial and multiple correlation coefficients and related tests	Presentation/ Lecture / Research Study.	Evaluation of Students on the basis of Assignment/Quiz /Class test.

Text Book:

1. Applied Statistics; - V.K Kapoor and S.C. Gupta, S Chand & sons.
2. Applied Statistics: - Primal Mukhopadhyay, Books and Allied (p) ltd.

E-Resources:

1. Probability and statistics by Dr. Somesh Kumar(IIT, Kharagpur)-NPTEL:https://nptel.ac.in/courses/probability
2. Probability and Statistics- The Science of Uncertainty:http://www.utstat.toronto.edu/mikevans/jeffrosenthal/book.pdf
3. AN INTRODUCTION TO PROBABILITY AND STATISTICS: http://www.ru.ac.bd/stat/wp-content/uploads/sites/25/2019/03/501_06_Rohatgi_An-Introduction-to-Probability-and-Statistics-Wiley-2015.pdf
4. LECTURE NOTES on PROBABILITY and STATISTICS: http://users.encs.concordia.ca/~doedel/courses/comp-233/slides.pdf

MSMH	Total Marks: 100
Semester-III	Internal Marks: 30
Paper Code: MSMH304B	External Marks: 70
MEASURE THEORY	No. of Hours: 75
Course Objective(s): To develop the basic concepts of measure theory and concept of product measure their applications.	Total Credits: 05

Unit No.	Details	Nos. of Hours
1	Lebesgue Outer and Inner measure and their properties, properties of a measurable set, Measurable functions and Their properties, limit sup, limit inf. and limit of sequence of Measurable functions, Little -Wood's three Principles, Egorff's Theorem, Lusin Theorem and some other Theorems.	**15**
2	Characteristic function, Simple function, Canonical representation of Simple function, Integral of Simple function, Some Important Theorem: - Fatou's Lemma, monotone Convergence Theorem, Bounded and dominated Convergence Theorem, Monotone Convergence Theorem. The general Lebesgue Integral,	**15**
3	Function of Bounded Variation, Curvature and Torsion, serret – Frenet formula, Locus of center of Curvature, Spherical Curvature, Locus of Centre of Spherical Curvature, Helics, curve determined by its intrinsic equations. Spherical indicatrix, Bertrand curves, envelope,	**15**
4	Developable Surfaces, osculating developable, Polar developable, Rectifying developed, Curvilinear Co-ordinates, First and Second order Magnitude, Curvature of Section, Meunier's Theorem.	**15**
5	Principle Directions and Curvature, Mean Curvature, Euler's Theorem, Dupin'sTheorem. Joachimsthal's Theorem, Dupinindicatrix, Conjugate direction, Conjugate systems, Asymptotic Lines – Curvature and torsions, Theorem of Beltrami and Enneper.	**15**

Course Outcome(s): After completing this course, the student will be able to:

CO1. Understand the basic concepts of measure and integration theory.
CO2. Learn some standard inequalities useful solve various boundness problems in science and engineering.
CO3. Understand signed measure and Radon Nikodyn derivatives which is useful for theoretical foundation of some applicable measures.
CO4. Understand the concept of product measure with their applications
CO5: Express the Fuzzy measures.

COURSE LEARNING OUTCOME:

UNIT NO.	COURSE LEARNING OUTCOME	TEACHING AND LEARNING ACTIVITY	ASSESSMENT TASK
I.	Understand the basic concepts of measure and integration theory	Presentation/ Lecture	Evaluation of Students on the basis of Assignment/Quiz
II.	Learn some standard inequalities useful solve various boundness problems in science and engineering	Application Based learning/ Research Oriented Teaching	Evaluation of Students on the basis of Assignment/Quiz /Class test
III.	Understand signed measure and Radon Nikodyn derivatives which is useful for theoretical foundation of some applicable measures	Presentation/Lecture	Evaluation of Students on the basis of Presentation/Application Oriented Question solving/ Assignment/ Quiz.
IV.	Understand the concept of product measure with their applications	Presentation/ Video/ Lecture / Research Study.	Evaluation of Students on the basis of Presentation/ Assignment/Quiz
V.	Express the Fuzzy measures	Presentation/ Lecture / Research Study.	Evaluation of Students on the basis of Assignment/Quiz /Class test.

Text Books:

1. Measure Theory: K. P. Gupta Measure Theory.
2. P. R. Halmos Measure Theory and Integration.

REFERENCES:

1. S. K. BerberianDifferential Geometry of Three dimension:
2. C. E. WeatherburnDifferential Geometry: Mittal and Agrawal.

E-Resources:

1. MEASURE THEORY by Prof. I. K. Rana(IIT Bombay)-NPTEL:https://nptel.ac.in/courses/Measuretheory
2. LECTURE NOTES IN MEASURE THEORY: http://www.math.chalmers.se/~borell/MeasureTheory.pdf
3. An Introduction to Measure Theory by Terence Tao: https://terrytao.files.wordpress.com/2012/12/gsm-126-tao5-measure-book.pdf
4. MEASURE THEORY Volume 2: https://wiki.math.ntnu.no/_media/tma4225/2011/fremlin-vol2.pdf

MSMH	Total Marks: 100
Semester-III	Internal Marks: 30
Paper Code: MSMH304C	External Marks: 70
Number Theory & Cryptography	No. of Hours: 75
Course Objective(s): Number theory is one of the oldest branches of Mathematics. In this course we introduce the basic concepts of Number theory such as Divisibility, Congruences with Prime Modulus, Quadratic reciprocity and some functions of Number Theory.	Total Credits: 05

Unit No.	Details	Nos. of Hours
1	Divisibility, Greatest common divisor, Euclidean Algorithm, The Fundamental Theorem of arithmetic, congruences, Special divisibility tests, Chinese remainder theorem, residue classes and reduced residue classes, Fermat's little theorem, Wilson's theorem, Euler's theorem.	**15**
2	Arithmetic functions $\phi(n)$, $d(n)$, $\sigma(n)$, $\mu(n)$, Mobius inversion Formula, the greatest integer function, perfect numbers, Mersenne primes and Fermat numbers,	**15**
3	Primitive roots and indices, Quadratic residues, Legendre symbol, Gauss's Lemma, Quadratic reciprocity law, Jacobi symbol, Diophantine equations: $ax + by = c$, $x^2 + y^2 = z^2$, $x^4 + y^4 = z^2$, sums of two and four squares, [Ref. 2]	**15**
4	Cryptography: some simple cryptosystems, need of the cryptosystems, Discrete log, the idea of public key cryptography, RSA cryptosystem. [Ref. 4].	**15**
5	Differential Cryptanalysis, Modes of DES, Attack on DES, Advanced encrypt standard.	**15**

Course Outcome(s): After completing this course, the student will be able to:

CO1: Understand the concepts of divisibility and Primes.
CO2: Solve congruences.
CO3: Describe Gauss's Lemma, Quadratic reciprocity law.
CO4: Discuss Cryptography and its applications.
CO5: Study the various cryptanalysis.

COURSE LEARNING OUTCOME:

UNIT NO.	COURSE LEARNING OUTCOME	TEACHING AND LEARNING ACTIVITY	ASSESSMENT TASK
I.	Understand the concepts of divisibility and Primes	Presentation/ Lecture	Evaluation of Students on the basis of

			Assignment/Quiz
II.	Understand the key concepts of congruences	Application Based learning/ Research Oriented Teaching	Evaluation of Students on the basis of Assignment/Quiz /Class test
III.	Describe Gauss's Lemma, Quadratic reciprocity law	Presentation/Lecture	Evaluation of Students on the basis of Presentation/Application Oriented Question solving/ Assignment/ Quiz.
IV.	Discuss Cryptography and its applications	Presentation/ Video/ Lecture / Research Study.	Evaluation of Students on the basis of Presentation/ Assignment/Quiz
V.	Study the various cryptanalysis	Presentation/ Lecture / Research Study.	Evaluation of Students on the basis of Assignment/Quiz /Class test.

RECOMMENDED BOOKS:

1. Burton, D.M., Elementary Number Theory, 7th Edition. McGraw-Hill Education, 2010.
2. Hardy, G.H. and Wright, E.M., An introduction to the Theory of Numbers, 4th edition. OxfordUniversity Press, 1975.
3. Niven, I., Zuckerman, H.S. and Montgomery, H.L., Introduction to Theory of Numbers, 5th Edition. John Wiley & Sons, 1991.
4. Koblitz N., A Course in Number Theory and Cryptography, Graduate Texts in Mathematics, No.114. New-York: Springer-Verlag, 1987.
5. Stallings, W., Cryptography and Network Security, 5th Editions. Pearson, 2010.

E-Resources:

1. Number Theory NPTEL - II Web Course by AnupamSaikia(IIT Guwahati): https://nptel.ac.in/courses/numbertheory
2. Lecture notes Number Theory and Cryptography byMatt Kerr: https://www.math.wustl.edu/~matkerr/NTCbook.pdf
3. Free Number theory and cryptography Books PDF :
4. http://www.freebookcentre.net/maths-books-download/Number-Theory-and-Cryptography.html
5. Number theory and cryptography:
6. https://ipgold.epfl.ch/_media/en/courses/2008-2009/cryptography_notes_en.pdf

M.Sc. (Mathematics) Semester –IV

MSMH	Total Marks: 100
Semester-IV	Internal Marks: 30
Paper Code: MSMH401	External Marks: 70
Integral Equation and COV	No. of Hours: 75
Course Objective(s): To learn the concepts of basic Integral equation and COV such as Volterra integral equationand also to work comfortably Euler'sPoisson equation, ostrogradsky equation**.**	Total Credits: 05

Unit No.	Details	Nos. of Hours
1	Introduction and basic examples, Classification of Integral equation, Conversion of Volterra integral equation into ODE, Conversion of IVP and BVP to integral equation.	**15**
2	Decomposition, Direct computation, successive approximation, successive substituting method for Fredholm integral equation, successive substituting method for Volterra integral equation.	**15**
3	Volterra integral equation of first kind, Integral equation with separable kernel, Integral equation with symmetric kernel, Integral equation with resolvent kernel, Eigen value and Eigen function of integral equation.	**15**
4	Functions and functional comparison between the notion of extrema of a function and a functional variational problem with the fixed boundaries, Euler's equation, fundamental lemma of calculus of variation and examples, function involving more than one dependent variable and their first derivatives.	**15**
5	Functional depending on the higher derivatives of the dependent variables, Euler's Poisson equation, ostrogradsky equation, Jacobi condition, The Weierstrass function, weak and strong extrema, the Legendre condition, transforming the Euler's equation into canonical forms.	**15**

Course Outcome(s): After completing this course, the student will be able to:

CO1: Understand Conversion of IVP and BVP to integral equation.
CO2: Express, successive substituting method for Fredholm integral equation.
CO3: Describe Eigen value and Eigen function of integral equation.
CO4: Discussfundamental lemma of calculus of variation and examples.
CO5: Study transforming the Euler's equation into canonical forms.

COURSE LEARNING OUTCOME:

UNIT NO.	COURSE LEARNING OUTCOME	TEACHING AND LEARNING ACTIVITY	ASSESSMENT TASK
I.	Understand Conversion of IVP	Presentation/	Evaluation of Students

	and BVP to integral equation	Lecture	on the basis of Assignment/Quiz
II.	Express, successive substituting method for Fredholm integral equation	Application Based learning/ Research Oriented Teaching	Evaluation of Students on the basis of Assignment/Quiz /Class test
III.	Describe Eigen value and Eigen function of integral equation	Presentation/Lecture	Evaluation of Students on the basis of Presentation/Application Oriented Question solving/ Assignment/ Quiz.
IV.	Discuss fundamental lemma of calculus of variation and examples	Presentation/ Video/ Lecture / Research Study.	Evaluation of Students on the basis of Presentation/ Assignment/Quiz
V.	Study transforming the Euler's equation into canonical forms	Presentation/ Lecture / Research Study.	Evaluation of Students on the basis of Assignment/Quiz /Class test.

References:

1.Calculus of variations Pergamon press limited.
2. Calculus of variation with application, Weinstock, Robert, Dover
3**.** Integral equation and application, Corduneanu, Cambridge university press.

E-resources:

1. Integral equations,calculus of variation and its applications by Prof. D. N. Pandey(IIT Roorkee): https://nptel.ac.in/courses/integral
2. HANDBOOK OF INTEGRAL EQUATIONS by Andrei D. Polyanin and Alexander V. Manzhirov: https://hupaa.com/book/HANDBOOK_OF_INTEGRAL_EQUATIONS.pdf
3. LECTURE NOTES FREDHOLM INTEGRAL EQUATIONS :https://services.math.duke.edu/~jtwong/math551-2019/lectures/Integrals1_Fredholm_IEs.pdf
4. INTEGRAL EQUATIONS AND CALCULUS OF VARIATIONS- MAHARSHI DAYANAND UNIVERSITY, ROHTAK: https://mdu.ac.in/UpFiles/UpPdfFiles/2021/Jun/4_06-28-2021_11-43-37_Integral%20Equations%20and%20Calculus%20of%20Variations(20MAT22C3).pdf

MSMH	Total Marks: 100
Semester-4	Internal Marks: 30
Paper Code: MSMH402A	External Marks: 70
Advance Optimization Technique and Control Theory	No. of Hours: 75
Course Objective(s): To understand modern and natural optimization technique like ANN,GeneticMemetic algorithms, Antcolony algorithm, Tabu Search and formulate and solve various industrial and managerial problems as linear programming problems	Total Credits: 05

Unit No.	Details	Nos. of Hours
1	Taguchi technique- introduction to DOE, ANOVA, F-TEST, Response surface methodology, Markov chain.	**15**
2	Introduction to modern optimization technique- ANN, Genetic Algorithms, Memetic algorithms, Ant colony algorithm, Tabu Search.	**15**
3	Dynamic programming, Bellman's principle of optimality, allocation problem, Cargo load problem, Stage coach problem,	**15**
4	Function taking values in extended reals, proper convex functions, sub gradients, Directional derivative, conjugate functions. Conjugate duality.	**15**
5	Optimal control problem, classical approach to solve variational problem, Pontryagin's maximum principle, Dynamic programming and maximum principle	**15**

Course Outcome(s): After completing this course, the student will be able to:

CO1 formulate and solve various industrial and managerial problems as linear programmingproblems.
CO2 formulate and solve various transportation and assignment problems.
CO3 apply the principles of game theory and network scheduling methods to solve problems that arise in business and industry.
CO4 develop queuing models for solving congestion problems.
CO5 understand the concept of optimal control problems and its applications.

COURSE LEARNING OUTCOME:

UNIT NO.	COURSE LEARNING OUTCOME	TEACHING AND LEARNING ACTIVITY	ASSESSMENT TASK
I.	Understand how solve various industrial and managerial problems as linear programming problems	Presentation/ Lecture	Evaluation of Students on the basis of Assignment/Quiz
II.	Gain the knowledge of various transportation and assignment problems	Application Based learning/ Research Oriented Teaching	Evaluation of Students on the basis of Assignment/Quiz /Class test
III.	Apply the principles of game theory and network scheduling methods to solve problems that arise in business and industry	Presentation/Lecture	Evaluation of Students on the basis of Presentation/Application Oriented Question solving/ Assignment/ Quiz.
IV.	Gain the knowledge of how to develop queuing models for solving congestion problems	Presentation/ Video/ Lecture / Research Study.	Evaluation of Students on the basis of Presentation/ Assignment/Quiz
V.	Understand the concept of optimal control problems and its applications	Presentation/ Lecture / Research Study.	Evaluation of Students on the basis of Assignment/Quiz /Class test.

Text Books:

1. Optimization methods in operation research and system analysis- K.V.Mital.
2. Quantitative technique – N. D. Vora, TMH PUB.
3. D. Liberzon, calculus of variations and Optimal control theory: A concise introduction, Princeton university press.

Reference Books:

1. Neural Network in computer intelligence- Li Min Fu-TMH.
2. O.Guler, Foundation of optimization, Springer,2010

E-resources:

1. Optimization Techniques & Control Theory (North Campus- Prof. C.S. Lalitha)-University of Delhi:http://maths.du.ac.in/Covid/PDF/week-1/Lectures%20-%20Optimization%20Techniques%20and%20Control%20Theory%20-%20North%20Campus.pdf
2. Optimization Techniques & Control Theory (South Campus- Shiva Kapoor)- University of Delhi:http://maths.du.ac.in/Covid/PDF/week-1/Optimization-South.pdf:
3. Dynamic Programming by Friedrich Eisenbrand:https://www.epfl.ch/labs/disopt/wp-content/uploads/2018/09/scribes09_Yankai_Shao.pdf
4. Optimization Methods: Dynamic Programming – Introduction-NPTEL: https://nptel.ac.in/content/storage2/courses/105108127/pdf/Module_5/M5L1_LN.pdf

MSMH	Total Marks: 100
Semester-IV	Internal Marks: 30
Paper Code: MSMH402B	External Marks: 70
Advance Coding Theory	No. of Hours: 75
Course Objective(s): Coding Theory helps to detects errors in Transmission of messages. In this course we introduce the basic concepts of Coding Theory such as, Double Error-Correcting B.C.H.code, Cyclic codes, The Group of a code, Quadratic residue codes and Bose-Chaudhuri Hocquenghem codes.	Total Credits: 05

Unit No.	Details	Nos. of Hours
1	Error detection: correction and decoding: Communication channels, Maximum likelihood decoding, Hamming distance, Nearest neighbour / minimum distance decoding, Distance of a code.	**15**
2	Linear codes: Vector spaces over finite fields, Linear codes, Hamming weight, Bases of linear codes, Generator matrix and parity check matrix, Equivalence of linear codes, encoding with a linear code, Decoding of linear codes, Cosets, Nearest neighbor decoding for linear codes, Syndrome decoding.	**15**
3	Cyclic codes: Definitions, Generator polynomials, Generator and parity check matrices, decoding of cyclic codes, Burst-error-correcting codes.	**15**
4	Some special cyclic codes: BCH codes, Definitions, Parameters of BCH codes, Decoding of BCH codes.	**15**
5	The Griesmer bound, Maximum distance separable (MDS) code, weight distribution of MDS code, Necessary and sufficient condition for a linear code to be an MDS code, MDS from RS codes, Abramson codes.	**15**

Course Outcome(s): After completing this course, the student will be able to:

CO1 Understand the concept of Maximum-Likelihood Decoding and SyndromeDecoding.

CO2 Analyze Double Error-Correcting B.C.H. code and Finite Fields Polynomials.

CO3 Understand Cyclic Codes.

CO4 Apply Quadratic Residue (*Q.R.*) Codes and find its applications.

CO5 Study the concept of Bose-Chaudhuri-Hocquenghem (*B.C.H.*) Codes and Weightdistributions.

COURSE LEARNING OUTCOME:

UNIT NO.	COURSE LEARNING OUTCOME	TEACHING AND LEARNING ACTIVITY	ASSESSMENT TASK
I.	Understand the concept of Maximum-	Presentation/ Lecture	Evaluation of Students on the basis of

	Likelihood Decoding and Syndrome Decoding		Assignment/Quiz
II.	Analyze Double Error-Correcting B.C.H. code and Finite Fields Polynomials	Application Based learning/ Research Oriented Teaching	Evaluation of Students on the basis of Assignment/Quiz /Class test
III.	Understand Cyclic Codes	Presentation/Lecture	Evaluation of Students on the basis of Presentation/Application Oriented Question solving/ Assignment/ Quiz.
IV.	Apply Quadratic Residue (*Q.R.*) Codes and find its applications	Presentation/ Video/ Lecture / Research Study.	Evaluation of Students on the basis of Presentation/ Assignment/Quiz
V.	Study the concept of Bose-Chaudhuri-Hocquenghem (*B.C.H.*) Codes and Weightdistributions	Presentation/ Lecture / Research Study.	Evaluation of Students on the basis of Assignment/Quiz /Class test.

Text book:

1. Applied Abstract Algebra - Lid and Pilz 2nd Edition

References:

1. San Ling and Chaoing Xing, Coding Theory- A First Course
2. E.R. Berlekamp, Algebraic Coding Theory, McGraw Hill Inc., 1984.

E-resources:

1. Notes on Coding Theory by J.I.Hall - Michigan State University East Lansing, MI 48824 USA: https://users.math.msu.edu/users/halljo/classes/codenotes/Topstuff.pdf
2. Maximum Distance Separable Codes:http://www-math.ucdenver.edu/~wcherowi/courses/m7823/mdscodes.pdf
3. BCH Codes by Yunghsiang S. Han- National Taipei University Taiwan: https://web.ntpu.edu.tw/~yshan/BCH_code.pdf
4. Coding Theory and Applications by EnesPasalic University of PrimorskaKoper: https://www.famnit.upr.si/sl/resources/files/knjiznica/studijsko-gradivo/epasalic-studijsko-gradivo-zbirka-nalog-cyclic-codes.pdf

MSMH	Total Marks: 100
Semester-IV	Internal Marks: 30
Paper Code: MSMH402C	External Marks: 70
Fluid Mechanics	
Course Objective(s): To study mechanical systems under generalized coordinate systems, virtual work, energy and momentum, to study mechanics developed by Newton, Lagrange, Hamilton and Jacobi.	No. of Hours: 75
	Total Credits: 05

Unit No.	Details	Nos. of Hours
1	Equation of state of substance, first law of Thermodynamics, Internal energy and specific heat of gas, Entropy, Second law of Thermodynamics.	**15**
2	Types of physical similarity,Nondimensionalizing the basic equation of incompressible viscous fluid flow,Nondimensionalparameters,Dimensional analysis.	**15**
3	Compressibility effects, Elements of wave motion in a gas, speed of sound, Basic equation of one-dimensional compressible flow,subsonic,sonic and supersonic flows,Flow through a nozzle.	**15**
4	Maxwell electromagnetic field equations, Equation of motion of a conducting fluid,Rate of flow of change, Magnetic Reynolds number and magnetic field equation.	**15**
5	Concept, Boundary layer thickness, Prandtl's boundary layer, Boundary layer on flat plate,Blasius solution, Karman's integral equation**.**	**15**

Course Outcome(s): After completing this course, the student will be able to:

CO1 Understand D' Alembert's Principle and simple applications of the LagrangianFormulation.

CO2 Analyze the Derivation of Lagrange's Equations from Hamilton's Principle and Extension of Hamilton's Principle to Non-holonomic Systems.

CO3 Study the concept of the Equations of Motion and the Equivalent One-Dimensional Problems.

CO4 Understand the Kepler Problem and Inverse-Square Law of Force.

CO5 Distinguish the concept of the Hamilton Equations of Motion and the Principle of Least Action.

COURSE LEARNING OUTCOME:

UNIT NO.	COURSE LEARNING OUTCOME	TEACHING AND LEARNING ACTIVITY	ASSESSMENT TASK
I.	Understand D' Alembert's Principle and simple applications of the Lagrangian Formulation	Presentation/ Lecture	Evaluation of Students on the basis of Assignment/Quiz
II.	Analyze the Derivation of Lagrange's Equations from Hamilton's Principle and Extension of Hamilton's Principle to Non-holonomic Systems	Application Based learning/ Research Oriented Teaching	Evaluation of Students on the basis of Assignment/Quiz /Class test
III.	Study the concept of the Equations of Motion and the Equivalent One-Dimensional Problems	Presentation/Lecture	Evaluation of Students on the basis of Presentation/Application Oriented Question solving/ Assignment/ Quiz.
IV.	Understand the Kepler Problem and Inverse-Square Law of Force	Presentation/ Video/ Lecture / Research Study.	Evaluation of Students on the basis of Presentation/ Assignment/Quiz
V.	Distinguish the concept of the Hamilton Equations of Motion and the Principle of Least Action	Presentation/ Lecture / Research Study.	Evaluation of Students on the basis of Assignment/Quiz /Class test.

Text books:

1. Text books of Fluid Dynamics, F. Chorlton,G.K.Publishers
2. Fluid Mechanics, P.K.Kundu, J.M.Cohen, Academic Press 2010.

Reference books:

1. Fluid Mechanics,P.K.Kundu,J.M.Cohen,Academic Press 2010.
2. Introduction to Fluid Mechanics,G.K. Batchelor,Foundationbook,New Delhi

E-Resources:

1. LECTURE NOTES ON THERMODYNAMICS by Joseph M. Powers-University of Notre Dame Notre Dame, Indiana 46556-5637 USA: https://www3.nd.edu/~powers/ame.20231/notes.pdf
2. Magnetohydrodynamics (MHD) by Professor Valery Nakariakov, V.Nakariakov:https://warwick.ac.uk/fac/sci/physics/research/cfsa/people/valery/teaching/khu_mhd/KHU_mhd_handout.pdf
3. Boundary Layer over a Flat Plate by P.P. Puttkammer:https://essay.utwente.nl/63314/1/BSc_report_Peter_Puttkammer.pdf

MSMH	Total Marks: 100
Semester-IV	Internal Marks: 30
Paper Code: MSMH403A	External Marks: 70
Numerical Solutions of ODE/PDE	No. of Hours: 75
Course Objective(s): Numerical Analysis deals with numerical solutions of certain problems of Mathematics. In this course we study an application of Numerical Integration, Types of partial differential equations and their solutions.	Total Credits: 05

Unit No.	Details	Nos. of Hours
1	Derivatives from Difference tables, Higher Order Derivatives, Extrapolation Techniques, Newton-Cotes Integration formulas, Gaussian Quadrature, Adaptive Integration, Multiple Integration with Variable Limits, An application of Numerical Integration- Fourier Transforms.	**15**
2	The Spring-Mass Problem- A variation, Multistep Method, Milnes Method, The Adams-Moulton Method, System of equation and higher Order Equation.	**15**
3	The Shooting Method, Solution Through aSolution, Through A set of equations, Derivative Boundary conditions, Characteristics Value problems, The alternating direction Implicit Method.	**15**
4	Types of partial differential equations, the heat equation and wave equation, Solution technique for the heat equation in one-dimension, Parabolic equation in two & three dimensions.	**15**
5	The Rayleigh-Ritz Method, The Collection and Galerkin's method, Finite Elements for ordinary differential equations, Finite elements for elliptic partial differential equations, Finite elements for parabolic and hyperbolic equations.	**15**

Course Outcome(s): After completing this course, the student will be able to:

CO1: Obtain the solutions of Higher Order Derivatives numerically.
CO2: Express the System of equations and higher Order Equation.
CO3: Apply the Shooting Method, the alternating direction Implicit Method.
CO4: State Types of partial differential equations.
CO5: Express the elements of ordinary differential equations.

COURSE LEARNING OUTCOME:

UNIT NO.	COURSE LEARNING OUTCOME	TEACHING AND LEARNING ACTIVITY	ASSESSMENT TASK
I.	Understand how to obtain the solutions of Higher Order	Presentation/ Lecture	Evaluation of Students on the basis of

	Derivatives numerically		Assignment/Quiz
II.	Express the System of equations and higher Order Equation	Application Based learning/ Research Oriented Teaching	Evaluation of Students on the basis of Assignment/Quiz /Class test
III.	Apply The Shooting Method, The alternating direction Implicit Method	Presentation/Lecture	Evaluation of Students on the basis of Presentation/Application Oriented Question solving/ Assignment/ Quiz.
IV.	Gain the knowledge of Types of partial differential equations	Presentation/ Video/ Lecture / Research Study.	Evaluation of Students on the basis of Presentation/ Assignment/Quiz
V.	Express the elements of ordinary differential equations	Presentation/ Lecture / Research Study.	Evaluation of Students on the basis of Assignment/Quiz /Class test.

Text Books:

1. Applied Numerical analysis- Curtis F. Gerald, Patrick O Wheatly, Addison Wesley.
2. Numerical Methods – S.C.Chapra&R.P.Canale, TMH Publisher.
3. Numerical Method in engineering & Science- B.S.Grewal, Khanna Pub.

Reference Books:

Numerical Methods – E. Balaguruswamy, TMH Publication.

E-Resources:

1. Numerical Analysis 8th Edition by Richard L. Burden, J. Douglas Faires:http://www.ru.ac.bd/stat/wp-content/uploads/sites/25/2019/03/Burden_-Numerical-analysis-Thomson-Brooks_Cole-2005.pdf
2. Numerical Analysis 7th Edition by Curtis F. Gerald and Patrick Wheatley- California polytechnic Stateuniversity:http://www.cse.iitm.ac.in/~vplab/downloads/opt/Applied%20Numerical%20Analysis.pdf
3. Lecture Notes on Finite Element Methods for Partial Differential Equations by EndreS¨uli - University of Oxford:https://people.maths.ox.ac.uk/suli/fem.pdf
4. Partial DifferentialEquations:https://www.cheric.org/files/education/cyberlecture/e200113/e200113-1101.pdf

MSMH	Total Marks: 100
Semester-IV	Internal Marks: 30
Paper Code: MSMH403B	External Marks: 70
Computer C++ and MATLAB	No. of Hours: 75
Course Objective(s): In this course we will study the basics of the programming language C++ such as tokens, expressions, Classes and Objects, Constructors and Destructors, Inheritance, Polymorphism and Files.	Total Credits: 05

Unit No.	Details	Nos. of Hours
1	OOP Paradigm: Comparison of Programming paradigms, Characteristics of Object – Oriented Programming Languages, Object – based programming languages C++, Brief History of C++, Structure of a C++ program, Difference between C and C++, - cin, cout, new, delete operators,	**15**
2	ANSI/ISO Standard C++, Comments, Working with Variables and const Qualifiers. Enumeration, Arrays and Pointer.	**15**
3	Implementing oops concepts in C++ Objects, Classes, Encapsulation, Data Abstraction, Inheritance, Polymorphism, Dynamic Binding, Message Passing, Default Parameter Value, Using Reference variables with Functions.	**15**
4	Introduction to MAT LAB, Elementary MATH Built – in Functions, Creating Arrays, one dimensional and Two-Dimensional arrays, Variables, Strings, Mathematical operations with arrays, Script files, Two dimensional plots, Functions and Function files.	**15**
5	Programming in C–Constants and variables. Arithmetic expressions, Input-output, Conditional statements, Implementing loops in programs. Defining and manipulating arrays, Processing character strings, functions. Files in C. Simple computer programming	**15**

Course Outcome(s): After completing this course, the student will be able to:

CO1: Identify the basic concept of Tokens, Expressions and Control Structures-Functions in C++
CO2: Analyze Classes and Objects.
CO3: Understand Constructors and Destructors
CO4: Apply the concept of Extending Classes-Pointers, Virtual Functions and Polymorphism.
CO5: Study practical course.

COURSE LEARNING OUTCOME:

UNIT NO.	COURSE LEARNING OUTCOME	TEACHING AND LEARNING ACTIVITY	ASSESSMENT TASK
I.	Understand the basic concept of Tokens, Expressions and Control Structures-Functions in C++	Presentation/ Lecture	Evaluation of Students on the basis of Assignment/Quiz
II.	Gain knowledge of Analyze Classes and Objects	Application Based learning/ Research Oriented Teaching	Evaluation of Students on the basis of Assignment/Quiz /Class test
III.	Understand Constructors and Destructors	Presentation/Lecture	Evaluation of Students on the basis of Presentation/Application Oriented Question solving/ Assignment/ Quiz.
IV.	Explore the concept of Extending Classes-Pointers, Virtual Functions and Polymorphism	Presentation/ Video/ Lecture / Research Study.	Evaluation of Students on the basis of Presentation/ Assignment/Quiz
V.	Understand how to build Elementary MATH Built	Presentation/ Lecture / Research Study.	Evaluation of Students on the basis of Assignment/Quiz /Class test.

REFERENCES:

1. MAT LAB An Introduction with Applications: Amos Gilat (Wiley India)
2. Programmingin C++: J. B. Dixit.
3. Let us C++:Yashavant P. Kanetkar.

E-resources:

1. Computer programming with MATLAB-CEA: https://www.cea-wismar.de/pawel/Study/z_Links_and_Sources/2015--Computer Programming With MATLAB--Textbook-PDF-3rdRevisedEdition-June-2015.pdf
2. Introduction to Computers and Programming using C++ and MATLAB by Alex F. Bielajew:http://dl.icdst.org/pdfs/files3/e73ba938886718a7fb47ac43be9266ca.pdf
3. Scientific Computing with MATLAB by Paul Gribble:http://www.audentia-gestion.fr/Matlab/scicomp.pdf
4. Guide to Scientific Computing in $C++$:https://petcomputacao.ufsc.br/wp-content/uploads/2020/06/2017_Book_GuideToScientificComputingInC.pdf
5. An Introduction to the C Programming Language and Software Design by Tim Bailey: https://www-personal.acfr.usyd.edu.au/tbailey/ctext/ctext.pdf

MSMH	Total Marks: 100
Semester-IV	Internal Marks: 30
Paper Code: MSMH403C	External Marks: 70
Computer Applications- Theory & Programming in C (ANSI features)-I	No. of Hours: 75
Course Objective(s): To develop the basic knowledge of computer and programming languages which help in the development of Applied Mathematics.	Total Credits: 05

Unit No.	Details	Nos. of Hours
1	An overview of programming. Programming language, Classification, Essentials-Program Development, Variables and constants Expressions, Assignment Statements, Formatting Source Files, Continuation Character, The Preprocessor, Scalar Data Types- Declarations. Different Types of Integers, Different kinds of Integer Constants.	**15**
2	Floating-Point Types, Initialization, Mixing Types, Explicit Conversions-Casts, Enumeration Types, The Void Data Type, Typedefs, Finding the Address of an object, Pointers, Operators and Expressions-Precedence and Associativity, Unary Plus and Minus Operators, Arithmetic Assignment Operators, Increment and Decrement Operators.	**15**
3	Comma Operator, Relational Operators. Logical Operators, Bitwise Assignment Operators, Cast Operator, Size of Operator, Conditional Operator (?:) Memory Operators, Control Flow-Conditional Branching, The Switch Statement, Looping, Nested Loops, The Break and continue Statements, The goto Statement, Infinite Loops.	**15**
4	Introduction to computers, Computer organization, Input-output devices,Memory system. Hardware and software. Operating system. Computer languages, System software and application software. Windows: Graphical user interface, control panel and all features there in files and folders management. Using Accessories, getting help, copying, moving and sharing information between programs. Setting up printer and fonts. Configuring modem. Introduction to MS Word and MS-Excel. Algorithms and flow charts. Programming languages and problem solving on computers.	**15**
5	Programming in C–Constants and variables. Arithmetic expressions,Input-output, Conditional statements, Implementing loops in programs. Defining and manipulating arrays, Processing character strings, functions. Files in C. Simple computer programming.	**15**

Course Outcome(s): After completing this course, the student will be able to:

CO1: Understand the Programming language and its Classification.
CO2: Express the various types of operators.
CO3: Describe various types of loop functions.
CO4: Discuss Computer organization.
CO5: Study the various Constants and variables.

COURSE LEARNING OUTCOME:

UNIT NO.	COURSE LEARNING OUTCOME	TEACHING AND LEARNING ACTIVITY	ASSESSMENT TASK
I.	Understand the Programming language and its Classification	Presentation/ Lecture	Evaluation of Students on the basis of Assignment/Quiz
II.	Express the various types of operators	Application Based learning/ Research Oriented Teaching	Evaluation of Students on the basis of Assignment/Quiz /Class test
III.	Describe various types of loop functions	Presentation/Lecture	Evaluation of Students on the basis of Presentation/Application Oriented Question solving/ Assignment/ Quiz.
IV.	Discuss Computer organization	Presentation/ Video/ Lecture / Research Study.	Evaluation of Students on the basis of Presentation/ Assignment/Quiz
V.	Study the various Constants and variables	Presentation/ Lecture / Research Study.	Evaluation of Students on the basis of Assignment/Quiz /Class test.

Text Book:

1. Peter A. Darnell and Philip E. Margolis: A Software Engineering Approach, NarosaPublishing House (Springer International Student Edition).

Reference Books:

1. Samuel P. Harkison and Gly L. Steele Jr. C.A. Reference Manual, 2nd Edition, Prentice Hall, 1984.
2. Brian W. Kernighan & Dennis M. Ritchie: The C Programme Language, 2nd Edition (ANS features), Prentice Hall 1989.
3. E. Balagurusamy: Programming in ANSI C Tata McGraw- Hall Publishing Company Limited, New Delhi.

E-resources:

1. Introduction to programming C –NPTEL (IIT Kanpur):https://nptel.ac.in/courses/progrmming
2. Programming in ANSI C: https://karadev.net/uroci/filespdf/files/Programming-in-ANSI-C.pdf
3. LECTURE NOTES ON C PROGRAMMING:https://vardhaman.org/wp-content/uploads/2018/12/Computer%20Programming.pdf
4. Free C Programming Books:http://www.freebookcentre.net/Language/Free-C-Programming-Books-Download-1.htm

MSMH	Total Marks: 300
Semester-IV	Internal Marks: 100
Paper Code: MSMH404P	External Marks: 200
Dissertation	