Guru Kashi University

Master of Science in Mathematics

Session: 2022-23

Department of Mathematics

PROGRAMME LEARNING OUTCOMES

1. Inculcate critical thinking to carry out scientific investigation objectively without being biased with preconceived notions, also groom students into qualitative scientific manpower.
2. Enhance mathematical skills and understand the fundamental concepts of pure and applied mathematics.
3. Capable to apply the Mathematical knowledge in industries, teaching, or secure acceptance in high-quality further educational and professional programs in Mathematics and other fields such as the field of quantitative / Mathematical finance, Mathematical computing, Statistics and Actuarial science.
4. Enlarge the abilities in using technology efficiently for conducting research and in their professional practices.
5. Continue to acquire mathematical and statistical knowledge and skills appropriately to professional activities and demonstrate highest standards of ethical issues in Mathematics.
6. Cultivate a core of mathematical and technical knowledge that is adaptable to changing technologies and provides a solid foundation for future learning.

Programme Structure

Semester: I						
Course Code	**Course Title**	**Type of Course**	**L**	**T**	**P**	**No. of Credits**
MMH101	Abstract Algebra	Core	4	0	0	4
MMH102	Real Analysis	Core	4	0	0	4
MMH103	Ordinary Differential Equations	Core	4	0	0	4
MMH104	MATLAB Programming I	Skill Based	2	0	4	4
MMH105	ICT in Mathematics Education	Skill Based	2	0	0	2
Ability Enhancement Course						
MMH106	Campus to Workplace	Ability Enhancement	1	0	0	1
MMH199		MOOC	--	--	--	--
Total			17	0	4	19

Semester: II						
Course Code	Course Title	Type of Course	L	T	P	No. of Credits
MMH201	Partial Differential Equations	Core	4	0	0	4

MMH202	Complex Analysis	Core	4	0	0	4
MMH203	MATLAB programming II	Skill Based	2	0	4	4
MMH204	Teaching Methodology	Skill Based	2	0	0	2
MMH205	Financial Mathematics	Skill Based	2	0	0	2
MMH206	Research Methodology	Research skill Based	4	0	0	4
Discipline Elective (Any one of the following)						
MMH207	Functional Analysis	Discipline Elective	4	0	0	4
MMH208	Field Theory					
MMH209	Mechanics of Solids					
MMH210	Analytical Number Theory					
Value added course - For other disciplines also						
MMH211	Human Values and Professional ethics	Value Added Course	1	0	0	1
Total			23	0	4	25

Semester: III						
Course Code	Course Title	Type of Course	L	T	P	No. of Credits
MMH301	Operations Research	Core	4	0	0	4
MMH302	Mathematical Methods	Core	4	0	0	4

MMH303	Numerical Computations Using MATLAB	Technical Skill	0	0	4	2
MMH304	Operations Research Lab	Technical Skill	0	0	4	2
Discipline Elective-I (Any one of the following)						
MMH305	Topology	Discipline Elective I	4	0	0	4
MMH306	Advanced Operation Research					
MMH307	Mathematical Modelling					
MMH308	Advanced Group Theory					
Discipline Elective-II (Any one of the following)						
MMH309	Fuzzy Sets and Application	Discipline Elective II	4	0	0	4
MMH310	Probability and Mathematical Statistics					
MMH311	Special Function					
MMH312	Integral Transforms and Their Applications					
Open Elective Courses- (Any one of the following)						
--	--	Open Elective	2	0	0	2
MMH399	MOOC	--	-	-	-	-
Total			18	0	8	22

Open Elective Courses- (Any one of the following)						
MMH313	Numerical Methods	Open Elective	2	0	0	2
MMH314	Discrete Mathematics					

MMH315	Measurement and Evaluation					
MMH316	Reasoning and Quantitative Aptitude					

Semester: IV

Course Code	Course Title	Type of Course	L	T	P	No. of Credits
MMH401	Innovative Research Project	Research Skill based	0	0	40	20
Total			0	0	40	20

Evaluation Criteria for Theory Courses

A. Continuous Assessment: [25 Marks] based on surprise test/Quiz/ Assignment/Seminar/Term Paper etc.

   i. CA – I (10 Marks)
   ii. CA – II (10 Marks)
   iii. CA – III (5 Marks)

B. Attendance (5 marks)
C. Mid Semester Test-1: [30 Marks]
D. Mid Semester Test -2: [20Marks]
E. End-Term Exam: [20 Marks]

ACADEMIC INSTURCTIONS

Attendance Requirements

A student shall have to attend 75% of the scheduled periods in each course in a semester; otherwise, he / she shall not be allowed to appear in that course in the University examination and shall be detained in the course(s). The University may condone attendance shortage in special circumstances (as specified by the Guru Kashi University authorities). A student detained in the course(s) would be allowed to appear in the subsequent university examination(s) only on having completed the attendance in the program, when the program is offered in a regular semester(s) or otherwise as per the rules.

SEMESTER-I

Course Title: Abstract Algebra

Course Code: MMH101

L	T	P	Cr
4	0	0	4

Total Hours:60

Course Learning Outcomes:

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

- Analyze the Cauchy's theorem for Abelian group and Sylow's theorem.
- Compute the Permutation groups and its Conjugacy.
- Perform the Homomorphism's, Ideals, and Quotient rings in ring theory.
- Design the Polynomial rings and polynomial over the rational field.

COURSE CONTENT

UNIT-I **15 hours**

Normal subgroups and Quotient Groups-Homomorphism-Cauchy's theorem for Abelian Group Sylow's theorem for Abelian Group-Automorphism-Cayley's theorem

UNIT-II **17 hours**

Permutation groups- Conjugacy- Normalizer-Centre-Cauchy theorem-Sylow's Theorem-Direct products. Rings-Homomorphism-Ideals-Quotient Rings-Maximal Ideal-Field of Quotients of integral domain

UNIT-III **12 hours**

Euclidean rings-Polynomial rings- polynomial over the rational field-polynomial rings over commutative rings

UNIT-IV **16 hours**

Vector spaces-elementary basic concepts-Extension fields-The Transcendence of e - roots of polynomials-Construction with straightedge and compass-Finite fields

Transaction Mode- Lecture, Demonstration, Video Based Teaching, Collaborative teaching, Group Discussion, Ted talks, E team Teaching, Flipped Teaching, Quiz, Open talk, Case analysis.

SUGGESTED READINGS:-

1. Luther I.S. and Passi I.B.S.(2007).*Algebra*, Vol.I& II, Narosa Publishing House, New Delhi.
2. Gallian J.A. (1999). *Contemporary Abstract Algebra*, Narosa Publishing House, New Delhi.
3. Singh, Surjeet and QaziZameeruddin (2006).Modern Algebra, Vikas Publishing House, New Delhi .8thEdition.
4. Bhattacharya P.B, Jain S.K. and Nagpal S.R.(2012).*Basic Abstract Algebra*.Cambridge University Press,New Delhi.
5. David. S. Dummit, Richarad M. Foote, (2004), *Abstract Algebra*, John-Wiley & sons, Third edition.
6. Fraleigh J.B. (2013.),*A first course in abstract algebra*, Narosa publications, Seventh edition.
7. Suggested digital platform: NPTEL/SWAYAM/MOOCs.

Course Title: Real Analysis

Course Code: MMH102

L	T	P	Cr
4	0	0	4

Total Hours:50

Course Learning Outcomes:

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

- Apply the knowledge and concepts of real analysis in order to study theoretical development of different mathematical techniques and their applications.
- Describe the nature of abstract mathematics and explore the concepts in further details. Identify challenging problems in real variable theory and find their appropriate solutions.
- Use theory of Riemann-Stieltjes integral in solving definite integrals arising in different fields of science and engineering.
- Extend their knowledge of real variable theory for further exploration of the Course for going into research.

COURSE CONTENT

UNIT-I **17 hours**

Sequence and Series of functions: Discussion of main problem, Uniform Convergence, Uniform Convergence and Integration, Uniform Convergence and Differentiation, Equicontinuous families of functions, Arzela's Theorem, Weierstrass Approximation theorem

UNIT-II **15 hours**

Measure Sets: Outer Measure, Lebesgue Measure, Properties of Measurable Sets, Non-Measurable Sets. Measurable Functions: Definition & Properties of Measurable functions, Characteristic functions, Step Functions and Simple Functions, Little wood's three Principles.

UNIT-III **16 hours**

The Lebesgue integral: The Lebesgue integral of a bounded function over a set of finite measure. The integral of a non-negative function. The general Lebesgue integral. Convergence in measure.

UNIT-IV **12 hours**

Differentiation and Integration: Differentiation of monotone functions. Differentiation of an integral. Absolute continuity. Convex functions. The general integral, Integration of series, Riemann and integrals.

Transaction Mode- Lecture, Demonstration, Video Based Teaching, Collaborative teaching, Group Discussion, ted talks, E team Teaching, Flipped Teaching, Quiz, Open talk, Case analysis.

SUGGESTED READINGS:-

1. Apostol, Tom. (1987). *Mathematical Analysis - A Modern Approach to Advanced Calculus*. Addison - Wesley Publishing Company, Inc.Indian Edition by Narosa Publishing House New Delhi.
2. Goldberg, R.R. (2012). *Methods of Real Analysis*. Oxford and IHB Publishing Company, New Delhi.
3. Malik, S.C. (1984). *Mathematical Analysis*, Wiley Eastern, New Delhi.
4. Rudin, Walter. (1983), *Principles of Mathematical Analysis*. Third Edition (International Student Edition) McGraw-Hill Inc.
5. Suggested digital platform: NPTEL/SWAYAM/MOOCs.

Course Title: Ordinary Differential Equations

Course Code: MMH103

L	T	P	Cr
4	0	0	4

Total Hours:60

Course Learning Outcomes:

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

- Grasp ordinary differential equations of various types, their solutions, and fundamental concepts about their existence.
- Recognize the Sturm-Liouville problem and analyze stability of linear and non-linear systems. Solve the first-order linear and non-linear equations.
- Evaluate problems of ordinary differential equations arising in various fields.
- Find series solution of first order equation and second order linear equation and understand the method of successive approximations

COURSE CONTENT

UNIT-I **16 hours**

Qualitative Properties of Solutions – The Sturm Comparison Theorem – Eigen Values and Eigen Functions – Vibrating String**.** Legendre Polynomials. Properties of Legendre Polynomials, Bessel Functions.

UNIT-II **17 hours**

Method of successive approximations, Existence and Uniqueness Theorem. System of differential equations, nth order differential equation, Existence and Uniqueness of solutions, dependence of solutions on initial conditions and parameters.

UNIT-III **15 hours**

Linear system of equations (homogeneous & non homogeneous). Superposition principle, Fundamental set of solutions, Fundamental Matrix, Wronskian, Abel

Liouville formula, Reduction of order, Adjoint systems and self-adjoint systems of second order, Floquet Theory.

UNIT-IV **12 hours**

Linear 2nd order equations, preliminaries, Sturm's separation theorem, Sturm's fundamental comparison theorem, Sturm Liouville boundary value problem, Characteristic values & Characteristic functions, Orthogonality of Characteristic functions, Expansion of a function in a series of orthonormal functions.

Transaction Mode- Lecture, Demonstration, Video Based Teaching, Collaborative teaching, Group Discussion, ted talks, E team Teaching, Flipped Teaching, Quiz, Open talk, Case analysis.

SUGGESTED READINGS:-

1. E. Coddington& N. Levinson (2010), *Theory of Ordinary Differential Equations*, Tata Mc-Graw Hill, India.
2. S.L. Ross. (1984),*Differential Equations*, 3rd edition, John Wiley & sons (Asia).
3. N. P. Bali, Bhavanari Satyanarayana, (2012), *A Text book of Engineering Mathematics*, IndraniPromod Kelkar, University Science Press, New Delhi.
4. A.C. King, J. Billingham, S.R. Otto. (2003). *Differential Equations, Linear, Nonlinear, Ordinary, Partial,* Cambridge University Press.
5. Williams E. Boyce and Richard C. DI Prima (2001), *Elementary differential equations and boundary value problems*, John Wiley and sons, New York, Seventh Edition.
6. Suggested digital platform: NPTEL/SWAYAM/MOOCs.

Course Title: MATLAB programming I

Course Code: MMH104

L	T	P	Cr
2	0	4	4

Total Hours:60

Course Learning Outcomes:

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

- Understand the main features of the MATLAB program development environment to enable their usage in the higher learning.
- Implement simple mathematical functions/equations in numerical computing environment.
- Interpret and visualize simple mathematical functions and operations thereon using plots.
- Write simple programs in MATLAB to solve scientific and mathematical problems

COURSE CONTENT

UNIT-I **15 hours**

Introduction:- Basic of MATLAB ,Types of Window ,Types of File Basic Operations

UNIT -II **16 hours**

Array Design:-Matrix Operation, Array Design, Array Operation, Multidimensional Array.

UNIT -III **15 hours**

Graphics:- Plotting, Multiple Plot, 2-D Plot, 3-d Plot, Subplot, Handle Graphics, Animation, Example(like a project)

UNIT -IV **14 hours**

Symbolic Calculations:-Symbols, Design Formula, Differentiation, Integration, Solve Equation, Example (like a project).

Transaction Mode- Lecture, Demonstration, Video Based Teaching, Collaborative teaching,Project based learning, E-team teaching, Group discussion, ted talks, E team Teaching, Flipped Teaching, Quiz, Open talk, Case analysis.

SUGGESTED READINGS:-

1. Rudra Pratab(2016), *Getting Started with MATLAB*, Oxford Univ. press, Seventh Edition.
2. K.SrinivasaRao(2012), *Introduction to MATLAB*, IMRF International Publications.
3. P.Nagarajan, K.Srinivasa Rao(2009), *Numerical Methods with Programs in MATLAB*, University Press, SCSVMV.
4. MiszaKalechman (2008), *Practical MATLAB-Basics for Engineers*, CRC Press.
5. D.M.Etter (1997), *Engineering Problems Solving with MATLAB,* Prentice Hall.
6. Suggested digital platform: NPTEL/SWAYAM/MOOCs.

Course Title: ICT in Mathematics Education

Course Code: MMH105

L	T	P	Cr
2	0	0	2

Total Hours:30

Course Learning Outcomes:

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

- Engage students in exploring real-world issues and solving authentic problems using digital tools and resources.
- Participate in local and global learning communities to explore creative application of technology to improve student learning.
- Promote student reflection using collaborative tools to reveal and clarify the students understanding and thinking, planning and creative processes.
- Develop a well-articulated perspective on information and communication technology in mathematics education informed by personal experience.

COURSE CONTENT

UNIT -I **7 hours**

Potentials of ICT in Mathematics Education ICT as a change agent, Place and purpose of technology in the curriculum, Means of ICT, technology embedded pedagogy

UNIT -II **8 hours**

ICT for enhanced learning Content planning using ICT, Role of ICT in content differentiation, ICT and self-paced learning, Use of ICT in inclusive classroom

UNIT -III **7 hours**

Safety issues in use of ICT Technology in the hands of teacher and student, connectivity through ICT on campus and off campus, learning space, e-content versus authentic information

UNIT -IV **8 hours**

Interactive Games and Puzzles: -Exploring resources and application of Mathematics, Digital application- From Toys to Learning tools. To design a story board of an education game: or design puzzle online.

Transaction Mode- Lecture, Demonstration, Video Based Teaching, Collaborative teaching, Project based learning, E-team teaching, Group discussion, ted talks, E team Teaching, Flipped Teaching, Quiz, Open talk, Case analysis.

SUGGESTED READINGS:-

1. Ron Taylor (2010), *Teaching mathematics in education with ICT*, illustrated, reprint, Continuum publication.
2. Kaushik Das (2019), *Role of ICT for Better Mathematics Teaching*, vol. 7, no. 4, pp. 19-28.
3. Hideyuki Kanematsu (2015), *STEM and ICT Education in intelligent Environments*, Springer Publishing company.

Course Title: Campus to Workplace

Course Code: MMH106

L	T	P	Cr
1	0	0	1

Total Hours:15

Course Learning Outcomes:

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

- Help students to develop confidence to face interviews and to groom them for workplace.
- Develop their individual ability, strengthening their employability.
- Equip himself/herself to get in to grips with its new realities.
- Provides a range of new challenges, all of which call for graduates to display accountability, professionalism and credibility

COURSE CONTENT

UNIT -I **5 hours**

Speaking Activities- Group Discussion, Mock Interview, Extempore, Declamation, Presentation.

Writing Skills Activity-Business letter, Cover Letter and Resume writing

UNIT -II **3 hours**

Reading Activity- Reading comprehension exercises from competitive tests.

Listening Skills Activity- Listening to comprehend.

UNIT -III **3 hours**

Personality Development Activity-SWOT Analysis, Grooming and Work Ethics

UNIT -IV **4 hours**

Vocabulary Enhancement Activity-Exercises on Synonyms& Antonyms, One word substitution

Grammar Activity- Exercises based on Narration, Change of voice and errors.

Transaction Mode- Lecture, Demonstration, Video Based Teaching, Collaborative teaching, E-team teaching, Group discussion, ted talks, E team Teaching, Flipped Teaching, Quiz, Open talk, Case analysis.

SUGGESTED READINGS:-

1. Sanjay Kumar &PushpLata (2014), *Communication Skills*, Oxford University Press.
2. Barron's Vocabulary Builder(2013), *Educational Series*, Bright Publishers
3. Wren & Martin (2009),*High School Grammar*, S. Chand & Company.
4. Dr. T. KalyanaChakravarthi& Dr. T. LathaChakravarthi (2012), *Soft Skills for Managers*, Bizantra.

SEMESTER -II

Course Title: Partial Differential Equations

Course Code: MMH201

L	T	P	Cr
4	0	0	4

Total Hours:60

Course Learning Outcomes:

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

- Formulate partial differential equations and solve boundary value problems related to Laplace, Heat and wave equations in one, two and three dimensions.
- Analyze a fundamental familiarity with homogeneous and non-homogeneous transport equation; also learn fundamental solution of Laplace equation.
- Familiarize themselves with Green's Function, Heat equation; uniqueness and solution.
- Explain about Kirchhoff's and Poisson formula, uniqueness of wave equation.

COURSE CONTENT

UNIT-I **18 hours**

Method of separation of variables to solve B.V.P. associated with one dimensional heat equation, heat equation in semi-infinite and infinite regions. Solution of three-dimensional Laplace equation in Cartesian, cylindrical and spherical coordinates. Solution of Wave equation in two dimensions and three dimensions (Cartesian, Cylindrical, Spherical)

UNIT-II **16 hours**

Partial Differential Equation of kth order: Definition, examples and classifications, Initial value problems, Transport equations: definition, solution of homogeneous and non-homogeneous transport equations, Laplace Equation, Fundamental solution of Laplace equation, Harmonic function, Mean Value formula for Harmonic function

UNIT-III **14 hours**

Green's formula, Corrector function, Green's function and its derivation, Representation formula using Green's function, Symmetry of Green's function, Energy methods: uniqueness, Dirichlet's Principle. Heat Equations: Fundamental solution of Heat equation, Uniqueness of Heat Equation: Energy methods

UNIT-IV **12 hours**

Wave equation: Physical interpretation, solution for one dimensional wave equation, Reflection method, derivation of Euler-Poisson-Darboux equation, Kirchhoff's and Poisson's formulas (for n = 2, 3 only), solution of non-homogeneous wave equation for n = 1, 3. Energy method, uniqueness of solution

Transaction Mode- Lecture, Demonstration, Video Based Teaching, Collaborative teaching, Group Discussion, ted talks, E team Teaching, Flipped Teaching, Quiz, Open talk, Case analysis.

SUGGESTED READINGS:-

1. E. Coddington& N. Levinson (2010), *Theory of Ordinary Differential Equations*, Tata Mc-Graw Hill, India.
2. S.L. Ross. (1984),*Differential Equations*, 3rd edition, John Wiley & sons (Asia).

3. NP. Bali, Bhavanari Satyanarayana (2012), *A Text book of Engineering Mathematics*, IndraniPromod Kelkar, University Science Press, New Delhi.
4. A.C. King, J. Billingham, S.R. Otto (2003), *Differential Equations, Linear, Nonlinear, Ordinary, Partial,* Cambridge University Press.
5. , Williams E. Boyce and Richard C. DI Prima (2001), *Elementary differential equations and boundary value problems*, John Wiley and sons, New York, Seventh Edition.
6. Suggested digital platform: NPTEL/SWAYAM/MOOCs.

Course Title: Complex Analysis

Course Code: MMH202

L	T	P	Cr
4	0	0	4

Total Hours:60

Course Learning Outcomes:

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

- Grasp the fundamental concepts of Complex analysis and its use in mathematics.
- Represent complex numbers algebraically and geometrically. Define and analyze limits and continuity for functions of complex variables.
- Evaluate complex integral and apply Cauchy Integral Theorem and formulas.
- Checking limit and continuity of complex function and apply the concept of analyticity and the Cauchy- Riemann Equation.

COURSE CONTENT

UNIT-I **18 hours**

Complex plane, geometric representation of complex numbers. Elementary functions: Trigonometric function, complex exponential function, logarithmic and hyperbolic functions. Complex valued functions and their continuity. Curves, connectivity through polygonal lines.

UNIT-II **14 hours**

Analytic functions, Cauchy-Riemann equations, Harmonic functions and Harmonic conjugates. Power series, exponential and trigonometric functions, Bilinear transformations, critical points, fixed points, cross ratio, Problems on cross-ratio and bilinear transformation.

UNIT-III **12 hours**

Complex Integration, line integral, Cauchy's theorem for a rectangle, Cauchy's theorem in a disc, index of a point with respect to a closed curve Cauchy's integral formula, higher derivatives.

UNIT-IV **16 hours**

Morrera's theorem, Liouville's theorem, the general form of Cauchy's theorem. Maximum Modules principle, Schwarz Lemma. Taylor series and Laurent series.

Transaction Mode- Lecture, Demonstration, Video Based Teaching, Collaborative teaching, Group Discussion, ted talks, E team Teaching, Flipped Teaching, Quiz, Open talk, Case analysis.

SUGGESTED READINGS:-

1. Shanti Narayan. (1986), *Theory of Functions of a Complex Variable*. S. Chand and Co. Seventh Edition.
2. Copson, E. T.(1985), *An Introduction to the Theory of Functions of a Complex Variable*. The English Language Book Society and Oxford University Press.
3. Knopp, K. (1947), *Theory of Functions*. (Translated by F. Bagemite) in Two Volumes, Dover Publications, Inc. New York.
4. Pati, T. (1971), *Functions of a Complex Variable*. Allahabad, Pothishala.
2. Saks, S and Zygmund, A.(1952), *Analytic Functions*. (Translated by E. J. Scott) Poland, Warszawa.
3. Silverman, R. (1967), *Introductory Complex Analysis*, Prentice-Hall Inc. Englewood Cliffs, N. J.
4. Deshpande, J. V. (1989), Complex Analysis. Tata McGraw-Hill Publishing Company Ltd.

5. Tutschke Wolfgang and Vasudeva, Harkrishan L. (2005), An Introduction to Complex Analysis,Classical and Modern Approaches. Chapman and Hall/CRC.
6. Ponnusamy S. (2005), Foundations of Complex Analysis. Second Edition Narosa Publishing House, New Delhi.
7. Suggested digital platform: NPTEL/SWAYAM/MOOCs.

Course Title: MATLAB programming II

Course Code: MMH203

L	T	P	Cr
0	0	4	2

Total Hours:30

Course Learning Outcomes:

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

- Understand the main features of the MATLAB program development environment to enable their usage in the higher learning.
- Implement simple mathematical functions/equations in numerical computing environment.
- Interpret and visualize simple mathematical functions and operations thereon using plots.
- Write simple programs in MATLAB to solve scientific and mathematical problems

COURSE CONTENT

UNIT-I **8 hours**

Operators:-Arithmetic Operator, Logical, Relational.

UNIT-II **8 hours**

Branch and Loop:-If statement, If-else statement, Else-if statement, Pause, Break, Continue Switch-case, try-catch, Return Statement, For Loop,While Loop, Example(like a project).

UNIT-III **7 hours**

Script and Function:-Script Design, Function Design, Types Of Function, Example (like a project).

UNIT-IV **7 hours**

GUI (Graphical User Interface):-Introduction of GUI, GUI Function Property, GUI Component Design, GUI Container, Writing the code of GUI Callback, Dialog Box, Menu Designing

Transaction Mode- :Lecture, Demonstration, , Video Based Teaching, Collaborative teaching, Project based learning, E-team teaching, Group discussion, ted talks, E team Teaching, Flipped Teaching, Quiz, Open talk, Case analysis.

SUGGESTED READINGS:-

1. RudraPratab (2016), *Getting Started with MATLAB*, Oxford Univ. press, Seventh Edition.
2. K.SrinivasaRao (2012), *Introduction to MATLAB*, IMRF International Publications .
3. P.Nagarajan, K.Srinivasa Rao (2009), *Numerical Methods with Programs in MATLAB*, University Press, SCSVMV.
4. MiszaKalechman (2008), *Practical MATLAB-Basics for Engineers*, CRC Press.
5. D.M.Etter (1997), *Engineering Problems Solving with MATLAB,* Prentice Hall.
6. Suggested digital platform: NPTEL/SWAYAM/MOOCs.

Course Title: Teaching Methodology

Course Code: MMH204

L	T	P	Cr
2	0	0	2

Total Hours:30

Course Learning Outcomes:

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

- Develop knowledge, Understanding and an insight of the various underlying concepts of Learning.
- Differentiate and establish a relationship between various Learning methods and techniques.
- Prepare and evaluate of different curricular materials, specific subject and teacher guide.
- Discuss and assess the different educational structure and system and the changing socio-cultural environment in context to education

COURSE CONTENT

UNIT-I **7 hours**

Fundamental elements in teaching – Levels of learning - Planning a course: trips and tips – Planning a class: no detail is too small – Experimental methods

UNIT-II **8 hours**

Enhancing the conversation: audiovisual tools and techniques – Executive education: contributing to organizational competitive advantage.

UNIT-III **8 hours**

Counseling students – Evaluating students: the twin tasks of certification and development.

UNIT-IV **7 hours**

Teaching evaluations: feedback that can help and hurt – Research presentations – Managing yourself and your time.

Transaction Mode-: Lecture, Demonstration, Video Based Teaching, Collaborative teaching, Group Discussion, ted talks, E team Teaching, Flipped Teaching, Quiz, Open talk, Case analysis.

SUGGESTED READINGS:-

1. James G.S. Clawson, Mark E.Haskins(2006),*Teaching Management*, Cambridge University Press, First Edition.
2. EnamulHoque (2016), *50 METHODS OF TEACHING*, University of English and Foreign Language.
3. RohitVaidwan (2021),*Teaching Methodology,* Adhayan Mantra Publication.
4. RohitVaidwan (2022),*Teaching aptitude and Methodology,* Adhayan Mantra Publication.

Course Title: Financial Mathematics

Course Code: MMH205

L	T	P	Cr
2	0	0	2

Total Hours:30

Course Learning Outcomes:

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

- Develop the understanding of mathematics as a deductive science.
- Apply mathematics to real world problems and experience with current mathematical software and technology.
- Provide students with necessary marketable credentials to work in the actuarial field or the financial industry.
- Provide the mathematical foundations for students in other discipline.

COURSE CONTENT

UNIT-I **7 hours**

Basic principles: Comparison, arbitrage and risk aversion, Interest (simple and compound, discrete and continuous), time value of money, inflation, net present value, internal rate of return (calculation by bisection and Newton-Raphson methods), comparison of NPV and IRR. Bonds, bond prices and yields,

UNIT-II **8 hours**

Macaulay and modified duration, term structure of interest rates: spot and forward rates, explanations of term structure, running present value, floating-rate bonds, immunization, convexity, puttable and callable bonds.

UNIT-III **8 hours**

Asset return, short selling, portfolio return, (brief introduction to expectation, variance, covariance and correlation), random returns, portfolio mean return and variance, diversification, portfolio diagram, feasible set.

UNIT-IV **7 hours**

Markowitz model (review of Lagrange multipliers for 1 and 2 constraints), Two fund theorem, risk free assets, One fund theorem, capital market line, Sharpe index. Capital Asset Pricing Model (CAPM), betas of stocks and portfolios, security market line, use of CAPM in investment analysis and as a pricing formula, Jensen's index.

Transaction Mode- Lecture, Demonstration, Video Based Teaching, Collaborative teaching, Group Discussion, ted talks, e- team Teaching, Flipped Teaching, Quiz, Open talk, Case analysis

SUGGESTED READINGS:-

1. David G. Luenberger(1998), *Investment Science*, Oxford University Press, Delhi.
2. John C. Hull, Options(2006), *Futures and Other Derivatives*, 6th Ed., Prentice-Hall India, Indian reprint
3. Sheldon Ross(2003),*An Elementary Introduction to Mathematical Finance*, 2nd Ed., Cambridge University Press, USA.

Course Title: Research Methodology

Course Code: MMH206

L	T	P	Cr
4	0	0	4

Total Hours:60

Course Learning Outcomes:

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

- Take survey and investigate by setting hypotheses and the social research question.
- Apply the conversion graphs, weighted graphs.
- Gain thorough knowledge on sampling techniques
- Solve LPP, Transportation and Assignment problems

COURSE CONTENT

UNIT-I **13 hours**

Introduction to Research: - Some fundamental concepts– Research, survey, investigation and experiment. Hypothesis in research Questionnaire, Experimental design in social research. Examples from case studies

UNIT-II **14 hours**

Graph theoretic Tools /Techniques: - Conversion of issues to graphs, weighted graphs, popular models, Examples from case studies. Techniques used in Numerical Methods, Examples from case studies.

UNIT- III **18 hours**

Statistical Tools / Techniques: -Sampling and types of sampling. Standard measures in statistics Examples from case studies.

Fuzzy Tools / Techniques: - Fuzzy - Neural network models, Examples from case studies

UNIT-IV **15 hours**

OR Tools / Techniques: -Normal distribution. Normal approximation to Binomial and Poisson distributions. Beta, Gamma, Chi-square and Bivariate normal distributions. Sampling distribution of mean and variance (normal population). Chebyshev's inequality, weak law of large numbers, Central limit theorems.

Transaction Mode- Lecture, Demonstration, Video Based Teaching, Collaborative teaching, Group Discussion, ted talks, E team Teaching, Flipped Teaching, Quiz, Open talk, Case analysis.

SUGGESTED READINGS:-

1. Gupta and Kapoor (2014), *Fundamentals of Mathematical Statistics*, Sultan Chand & Sons.
2. Hamdy A. Taha (2007), *Operations Research*, Prentice Hall, Eighth Edition.
3. CR Kothar (2004), *Research methodology*, New Age International Publishers.
4. George J.Klir and Bo Yuan (1995) ,*Fuzzy sets and Fuzzy Logic* Prentice Hall.
5. Kauffmann, A. (1975), *Theory of Fuzzy subsets*, Academic Press.

Course Title: Functional Analysis

Course Code:MMH207

L	T	P	Cr
4	0	0	4

Total Hours:60

Course Learning Outcomes:

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

- Understand convergence of operators by using a suitable norm, compute the dual spaces.
- Analyze weak and strong convergence and uniform boundedness theorem, open mapping
  theorem and closed graph theorem.
- Explain the properties of compact operators.
- Apply the operators into self-adjoint, unitary and normal operators

UNIT-I **18 hours**

Normed spaces, Banach spaces, Finite dimensional normed spaces and subspaces, Compactness and finite dimension, Bounded and continuous linear operators, Linear operators and functionals on finite dimensional spaces, Normed spaces of operators, Dual spaces.

UNIT-II **16 hours**

Hahn Banach theorems for real and complex normed spaces, Adjoint operator, Reflexive spaces,

Uniform boundedness theorem strong and weak convergence, Convergence of sequences of operators and functionals, Open mapping theorem, Closed graph theorem.

UNIT-III **12 hours**

Hilbert spaces, Orthogonal complements and direct sums, Bessel's inequality, Total orthonormal sets and sequences, Representation of functionals on Hilbert spaces, Hilbert adjoint operators, Self-adjoint, unitary and normal operators.

UNIT-IV **14 hours**

Compact operator and its relation with continuous operator, Compactness of linear transformation on a finite dimensional space, Properties of compact operators, Compactness of the limit of the sequence of compact operators.

Transaction Mode-: Lecture, Demonstration, Video Based Teaching, Collaborative teaching, Group Discussion, ted talks, E team Teaching, Flipped Teaching, Quiz, Open talk, Case analysis

SUGGESTED READINGS:-

1. Kreyszig E. (2006), *Introductory Functional Analysis with Applications*, John Wiley & Sons, India.
2. Simmons George F. (1963), *Introduction to Topology and Modern Analysis*, McGraw-Hill BookCompany.
3. Bachman G. and NariciL.(2000), *Functional Analysis,* Dover Publications.
4. Bhatia R.(2009), *Notes on Functional Analysis*, Hindustan Book Agency, India.
5. Schechter M.(2001), Principles of Functional Analysis, Second Edition, American Mathematical Society.
6. Suggested digital platform: NPTEL/SWAYAM/MOOCs.

Course Title: Field Theory

Course Code: MMH208

L	T	P	Cr
4	0	0	4

Total Hours:60

Course Learning Outcomes:

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

- Grasp the concepts of fields, extension of fields and splitting fields of polynomials.
- Establish all properties of finite fields and Galois theory and their application.
- Implement the concepts of vector spaces, basis, dimension and linear transformations.
- Derive the Roots of unity and cyclotomic polynomials. Cyclic extension, Polynomials solvable by radicals,

COURSE CONTENT

UNIT-I **18 hours**

Fields, examples, Algebraic and transcendental elements, Irreducible polynomials. Gauss Lemma, Eisenstein's criterion, Adjunction of roots, Kronecker's theorem, algebraic extensions.

UNIT-II **14 hours**

Algebraically closed fields. Splitting fields, Normal extensions, multiple roots, finite fields, Separable extensions, perfect fields, primitive elements, Lagrange's theorem on primitive elements.

UNIT- III **15 hours**

Automorphism groups and fixed fields, Galois extensions, Fundamental theorem of Galois theory, Fundamental theorem of algebra.

UNIT-IV **13 hours**

Roots of Unity and cyclotomic polynomials. Cyclic extension, Polynomials solvable by radicals, Symmetric functions, cyclotomic extension, quintic equation and solvability by radicals.

Transaction Mode-: Lecture, Demonstration, Video Based Teaching, Collaborative teaching, Group Discussion, ted talks, E team Teaching, Flipped Teaching, Quiz, Open talk, Case analysis

SUGGESTED READINGS:-

1. Bhattacharya, P. B. Jain, S. K. &Nagpal, S, R. (1995), *Basic abstract algebra* (Chapters 15-17, Chapter and Nagpaul18:excluding section 5), Cambridge University Press.

2. M. Artin (2010),*Algebra.* Pearson Education, India.

3.Luther I.S. and PassiI.B.S.(1993), *Algebra*, Vol.I& II, Narosa Publishing House, New Delhi.

4. Gallian J.A. (2008), *Contemporary Abstract Algebra,* Narosa Publishing House, New Delhi.

5. Singh Surjeet and QaziZameeruddin(2006), *Modern Algebra,* Vikas Publishing House, New Delhi 8th Edition.

6.Bhattacharya P.B, Jain S.K. and Nagpal S.R.(1994), *Basic Abstract Algebra*. Cambridge University Press,New Delhi.

7.Burnside W. (1955), *The Theory of Groups of Finite Order*. 2nd Ed., Dover, New York, 1955.

8. Hungerford T.W. (1974), Algebra, Springer.

9. Suggested digital platform: NPTEL/SWAYAM/MOOCs.

Course Title: Mechanics of Solids

Course Code: MMH209

L	T	P	Cr
4	0	0	4

Total Hours:60

Course Learning Outcomes:

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

- Understand concept of tensors; Gradient, Divergence and Curl in Tensor notations
- Analyze strain tensor and its various concepts
- Understand and analyze stress tensor and principal stresses
- Understand and apply Generalized Hooke's Law

COURSE CONTENT

UNIT-I **15 hours**

Summation convention, coordinate transformation, cartesian tensor of various orders, algebra of tensors, contraction, symmetric and skew-symmetric tensor, Kronecker delta, Alternating tensor, Gradient, Divergence, Curl in tensor notations, Gauss-divergence theorem, partial derivatives, contravariant and covariant tensors.

UNIT-II **14 hours**

Deformation in elastic bodies, homogeneous strain and its properties, Affine transformation, infinitesimal affine transformation, geometric interpretation of components of strain, strain quadric of Cauchy, strain-displacement relations, Strain invariants, principal direction and principal strain, homogeneous deformation.

UNIT- III **18 hours**

Stress vector and stress tensor, symmetry of stress tensor, stress quadric of Cauchy, equation of equilibrium and motion, principal stresses.

UNIT-IV **13 hours**

Generalized Hooke's Law- relation between stress and strain, Elastic constants and their physical significance, strain energy function and its connection with Hooke's Law, Beltrami-Michell compatibility equations.

Transaction Mode- Lecture, Demonstration, Video Based Teaching, Collaborative teaching, Group Discussion, ted talks, E team Teaching, Flipped Teaching, Quiz, Open talk, Case analysis

SUGGESTED READINGS:-

1. Young, E. C.(1993), *Vectors and tensor analysis*, 2nd edition.
2. Kolsky, H.(1963), *Stress waves in Solids*. Dover Publications.
3. Ghosh, P. K.(1975), *Mathematics of waves and vibrations*. New Delhi: The Macmillan Company of India Limited.
4. Timoshenko S. and Goodier N.(1970), *Theory of Elasticity,* McGraw Hill, New York.
5. Fung Y.C.(2009), *Foundations of Solid Mechanics*, Prentice Hall, New Delhi.
6. Suggested digital platform: NPTEL/SWAYAM/MOOCs.

Course Title: Analytical Number Theory

Course Code: MMH210

L	T	P	Cr
4	0	0	4

Total Hours:60

Course Learning Outcomes:

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

- Apply the knowledge of Number theory to attain a good mathematical maturity and enables to build mathematical thinking and skill.
- Utilize the congruences, Chinese remainder theorem, indices, residue classes, Legendre symbols to solve different related problems. Identify and analyze different types of divisibility tests, Euler's theorem, Wilson theorem, Mobius inversion formula to formulate and solve various related problems.
- Design, analyze and implement the concepts of Diophantine equations for solving different types of problems, for example, sum of two and four squares.
- Identify the challenging problems in modern mathematics and find their appropriate solutions.

COURSE CONTENT

UNIT-I **15 hours**

Divisibility, Division algorithm, G.C.D. (Greatest Common Divisors), L.C.M (Least Common Multiple), Prime numbers, Euclidean algorithm, Fundamental theorem of Arithmetic. Congruences and basic properties, Linear Diophantine equation, Chinese remainder theorem

UNIT-II **14 hours**

Fermat's little theorem and applications, Wilson's theorem and applications, Number theoretic functions, sum and number of divisors, perfect numbers.

UNIT- III **18 hours**

The Mobius function- The Euler Totient function, relation connecting, a product formula, the Dirichlet product of arithmetical function-Dirichlet inverses and Mobius inversion formula- The mangold function -Multiplicative function, Inverse of a completely multiplicative function.

UNIT-IV **13 hours**

Quadratic Residues, Legendre's symbol and its properties, Evaluation of (–1 | p) and (2 | p), Gauss' lemma, The Quadratic Reciprocity law, Applications, The Jacobi symbol.

Transaction Mode- Lecture, Demonstration, Video Based Teaching, Collaborative teaching, Group Discussion, ted talks, E team Teaching, Flipped Teaching, Quiz, Open talk, Case analysis

SUGGESTED READINGS:-

1. Tom M.Apostoln(2013) *Introduction to Analytic Number Theory*, Springer Science and Business media, New Delhi, Illustrated Edition.
2. Ivan Niven, Herbert S. Zuckerman (1989), An Introduction to the Theory of Numbers, Wiley Eastern University Edition, Fifth Edition.
3. W.J.Leveque (1956), *Topics in Number Theory*, Addison Wesley.
4. Bressoud, D.and Wagon, S. (2000), *A Course in Computational Number Theory*, Key College Publishing, Illustrated Edition.
5. Robbins N. (2017) ,*Beginning Number Theory*, 2nd edition, Jones & Bartlett Learning,.
6. Jones G. A. and Jones J.M. (1998), *Elementary Number Theory*, Springer.
7. Suggested digital platform: NPTEL/SWAYAM/MOOCs.

Course Title: Human Values and Professional Ethics

Course Code: MMH211

L	T	P	Cr
1	0	0	1

Total Hours:15

Course Learning Outcomes:

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

- Apply ethics in society
- Discuss the ethical issues related to science and engineering and realize the responsibilities and rights in the society.
- Enhance Senses of Ethics, Variety of moral issues.
- Use Professional Rights, Employee Rights, Intellectual Property Rights

COURSE CONTENT

UNIT I **5 hours**

Morals, values and Ethics, Integrity, Work ethic, Service learning, Civic virtue, Respect for others, living peacefully, Caring, Sharing, Honesty, Courage, Valuing time, Cooperation, Commitment, Empathy, Self-confidence, Character, Spirituality, Introduction to Yoga and meditation for professional excellence and stress management.

UNIT II **3 hours**

Senses of Ethics, Variety of moral issues, Types of inquiry, Moral dilemmas, Moral Autonomy, Consensus and Controversy, Models of professional roles, Theories about right action, Self, interest, Customs and Religion.

UNIT -III **3 hours**

Social Experimentation, Professionals as responsible Experimenters, Codes of Ethics, A Balanced Outlook on Law.

UNIT -IV **4 hours**

Professional Rights, Employee Rights, Intellectual Property Rights (IPR) Gender inequality, causes and consequences. Discrimination, Social understandings, Women and Men in the Organization, Consequences of sexual harassment and global issues like Multinational Corporations, Environmental Ethics, Computer Ethics, Weapons Development, Professionals as Managers

Transaction Mode- Lecture, Demonstration, Video Based Teaching, Collaborative teaching, E-team teaching, Group discussion, ted talks, E team Teaching, Flipped Teaching, Quiz, Open talk, Case analysis.

SUGGESTED READINGS:-

8. Mike W. Martin and Roland Schinzinger (2003), "*Ethics in Engineering*", Tata McGraw Hill, New Delhi.
9. Govindarajan M, Natarajan S, Senthil Kumar V. S,(2004), "*Engineering Ethics*", Prentice Hall of India, New Delhi.
10. Charles B. Fleddermann (2004), "*Engineering Ethics*", Pearson Prentice Hall, New Jersey.
11. 2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins (2009) "*Engineering Ethics – Concepts and Cases*", Cengage Learning.
12. 3. John R Boatright (2003) "*Ethics and the Conduct of Business*", Pearson Education, New Delhi.
13. Edmund G Seebauer and Robert L Barry (2001), "*Fundamentals of Ethics for Scientists and Engineers*", Oxford University Press, Oxford.
14. Laura P. Hartman and Joe Desjardins (2013), "*Business Ethics: Decision Making for Personal Integrity and Social Responsibility*" Mc Graw Hill education, India Pvt. Ltd., New Delhi.

SEMESTER-III

Course Title: Operation Research

Course Code:MMH301

L	T	P	Cr
4	0	0	4

Total Hours:60

Course Learning Outcomes:

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

- Establish some real-life problems into Linear programming problem.
- Apply the simplex method to find an optimal vector for the standard linear programming problem and the corresponding dual problem
- Prove the optimality condition for feasible vectors for Linear programming problem and Dual Linear programming problem. Find optimal solution of transportation problem and assignment problem.
- Formulate and solution of linear programming model of two-person zero sum game. Solve nonlinear programming problems using Lagrange multiplier and using Kuhn-Tucker conditions

COURSE CONTENT

UNIT-I **17 hours**

Linear Programming and examples, Convex Sets, Hyperplane, Open and Closed half-spaces, Feasible, Basic Feasible and Optimal Solutions, Extreme Point & graphical methods. Simplex method, Charnes-M method, two phase method.

UNIT-II **18 hours**

Determination of Optimal solutions, unrestricted variables, Duality theory, Dual linear Programming Problems, fundamental properties of dual Problems, Complementary slackness, Unbounded solution in Primal. Dual Simplex method.

UNIT-III **13 hours**

Revised Simplex method, Transportation Problems, Balanced and unbalanced Transportation problems, U-V method, Paradox in Transportation problem, Assignment problems. Integer Programming problems, Pure and Mixed Integer Programming problems, Travelling salesman problem.

UNIT-IV **12 hours**

Game theory: Two-person zero sum game, game with mixed strategy, Dominance property.

Transaction Mode- Lecture, Demonstration, Video Based Teaching, Collaborative teaching, Group Discussion, ted talks, E team Teaching, Flipped Teaching, Quiz, Open talk, Case analysis

SUGGESTED READINGS:-

1. G. Hadley (1995), *Linear Programming*, Narosa Publishing House, 6th edition.
2. N.S. Kambo (1984),*Mathematical Programming Techniques*, Affiliated East-West Press Pvt.Ltd. New Delhi, Madras.
3. Suresh Chandra, Jayadeva, Aparna Mehra (2009),*Numerical Optimization with Applications*, Narosa Publishing House,1st edition.
4. 4. S.M. Sinha (2006*), Mathematical Programming, Theory and Methods,* Elsevier, 1st edition.
5. Suggested digital platform: NPTEL/SWAYAM/MOOCs.

Course Title: Mathematical Methods

Course Code: MMH302

L	T	P	Cr
4	0	0	4

Total Hours:60

Course Learning Outcomes:

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

- Understand Co-ordinate Transformation and orthogonal co-ordinates
- Understand Fourier series and able to apply Fourier transform
- Apply Maline and Hankel transforms
- Analyze problems based on Bessel's and Legendre's functions

COURSE CONTENT

UNIT-I **17 hours**

Curvilinear Co-ordinates: co-ordinate transformation, orthogonal co-ordinates, change of coordinates, cartesian, cylindrical and spherical coordinates, expressions for velocity and acceleration ds, dv and ds2 in orthogonal coordinates, area, volume and surface area in cartesian, cylindrical and spherical coordinates in few simple cases, gradient, divergence, curl, Laplacian in orthogonal coordinates, contravariant and co-variant components of a vector, metric coefficients and the volume element. Contravariant and co-variant components of a vector, metric coefficients and the volume element.

UNIT-II **18 hours**

Fourier Series: Periodic Functions, Euler's formulae for Fourier series, Fourier series for discontinuous functions, half range series, Parseval's identity, Fourier integral theorem.

Fourier Transform: Definition and properties, Fourier transform of some elementary functions, convolution theorem, application of Fourier transforms to solve ordinary and partial differential equation.

UNIT-III **13hours**

Mellin Transform: Definition, elementary properties, Mellin transform of derivatives, Integrals, Inverse Mellin transform, Convolution theorem, Inverse Mellin transform of two functions.

Hankel Transform: Definition, Elementary properties, Hankel transform of derivatives, Exponential functions, Inversion formula for Hankel transformation, Parseval's theorem, relation between Hankel and Laplace transform.

UNIT-IV **12hours**

Bessel's functions, Bessel function of second kind of order n, Trigonometric expansion involving

Bessel Functions, Bessel Integral, Fourier-Bessel Expansion, ber and bei function.

Legendre's associated functions and differential equation, integral expression for associated Legendre polynomial, recurrence relation for associated Legendre polynomial.

Transaction Mode- Lecture, Demonstration, Video Based Teaching, Collaborative teaching, Group Discussion, ted talks, E team Teaching, Flipped Teaching, Quiz, Open talk, Case analysis

SUGGESTED READINGS:-

1. Sneddon, I. N.(1972), *The Use of integral Transforms*, McGraw Hill.
2. Bell W. W.(2004), *Special Functions for Scientists and Engineers*, Courier Corporation.
3. Spiegel M., Lipschutz S., Spellman D.(2011), *Vector Analysis*, Schaum's Series .
4. Suggested digital platform: NPTEL/SWAYAM/MOOCs.

Course Title: Numerical Computations Using MATLAB

Course Code:MMH303

L	T	P	Cr
0	0	4	2

Total Hours:30

Course Learning Outcomes:

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

- Solve ordinary differential equations
- Perform one dimensional and two-dimensional interpolation.
- Solve non-linear equations and system of non-linear equations
- Do data analysis using curve fitting tool box

COURSE CONTENT

UNIT-I **7 hours**

Solution of first orders ordinary differential equations-simultaneous ODE-Second and higher orders ODE using ODE solvers.

UNIT-II **8 hours**

Solution of nonlinear equations –single variable using fzero function Solution of system of nonlinear equations using fsolve function

UNIT-III **8 hours**

Interpolation: One dimensional interpolation using interp1 function- Two dimensional interpolation using inter2 function

UNIT-IV **7 hours**

Data Analysis using curve fitting tool box.

Transaction Mode- Lecture, Demonstration, Video Based Teaching, Collaborative teaching, Project based learning, E-team teaching, Group

discussion, ted talks, E team Teaching, Flipped Teaching, Quiz, Open talk, Case analysis.

SUGGESTED READINGS:-

1. Rudra Pratab (2016), *Getting Started with MATLAB*, Oxford Univ. press, Seventh Edition.
2. K.Srinivasa Rao (2013), *Introduction to MATLAB*, IMRF International Publications
3. P.Nagarajan, K.Srinivasa Rao (2012)*Numerical Methods with Programs in MATLAB,* University Press, SCSVMV
4. 4.MiszaKalechman (2008) ,*Practical MATLAB-Basics for Engineers*, CRC Press,
5. D.M.Etter (1997) ,*Engineering Problems Solving with MATLAB*, Prentice Hall.
6. Suggested digital platform: NPTEL/SWAYAM/MOOCs.

Course Title: Operations Research Lab

Course Code:MMH304

L	T	P	Cr
0	0	4	2

Total Hours:30

Course Learning Outcomes:

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

- Understand how to add solver add-in in MS Excel as well as they understood an optimization tool used to determine the desired outcome
- Solve which help in finding optimization of transportation problems.
- Help in finding optimization of assignment problems.
- Explain how to use MS Excel to find the critical path for network problems and they used tree plan add-in to find the decision making problems

COURSE CONTENT

UNIT-I **7 hours**

Linear and Non-Linear Programming – Simplex method, Revised Simplex method.

UNIT-II **8 hours**

Integer Programming, Bounded variables, Dynamic programming, Non – Linear Programming.

UNIT-III **8 hours**

Transportation Problem – Maximization Problem, Minimization Problem, Unbalanced problem.

UNIT-IV **7 hours**

Assignment Problem - Maximization Problem, Minimization Problem, Unbalanced problem, Travelling Salesman Problem.

Transaction Mode- Video Based Teaching, Collaborative teaching, Project based learning, E-team teaching, Group discussion, ted talks, E team Teaching, Flipped Teaching, Quiz, Open talk, Case analysis.

Suggested Readings:-

1. G. Hadley (1995). *Linear Programming*, Narosa Publishing House, 6th edition.
2. N.S. Kambo (1984). *Mathematical Programming Techniques*, Affiliated East-West Press Pvt.Ltd. New Delhi, Madras.
1. Suresh Chandra, Jayadeva, Aparna Mehra(2009). *Numerical Optimization with Applications*, Narosa Publishing House,1st edition.
2. 4. S.M. Sinha (2006). *Mathematical Programming*, Theory and Methods, Elsevier, 1st edition.
3. Suggested digital platform: NPTEL/SWAYAM/MOOCs.

Course Title: Numerical Methods

Course Code:MMH313

L	T	P	Cr
2	0	0	2

Total Hours:30

Course Learning Outcomes:

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

- Analyze different types of errors encountered in numerical computing. Apply the knowledge of Numerical Mathematics to solve problems efficiently arising in science, engineering and economics etc.
- Utilize the tools of the Numerical Mathematics in order to formulate the real-world problems from the view point of numerical mathematics. Design, analyze and implement of numerical methods for solving different types of problems, viz. initial and boundary value problems of ordinary differential equations etc.
- Create, select and apply appropriate numerical techniques with the understanding of their limitations so that any possible modification in these techniques could be carried out in further research.
- Identify the challenging problems in continuous mathematics (which are difficult to deal with analytically) and find their appropriate solutions accurately and efficiently.

COURSE CONTENT

UNIT-I **7 hours**

Solution of algebraic and transcendental equations: Bisection method, Newton's Raphson method.

UNIT-II **8 hours**

Gauss Elimination method, Gauss Jordon method, LU decomposition method, Jacobi's method, Gauss-Seidal method, Relaxation method.

UNIT-III **8 hours**

Langrage's interpolation formula and Newton 's divided difference formulae. Numerical differentiation and integration: Formula for derivatives, Trapezoidal rule, Simpson's 1/3rd and 3/8th rules, Boole's rule and Weddle's rule.

UNIT-IV **7 hours**

Numerical solution of O.D.E.: Taylor series, Picard's method, Euler's Method, Modified Euler method, Runge-Kutta second and fourth order methods,. Finite element method.

Transaction Mode- Lecture, Demonstration,Video Based Teaching, Collaborative teaching, Group Discussion, ted talks, E team Teaching, Flipped Teaching, Quiz, Open talk, Case analysis

Suggested Readings:-

1. Conte, S.D., and Boor Carl de (1980), *Elementary Numerical Analysis- An Algorithmic Approach*, Tata McGraw Hill.
2. Atkinson, K. E. (1989), Introduction to Numerical Analysis, John Wiley.
3. Gerald, C.F., and Wheatley P.O.(1994), *Applied Numerical Analysis*, Addison Wesley.
4. Jain, M.K., Iyengar, S.R.K., and Jain, R.K. (2004), *Numerical Methods for Scientific and Engineering Computation*, New Age International Publisher.
5. Suggested digital platform: NPTEL/SWAYAM/MOOCs.

Course Title: Discrete Mathematics

Course Code: MMH314

L	T	P	Cr
2	0	0	2

Total Hours:30

Course Learning Outcomes:

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

- Implement the basic principles of fluid mechanics, such as Lagrangian and Eulerian approach, conservation of mass etc.
- Use Euler and Bernoulli's equations and the conservation of mass to determine velocity and acceleration for incompressible and inviscid fluid.
- Acquired the concept of rotational and irrotational flow, stream functions, velocity potential, sink, source, vortex etc.
- Analyze simple fluid flow problems (flow between parallel plates, flow through pipe etc.) with Navier - Stoke's equation of motion. Understand the phenomenon of flow separation and boundary layer theory.

COURSE CONTENT

UNIT-I **7 hours**

Relations and Functions: Binary relations, equivalence relations and partitions, partial order relations, inclusion and exclusion principle, Hasse diagram, Pigeon hole principle. Mathematical Logic: Basic logical operations, conditional and bi-conditional Statements, tautologies, contradiction, quantifiers, prepositional calculus

UNIT-II **8 hours**

Mathematical Logic: Basic logical operations, conditional and bi-conditional Statements, tautologies, contradiction, quantifiers, prepositional calculus.

UNIT-III **7 hours**

Trees and Colouring of the graph: Rooted tree, search tree, tree traversals, spanning trees, minimal spanning trees, Kruskal's algorithm. Chromatic number, four-colour problem,chromatic polynomials.

UNIT-IV **8 hours**

Grammar and Languages: Phrase structure grammars, rewriting rules, derivation sentential forms, language generated by grammar, regular, context free and context sensitive grammar and languages.

Transaction Mode- Lecture, Demonstration,Video Based Teaching, Collaborative teaching, Group Discussion, ted talks, E team Teaching, Flipped Teaching, Quiz, Open talk, Case analysis

SUGGESTED READINGS:-

1. Trambley, J.P. and Manohar,R. (2017), Discrete Mathematical Structure with Applications to computer science. McGraw Hill Education.
2. Balakrishan, V. K. (2000), Introductory Discrete Mathematics. Dover Books on Computer Science.
3. Johnsonbaugh, R. (2007), *Discrete Mathematics*. Pearson.
4. Rosen, K. (2019), *Discrete Mathematics And its Application.* McGraw Hill.
5. Suggested digital platform: NPTEL/SWAYAM/MOOCs.

Course Title: Measurement and Evaluation

Course Code:MMH315

L	T	P	Cr
2	0	0	2

Total Hours:30

Course Learning Outcomes:

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

- Develop an assessment plan that is constructively aligned with learning outcomes and teaching and learning activities.
- Design a comprehensive evaluation plan for educational processes and products.
- Utilize key concepts in measurement and evaluation to analyze and critique assessment and evaluation reports.
- Appraise the body of research in evaluation that supports and informs the practice of teaching and learning.

COURSE CONTENT

UNIT-I **8 hours**

Measurement and evaluation: concept, need, scope; difference and relevance. Educational testing and assessment: concept, context, issues and current trends. Scales of measurement: ordinal, nominal, interval, ratio.

UNIT-II **7 hours**

Characteristics of a good test. Planning for different types of test. Validity-- types and methods and usability. Reliability-- types and methods and usability

UNIT-III **7 hours**

Test construction. Test standardization. Item analysis: Item difficulty, discrimination index. Effectiveness of distracters. Development of Norms of a test.

UNIT-IV **8 hours**

Criterion referenced test, Norm reference test, Factors influencing test scores: nature of test, psychological factors and environmental factors.

Transaction Mode- Lecture, Demonstration,Video Based Teaching, Collaborative teaching, Group Discussion, ted talks, E team Teaching, Flipped Teaching, Quiz, Open talk, Case analysis

SUGGESTED READINGS:-

1. Robert. Linn (2009), *Measurement and assessment in teaching,* Pearson education India.
2. Herman Hennry, (1988), *A practical introduction to measurement and evaluation*. Wiley Series.
3. David D Williams, (1998), *Online assessment Measurement and evaluation,* Vol-II (7th Ed.).
4. Deniel, W.W. (1999), *An Introduction to Educational Assessment Measurement and Evaluation*.Books/Cole.

Course Title: Reasoning and Quantitative Aptitude

Course Code:MMH316

L	T	P	Cr
2	0	0	2

Total Hours:30

Course Learning Outcomes:

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

- Use Concepts that will help not just to crack the competitive exams but everywhere in mathematical reasoning.
- Use skills that are required to help students to develop mathematically and allow them to think critically
- Derive all to make sense of the world in which we live as we go about our daily lives.
- Increase Speed and accuracy in Maths questions

COURSE CONTENT

UNIT-I **7 hours**

Reasoning:-Blood Relations, Syllogism, Coding-Decoding, Directions, Non-Verbal Series

UNIT-II **7 hours**

Clocks & Calendars, Number Ranking, Decision Making, Analogy, Statements & Arguments

UNIT-III **8 hours**

Quantitative Methods:-Simplification ,Ratio and Proportion, Problems on H.C.F and L.C.M., Banker's Discount, Partnership

UNIT-IV **8 hours**

Decimal Fraction, Pipes and Cistern, Problems on Ages, Time and Distance, Logarithm, Allegation or Mixture, Probability

Transaction Mode- Video Based Teaching, Collaborative teaching, Group Discussion, ted talks, E team Teaching, Flipped Teaching, Quiz, Open talk, Case analysis

SUGGESTED READINGS:-

1.Sijwali,B. S. and Sijwali, I. (2020), A New Approach to Reasoning Verbal, Non-Verbal & Analytical, Kindle Edition.

2.Aggarawal R. S., S. Chand Publishing (2017), Quantitative Aptitude for Competitive Examinations Revised edition, 2017.

3. Verma R. (2018), Fast Track Objective Arithmetic, Arihant Publications, Fourth edition.

4. Guha A.(2016), Quantitative Aptitude for All Competitive Examinations McGraw Hill Education, Sixth edition.

Course Title: Topology

Course Code:MMH305

L	T	P	Cr
4	0	0	4

Total Hours:60

Course Learning Outcomes:

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

- Understand interior, closure, and boundary points, limit points of subsets and basis and sub basis of topological spaces. Check whether a collection of subsets is a basis for a given topological spaces or not, and determine the topology generated by a given basis.
- Analyse the continuous maps between two spaces and maps from a space into product space and determine common topological property of given two spaces.
- Understand the connectedness and path connectedness of the product of an arbitrary family of spaces.
- AnalyzeHausdorff spaces using the concept of net in topological spaces and learn about 1st and 2nd countable spaces, separable and Lindelof spaces. Understand Urysohn's lemma, Tietze's extension theorem, Urysohn'smetrization theorem.

COURSE CONTENT

UNIT - I **14 hours**

Topological spaces, basis and sub basis, ordered topology, quotient topology, product topology, Limit points, adherent points, Derived sets, Closure, interior, exterior and boundary points of a set, subspace.

UNIT - II **14 hours**

Continuity, homeomorphism, countability axioms, first and second countable spaces, Separable

Space Connectedness: connected sets, component, path component, local connectedness, disconnected sets, Totally Disconnected sets, locally connected spaces.

UNIT - III **16 hours**

Compact spaces; limit point compact and sequentially compact spaces, local compactness and one point compactification, finite product of compact spaces, Tychonoff's theorem (without proof).

UNIT-IV **16 hours**

Separation axioms (T0, T1, T2, T3 spaces, Regular space, completely regular spaces, Normal spaces), their characterizations and basic properties, Urysohn's lemma, Statement of Tietze's extension theorem, statement of Urysohn'smetrization theorem.

Transaction Mode- Lecture, Demonstration,Video Based Teaching, Collaborative teaching, Group Discussion, ted talks, E team Teaching, Flipped Teaching, Quiz, Open talk, Case analysis

SUGGESTED READINGS:-

1. James R. Munkers (2002), *Topology. Second* Edition. Prentice Hall of India.
2. Singh T.B. (2013), Elements of Topology, CRC Press, Taylor & Francis.
3. John L. Kelley(2004), *General Topology*. Dover Publications.
4. Willard S. (2004) ,General Topology, Dover Publications.
5. Bourbaki N. (1995), *General Topology* . Springer-Verlag Berlin Heidelberg.
6. Simmons, G, F. (1983), *Introduction to Topology and Modern Analysis* .McGraw Hill, New York.

7. E.T. Copson. (1968), *Metric Spaces*. Cambridge University Press.
8. S. Willord. (2012) ,*General Topology*. Addison Wesley Publishing Company.
9. Suggested digital platform: NPTEL/SWAYAM/MOOCs.

Course Title: Advanced Operation Research

Course Code:MMH306

L	T	P	Cr
4	0	0	4

Total Hours:60

Course Learning Outcomes:

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

- Understand and use quantitative methods and technique for effective decision making.
- Remember model formulation and apply them in solving business.
- Understand sensitivity analysis and applications of linear programming.
- Evaluate problem related to inventory using appropriate inventory models.

COURSE CONTENT

UNIT - I **14 hours**

Sensitivity Analysis & Integer Linear Programming: Introduction of Sensitivity Analysis, Change in Objective function coefficient, Change in availability of resources, Addition of new variable and new constraint. Introduction to Integer Linear Programming, Gomory's all integer cutting plane method, Gomory's mixed-integer cutting plane method, Branch and bound method, Application of Zero-One integer Programming.

UNIT - II **14 hours**

Dynamic Programming: Bellman's Principle of optimality of Dynamic Programming, Multistage decision problem and its solution by Dynamic Programming with finite number of stages, Solution of linear programming problems as a Dynamic Programming problem.

UNIT - III **16 hours**

Inventory control models: Economic order quantity (EOQ) model with uniform demand, EOQ when shortages are allowed, EOQ with uniform replenishment, Inventory control with price breaks.

UNIT-IV **16 hours**

CPM and PERT: Common errors in network drawing, Rules for network construction, Fulkerson's Rule, Float and Network diagram, PERT computation, Critical Path Analysis, Estimation of Project Completion Time, Project crashing.

Transaction Mode- - Lecture, Demonstration,Video Based Teaching, Collaborative teaching, Group Discussion, ted talks, E team Teaching, Flipped Teaching, Quiz, Open talk, Case analysis

SUGGESTED READINGS:-

1. 1 Sharma, J.K.*(2007) , Mathematical Model in Operation Resear*ch, Tata McGraw Hill. S
2. Hillier S. and Lieberman G. J.*(2004), Introduction to Operations Research 8th edition,* Tata Mc Graw Hill, Singapore.
3. Gupta P K. and Hira D.S.(2012) , *Operations Research*. S. Chand & Co, New Delhi.
4. Satty T. L.(1983), *Elements of Queueing Theory with Application*s, Dover, NY.
5. Hadley G.(1964) , *Nonlinear and Dynamic Programming*, Addison-Wesley.
6. Suggested digital platform: NPTEL/SWAYAM/MOOCs.

Course Title: Mathematical Modelling

Course Code: MMH307

L	T	P	Cr
4	0	0	4

Total Hours:60

Course Learning Outcomes:

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

- Understand various techniques of mathematical modeling.
- Apply mathematical models in different fields and situations.
- Understand and apply mathematical modeling through partial differential equations.
- Analyze Stochastic models and their needs.

COURSE CONTENT

UNIT-I **16 hours**

Introduction and the technique of mathematical modeling, Classification and characteristics of mathematical models, Mathematical modeling through algebra, Effects of Immigration and Emigration on Population size, decrease of temperature, Diffusion, Change of price of a commodity, Logistic law of population growth, A simple compartment models, Diffusion of glucose or a Medicine in the blood stream.

UNIT-II **15 hours**

Mathematical modelling of epidemics, A simple epidemics model, A susceptible-infected-susceptible (SIS) model, SIS model with constant number of carriers, Simple epidemic model with carriers, Model with removal, Model with removal and immigration, Mathematical modeling in economics, Mathematical modeling in medicine, A model for diabetes mellitus, Arms race and battles: Richardson model for arms race, Lamechester combat model.

UNIT-III **14 hours**

Mathematical modeling through partial differential equations: Mass-balance Equations, Momentum balance Equations, Variational principles, Probability generating function, Modeling for traffic on a highway.

UNIT-IV **15 hours**

Stochastic models of population growth, Need for stochastic models, Linear birth-death-immigration emigration processes, Linear birth-death process, Linear birth-death-immigration process, Linear birth-death-emigration process, Non-linear birth-death process.

Transaction Mode- Lecture, Demonstration,Video Based Teaching, Collaborative teaching, Group Discussion, ted talks, E team Teaching, Flipped Teaching, Quiz, Open talk, Case analysis

SUGGESTED READINGS:-

1. Burghes D.N. and Wood A.D.(1980), *Mathematical Models in the Social, Management and Life Sciences,* John Wiley and Sons.
2. Andrews J.G. and Mclone R.R.(1976), *Mathematical Modeling,* Butterworths (Pub.) Inc.
3. Suggested digital platform: NPTEL/SWAYAM/MOOCs.

Course Title: Advanced Group Theory

Course Code: MMH308

L	T	P	Cr
4	0	0	4

Total Hours:60

Course Learning Outcomes:

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

- Define solvable groups, nilpotent groups.
- Derive upper and lower central series, derived series and representation of linear groups
- Reason mathematically, to write simple proofs, and can judge when an attempted proof in group theory is correct and complete.
- Reason mathematically, to write simple proofs, and can judge when an attempted proof in group theory is correct and complete.

COURSE CONTENT

UNIT-I **16 hours**

The Orbit Stablizer Theorem: Stablizer, Orbit, A group with p^2elements, Simplicity of An, $n\geq$, Classification of Groups with at most 8 elements, **Sylow Theorems:** Sylow theorems (with proofs), Applications of Sylow Theory.

UNIT-II **15 hours**

Products in Groups: Direct Products, Classification of Finite Abelian Groups, Characteristic and fully invariant subgroups, Normal products of groups, Holomorph of a group.

UNIT-III **14 hours**

Series in Groups: Series in groups, Zassenhaus lemma, Normal series and their refinements, Composition series, The Jordan Holder Theorem, **Solvable**

Groups: Solvable groups, Definition and examples, Theorems on solvable groups.

UNIT-IV **15 hours**

Nilpotent Groups: Characterisation of finite nilpotent groups, Frattini subgroups.

Linear Groups: Linear groups, types of linear groups, Representation of linear groups, The projective special linear groups

Transaction Mode- Lecture, Demonstration,Video Based Teaching, Collaborative teaching, Group Discussion, ted talks, E team Teaching, Flipped Teaching, Quiz, Open talk, Case analysis

SUGGESTED READINGS:-

1. J. Rotman (1995), *The Theory of Groups*, Springer- Verlag, New York.
2. J. B. Fraleigh (2003), *A First Course in Abstract Algebra*,Addison-Wesley Publishing Co.
3. J. A. Gallian (1998), *Contemporary Abstract Algebra*, Narosa.
4. I.N. Herstein (1975), *Topics in Algebra*, John Wiley and Sons.
5. J. S. Rose (1994), *A Course on Group Theory*, Dover Publications.
6. Humphreys, John F. (2004), *A Course on Group Theory*, Oxford University Press.
7. Suggested digital platform: NPTEL/SWAYAM/MOOCs.

Course Title: Fuzzy Sets and Applications

Course Code:MMH309

L	T	P	Cr
4	0	0	4

Total Hours:60

Course Learning Outcomes:

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

- Gain the main subject of fuzzy sets, learn crips and fuzzy set theory and decide the difference between crips set and fuzzy set theory.
- Make calculation on fuzzy set theory, gain the methods of fuzzy logic, recognize fuzzy logic membership function and fuzzy inference systems and make applications on Fuzzy logic membership function and fuzzy inference systems.
- Gain the main subject of fuzzy sets, learn crips and fuzzy set theory and decide the difference between crips set and fuzzy set theory.
- Get theory of the statistics fuzzy logic theory together and evaluate fuzzy statistics applications.

COURSE CONTENT

UNIT-I **15 hours**

Classical Sets and Fuzzy Sets: Overview of Classical Sets, Membership Function, a-cuts,

Properties of a-cuts, Decomposition Theorems, Extension Principle.

Operations on Fuzzy Sets: Compliment, Intersections, Unions, Combinations of operations,

Aggregation Operations.

UNIT-II **12 hours**

Fuzzy Arithmetic: Fuzzy Numbers, Linguistic Variables, Arithmetic Operations on intervals
and Numbers, Lattice of Fuzzy Numbers, Fuzzy Equations.

UNIT-III **16 hours**

Fuzzy Relations: Crisp and Fuzzy Relations, Projections and Cylindric Extensions, Binary
Fuzzy Relations, Binary Relations on single set, Equivalence, Compatibility and Ordering
Relations, Morphisms, Fuzzy Relation Equations.

UNIT-IV **17 hours**

Possibility Theory: Fuzzy Measures, Evidence and Possibility Theory, Possibility versus
Probability Theory.

Fuzzy Logic: Classical Logic, Multivalued Logics, Fuzzy Propositions, Fuzzy Qualifiers, Linguistic Hedges.

Uncertainty based Information: Information and Uncertainty, Nonspecificity of Fuzzy and Crisp sets, Fuzziness of Fuzzy Sets. Applications of Fuzzy Logic.

Transaction Mode- Lecture, Demonstration,Video Based Teaching, Collaborative teaching, Group Discussion, ted talks, E team Teaching, Flipped Teaching, Quiz, Open talk, Case analysis

SUGGESTED READINGS:-

1. Klir G. J. and Folyger T. A. (1988), Fuzzy Sets: Uncertainty and Information, PHI.

2. Klir G. J. and Yuan B. (1995), Fuzzy sets and Fuzzy logic: Theory and Applications, PHI.
3. Zimmermann H. J. (1991), Fuzzy Set Theory and its Applications, Allied Publishers.
4. Mohan, C, (2015), An Introduction to Fuzzy Set Theory and Fuzzy Logic, M V Learning Publishers, New Delhi (INDIA) and London (UK).
5. Suggested digital platform: NPTEL/SWAYAM/MOOCs.

Course Title: Probability and Mathematical Statistics

Course Code:MMH310

L	T	P	Cr
4	0	0	4

Total Hours:60

Course Learning Outcomes:

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

- Compute the probabilities of composite events using the basic rules of probability.
- Demonstrate understanding the random variable, expectation, variance and distributions. Explain the large sample properties of sample mean.
- Apply the concept of the sampling distribution of a statistic, and in particular describe the behaviour of the sample mean.
- Analyze the correlated data and fit the linear regression models. Demonstrate understanding the estimation of mean and variance and respective one-sample and two-sample hypothesis tests.

COURSE CONTENT

UNIT-I **16 hours**

Measures of variability of data: Central and non-central moments, Sample and Population variance. Skewness and Kurtosis.

Correlation & Regression Analysis: Scatter diagram. Karl Pearson's and Spearman's rank correlation coefficient. Linear Regression and its properties. Multiple Regression, Partial and multiple correlation. Theory of attributes. Modes of convergence and their interrelationships, law of large numbers, central limit theorem.

UNIT-II **16 hours**

Random Variables and Distributions: Discrete and Continuous random variables. Probability mass function and Probability density function. Cumulative distribution function. Expectation of single- and two-dimensional

random variables. Properties of random variables. Moment generating function and probability generating functions.

UNIT-III **12 hours**

Discrete Distributions: Bernoulli distribution. Binomial distribution. Poisson distribution, Negative Binomial and Hypergeometric distributions. Uniform.

UNIT-IV **16 hours**

Continuous Distributions: Normal distribution. Normal approximation to Binomial and Poisson distributions. Beta, Gamma, Chi-square and Bivariate normal distributions. Sampling distribution of mean and variance (normal population). Chebyshev's inequality, weak law of large numbers, Central limit theorems.

Transaction Mode- Lecture, Demonstration,Video Based Teaching, Collaborative teaching, Group Discussion, ted talks, E team Teaching, Flipped Teaching, Quiz, Open talk, Case analysis

SUGGESTED READINGS:-

1. Goon, A.M., Gupta, M.K., Dasgupta, B. (1998), *Fundamentals of Statistics*, Vol-I & Vol-II . 7th Ed.
1. Sheldon Ross. (2002), A First Course in Probability, 6th edition, Pearson Education Asia.
2. Meyer, P.L. (1970), *Introductory Probability and Statistical Applications.* Generic Publisher.
3. Hogg, R.V. and Craig, T.(2002), *Introduction to Mathematical Statistics.* MacMillan.
4. Suggested digital platform: NPTEL/SWAYAM/MOOCs.

Course Title: Special Function

Course Code:MMH311

L	T	P	Cr
4	0	0	4

Total Hours:60

Course Learning Outcomes:

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

- Understand the general properties of Hypergeometric series, functions and their linear relationship.
- Explain methods of studying Legendre's function, recurrence relation and their applications.
- Solve Bessel's linear differential equations from application point of view.
- Explore, formulate and solve this concept in real life situation.

COURSE CONTENT

UNIT-I **16 hours**

Hypergeometric Functions: The hypergeometric series, An integral formula for the hypergeometric series, The hypergeometric equation, Linear relations between the solutions of the hypergeometric equation, Relations of contiguity, The confluent hypergeometric function, Generalised hypergeometric series.

UNIT-II **14 hours**

Legendre Functions: Legendre polynomials, Recurrence relations for the Legendre polynomials, The formulae of Murphy and Roderigues, Series of Legendre polynomials, Legendre's differential equation, Neumann's formula for the Legendre functions, Recurrence relations for the functions Qn (μ).

UNIT-III **13 hours**

The use of Legendre functions in potential theory, Legendre's associated functions, Integral expression for the associated Legendre function, Surface spherical harmonics, Use of associated Legendre functions in wave mechanics.

UNIT-IV **17 hours**

Bessel Functions: The origin of Bessel functions, Recurrence relations for the Bessel coefficients, Series expansions for the Bessel coefficients, Integral expressions for the Bessel coefficients, The addition formula for the Bessel coefficients, Bessel's differential equation, Spherical Bessel functions, Integrals involving Bessel functions, The modified Bessel functions, The Ber and Bei functions, Expansions in series of Bessel functions, The use of Bessel functions in potential theory, Asymptotic expansion of Bessel functions.

Transaction Mode- Lecture, Demonstration,Video Based Teaching, Collaborative teaching, Group Discussion, ted talks, E team Teaching, Flipped Teaching, Quiz, Open talk, Case analysis

SUGGESTED READINGS:-

1. L. Andrews, (1985), *Special Functions for Engineers and Applied Scientists*, Macmillan.
2. N. N. Lebedev, (1976), Special Functions & Their Applications, Revised Edition, Dover.
3. W. W. Bell,(1968), Special Functions for Scientists and Engineers, Dover.
4. Sao, G.S.(2020), *Special functions,* Shree shiksha Sahitya Parkasham , Meerut.
5. Dhaonchak,P.K.(2016), *Special function and Integral functions,* Jeevan sons Publications.

6. Suggested digital platform: NPTEL/SWAYAM/MOOCs.

Course Title: Integral Transforms and Their Applications

Course Code:MMH312

L	T	P	Cr
4	0	0	4

Total Hours:60

Course Learning Outcomes:

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

- Familiar with the notation and terminology related to differential equations, Laplace Transform, Fourier Transform.
- Differentiate between ODE and PDE, know the methods to solve differential equations and be able to solve ODE and PDE of special type.
- Understand the utility of Laplace Transform and Fourier series in solving PDE.
- Integrate and differentiate the Hankel transform and Fourier transform functions and examine the theory of integral equations.

COURSE CONTENT

UNIT-I **16 hours**

Laplace Transforms: Definition and examples, Existence theorem and basic properties, Convolution theorem and properties of convolution, Differentiation and Integration of Laplace transform, the inverse Laplace transform and examples, Tauberian theorems for Laplace transforms and Watson's Lemma, Laplace transforms of fractional integrals and fractional derivatives.

UNIT-II **16 hours**

Applications of Laplace Transform to solve/evaluate: Ordinary and partial differential equations, Initial and boundary value problems, Integral equations, Definite integrals, Difference equations and Differential-difference equations.

Finite Laplace Transforms: Definition and examples, Basic operational properties, Applications, Tauberian theorems for finite Laplace transforms.

UNIT-III **12 hours**

Hankel Transforms: Definition and examples, operational properties, Applications to solve partial differential equations. Fourier Transforms: Fourier Integral formulas, Definition and examples, Basic properties, Fourier cosine and sine transforms and examples, Basic properties of Fourier cosine and sine transforms, Multiple Fourier transforms.

UNIT-IV **16 hours**

Applications of Fourier Transform to solve/evaluate: Ordinary and Partial differential equations, Integral equations, Definite integrals. Applications of Multiple Fourier transform. Finite Fourier Cosine and Sine Transforms: Definition and examples, Basic properties, Applications, Multiple finite Fourier transforms and their applications. Mellin Transforms: Definition and examples, Basic operational properties and Applications.

Transaction Mode- Lecture, Demonstration, Video Based Teaching, Collaborative teaching, Group Discussion, ted talks, E team Teaching, Flipped Teaching, Quiz, Open talk, Case analysis

SUGGESTED READINGS:-

1. LoknathDebnath(1995), *Integral Transforms and Their Applications*, CRC Press, Inc.
2. P.P.G. Dyke (2001) *An Introduction to Laplace Transforms and Fourier Series*, Springer-Verlag, London.
3. Austin Keane (1965), *Integral transforms*, Science Press.
4. Brian Davies (2001), *Integral Transforms and their Applications*, 3rd Edition, Springer-Verlag, New York, Inc.

5. Suggested digital platform: NPTEL/SWAYAM/MOOCs.

SEMESTER-IV

Course Title: Innovative Research Project

Course Code:MAT401

L	T	P	Cr
0	0	40	20

Guidelines for Dissertation:

The purpose of the dissertation in M.Sc. 4th semester is to introduce **research methodology** to the students. It may consist of review of some research papers, development of a laboratory experiment, fabrication of a device, working out some problem related to subject, participation in some ongoing research activity, analysis of data, etc. The work can be carried out in any thrust areas of subject (Experimental or Theoretical) under the guidance of allotted supervisor of the department. The students must submit their dissertation in the department as per the date announced for the submission**.**
Internal assessment of the dissertation work will be carried out by respective supervisor through
power point presentation given by candidates during the semester. External assessment of the dissertation work will be carried out by an external examiner (nominated by the Chairperson of the Department) through power-point presentation given by candidates. This load (equivalent to 2 hours per week) will be counted towards the normal teaching load of the teacher.
1. Dissertation will contain a cover page, certificate signed by student and supervisor, table of contents, introduction, Objective, Literature review, methodology, results and discussions, conclusion, and references.
- The paper size to be used should be A-4 size.
- The font size should be 12 with Times New Roman.
- The text of the dissertation may be typed in 1.5 (one and a half) space.

● The print out of the dissertation shall be done on both sides of the paper (instead of single side printing)

● The total no. of written pages should be between 40 to 60 for dissertation.

2. The candidate shall be required to submit two soft bound copies of dissertation along with a CD in the department as per the date announced.

3. Dissertation will be evaluated internally by the supervisor allotted to the student during the semester.

4. The candidate will defend her/his dissertation/project work through presentation before the

External examiner at the end of semester and will be awarded marks.

5. In case, a student is not able to score passing marks in the dissertation exam, he/she will have to resubmit her/his dissertation after making all corrections/improvements & this dissertation shall be evaluated as above. The candidate is required to submit the corrected copy of the dissertation in hardbound within two weeks after the viva -voce.

Transaction Mode- Video Based Teaching, Collaborative teaching, Group Discussion, ted talks, E team Teaching, Flipped Teaching, Quiz, Open talk, Case analysis.