UNIVERSITY OF KASHMIR, SRINAGAR
HAZRATBAL, SRINGAR-190006

NOTIFICATION

It is notified for the information of all the concerned that the Vice-Chancellor ,in anticipation of the approval of the Competent Body, has authorized prescription of Syllabi (1st to 6th Semester) and course of study for Five (5) **Year Integrated Masters Programme in Mathematics** offered at Jammu Kashmir Institute of Mathemtical Science(**JKIMS**), affiliated with University of Kashmir, under NEP-2020 guidelines for its implementation to the batch 2024 and onwards.

Assistant Registrar
(ACADEMIC)
13/2/25
13/2/25
13/2

No F(Pres-Syllabi-JKIMSAcad/KU/25
Dated: 13-02-2025

Copy to the:-

1. Dean Academic Affairs, University of Kashmir,
2. Dean ,School of Applied and Mathematical Science , University of Kashmir,
3. Controller of Examinations, University of Kashmir,
4. Head, Department of Mathematics, University of Kashmir,
5. Director, JKIMS ,
6. Assistant Registrar/Controller of Examinations/Secrecy/Tabulation/UG, Exams, University of Kashmir, Srinagar.

Post-Graduate Department of Mathematics

NAAC Accredited Grade "A+"

UNIVERSITY OF KASHMIR, SRINAGAR.

NOTES :

*No:*_____

*Dated*_____

Minutes of the Meeting

Meeting: Board of Studies in Mathematics
Date: November 8, 2024 **Time:** 11.00AM
Venue: Department of Mathematics, University of Kashmir, Srinagar.

Members participated:

01	Prof. MA Khanday, HOD Mathematics, KU	Chairman	09	Prof. Tariq A Shikari Director JKIMS	Member
02	Prof. S. Pirzada	Member	10	Dr. Nisar Ahmad Lone, JKIMS	Member
03	Prof. MA Mir	Member	11	Prof. Tariq A Chishti Mathematics, CDOE, KU	Member
04	Prof. Gowhar Bashir, HOD Physics, KU	Member	12	Prof. Mushtaq A Sidiqi Chief Coordinator NEP Cell	Co-opted Member
05	Prof. Iffat Maqbool HOD, English, KU	Member	13	Prof. M. Ashraf, Ex. Principal	Co-opted Member
06	Dr. Zamrooda Jabeen HOD, NIT Srinagar	Member	14	Dr. Azeem u Shan Banday Physics, JKIMS	Co-opted Member
07	Dr. Javaid Iqbal HOD, Computer Sciences, KU	Member	15	Prof. Saika Mumtaz Computer Sciences, JKIMS	Co-opted Member
08	Mr. Nayied Ahmad Naveed	Scholar	16	Mr. Ummer Mushtaq	Scholar

Agenda: Designing the Curriculum and Syllabus for **5-Year Integrated Course in Mathematics under NEP-2020** taught at JKIMS, Srinagar for the academic year 2024 and onwards.

The meeting commenced with a warm welcome from **Prof. MA Khanday**, Chairman of the Board of Postgraduate Studies. The Chairman expressed gratitude to all the members for attending the meeting to discuss the design and structure of the 5-Year Integrated Mathematics Course under the framework of NEP-2020. He emphasized the importance of developing a comprehensive syllabus that aligns with the current trends in mathematical research and its applications in other disciplines. The primary objective is to provide students with a strong foundation in both pure and applied mathematics while ensuring that the curriculum remains flexible and adaptive to future advancements in the field. The course will span five years, culminating in a Master's degree in Mathematics, and will consist of a combination of Major/Minor courses, Multidisciplinary courses, Ability Enhancement courses, Value Added Courses, Skill Enhancement Courses, practical components, and internships.

Detailed Discussion on Course Structure was held and it was agreed that initially the structure and syllabus for only 3 years (six semesters) shall be framed to cover essential topics in Pure Mathematics, Applied Mathematics, and Computational Mathematics. Some of the primary areas discussed included on the basis of the members consensus, were Calculus, Mathematical Analysis, Linear Algebra, Abstract Algebra, Differential Equations, Probability Theory, Numerical Analysis, Operations Research, Discrete Mathematics, Topology, Mathematical Modeling etc. In addition, the courses from Physics and Computer Sciences were added as minor courses. Updation of electives regularly to reflect emerging mathematical applications and relevance needs were discussed.

- **Ability Enhancement Courses (AEC):**
  - Courses like Communication Skills and Quantitative Techniques were suggested to enhance students' presentation and problem-solving skills.

Dr. Javaid Iqbal

Prof MA Khanday

Prof. Mushtaq A. Sidiqi

Prof. T. Ashraf

S. Pirzada

Prof Gowhar Bashir

Prof TA Chishti

Prof MA Mir

Prof. Zamrooda Jabeen

Dr. Azeem u shan Banday

PROF. IFFAT MAQ

NOTES :

*No:*_____

*Dated*_____

- It was proposed that students should also engage in workshops, seminars, and research presentations as part of these courses.

- **Multi-Disciplinary Courses (MDC):**
  - A requirement for multi-disciplinary courses was emphasized. Suggested areas include:
    - Computer Science and Programming (as many mathematical problems require computational tools).
    - Physics (to apply mathematical concepts in modeling physical phenomena).

- **Practical Components, Skill and Internships:**
  - It was also stressed the importance of incorporating practical components, Skill courses, internships and research projects.
    - The skill courses can help the students to improve hands-on skills such as Mathematical Computing, Data Visualization, and Mathematical Programming.
    - An internship in the 5th semester will allow students to apply mathematical theories to real-world scenarios, particularly in industries, research institutions, or NGOs.
    - Students will be required to submit a report on their internship experience, which will be evaluated by external examiners.
    - Research projects shall be incorporated in the final year of the course, enabling students to work on advanced topics with faculty supervision.

Recommendations:

After reviewing the draft curriculum and syllabus, the Board Members unanimously recommended that the curriculum and syllabus for the first 3 years (6 Semesters) be approved for implementation starting from the academic year 2024 and onwards [see Annexure-I].

The meeting terminated with a vote of thanks.

Signatures of the members

Prof. MA Khanday — Prof. S. Pirzada — Prof. MA Mir — Prof. Tariq A Shikari

Dr. Nisar A Lone — Prof. Gowhar Bashir — Prof. Iffat Maqbool — Prof. Tariq A Chishti

Dr. Javaid Iqbal — Prof. Mushtaq A Sidiqi — Prof. M. Ashraf — Dr. Zamrooda Jabeen

Dr. Azeem u Shan (Co-opted Member) JKIMS — Prof. Saika Mumtaz (Co-opted Member) JKIMS — Mr. Nayied Ahmad Naveed Scholar (Senior) — Mr. Ummer Mushtaq Scholar (Senior)

Chairman

Annexure to Notification No.Fc/Res-Syllabi-JKIMS)Acad/KU/25 Dated: 13-02-2025

JAMMU KASHMIR INSTITUTE OF MATHAMTICAL SCIENCES-JKIMS

Amar Singh College, Srinagar

Affiliated With

UNIVERSITY OF KASHMIR

Hazratbal Srinagar-190006, Jammu and Kashmir, India

Members of Board of Studies: 5-Year Integrated Master's Programme (FYIMP) in Mathematics

Dr. Mukhtar A. Khanday Professor & Head Department of Mathematics University of Kashmir, Srinagar (Chairman)	**Dr. S. Pirzada** Professor Department of Mathematics University of Kashmir, Srinagar (Member)	**Dr. M. Abdullah Mir** Professor Department of Mathematics University of Kashmir, Srinagar (Member)	**Prof. Tariq Ahmad Shikari** Director, JKIMS, Srinagar (Member)
Dr. Gowhar Bashir Vakil Professor HOD, Department of Physics University of Kashmir, Srinagar (Member)	**Dr. Iffat Maqbool** Professor HOD, Department of English University of Kashmir, Srinagar (Member)	**Dr. Javaid Iqbal** Associate Professor & HOD Department of Computer Sciences University of Kashmir, Srinagar (Member)	**Dr. Nisar A. Lone** Sr. Assistant Professor JKIMS, Srinagar (Member)
Dr. M. H. Gulzar Ex. Professor Department of Mathematics University of Kashmir, Srinagar (Co-Opted Member)	**Dr. Tariq A Chisti** Professor (Mathematics) Directorate of Distance Education University of Kashmir, Srinagar (Co-Opted Member)	**Dr. H. R. Bhapkar** Associate Professor HOD, Mathematics Central University of Kashmir (Member)	**Dr. Zamrooda Jabeen** HOD, Mathematics NIT Srinagar (Member)
Prof. M. Ashraf Shah Ex. Principal, JK Higher Education Department (Co-Opted Member)	**Prof. Mushtaq Ahmad Sidiqi** Chief Coordinator NEP Cell University of Kashmir, Srinagar (Co-Opted Member)	**Prof. Saika Mumtaz, Computer sciences,** JKIMS **Dr. Azeem u Shan Banday,** Physics JKIMS Scholar	**Mr. Nayied Ahmad Naveed** Sr. Research **Mr. Ummer Mushtaq** Sr. Research Scholar

Venue of the BoS Meeting: Department of Mathematics, University of Kashmir, Srinagar-190006
Date of Meeting: November 8, 2024

Brief information about regulations, structure and evaluation system

The design and structure in the proposed system ensures that students receive a comprehensive education, with a strong emphasis on both theoretical understanding and practical skills. The evaluation model encourages active learning, group engagement, and consistent internal assessments.

1. **Programme Structure**:
   The students enrolled for 5-Year Integrated Course in Mathematics shall be awarded degree strictly in accordance with the statutes issued by the University vide No. F(Statues-Integrated-Program)/Acad/KU/24 Dated: 25.07.2024.

2. The academic programme includes a combination of **Major**, **Minor**, **Ability Enhancement Courses (AEC)**, **Multi-Disciplinary Courses (MDC)**, **Value Added Courses (VAC)**, and **Skill Enhancement Courses (SEC)**.
   - For the **3-Year Degree Programme**, a minimum of **120 credits** is required, and for the **5-Year Degree Programme**, a minimum of **160 credits** is required.
   - **50% of the courses** must be completed from the Major category, and at least 12 credits from Minor courses, ensuring a strong focus on the primary subject area.
3. The **internship** in the **5th semester** is designed to provide **experiential learning** by allowing students to work in a **recognized organization, institute, or industry**. The main goal is to encourage students to apply **mathematical concepts** in solving real-life problems.
   - The mentor shall guide the students, and provide them specific problems to solve and helping them apply theoretical knowledge to practical scenarios.
   - The mentor provides continuous **support and feedback** to help the student in identifying the problem and connect other organizations to improve their problem-solving skills and learn how to effectively approach complex tasks.

   Internship Topics:
   - These internship topics in **Mathematical Modeling** and **Operations Research** provide a wide range of applications for students to develop practical problem-solving skills. They involve applying mathematical models, optimization techniques, and decision-making processes to improve efficiency, reduce costs, and make informed decisions across various industries. Some of the topics are given below, but it will not remain confined to these topics only.
   - After the completion of the Internship, the students shall submit a report and the evaluation of external marks shall be based on quality of the resport along with viva-voce.

   - ***<u>The mentors at the JKIMS along with the external mentors at organization/Institute/Industry etc shall coordinate, decide and assign the topic of interest to the student(s) based on their exprtise and availability of infrastructure/resources.</u>***

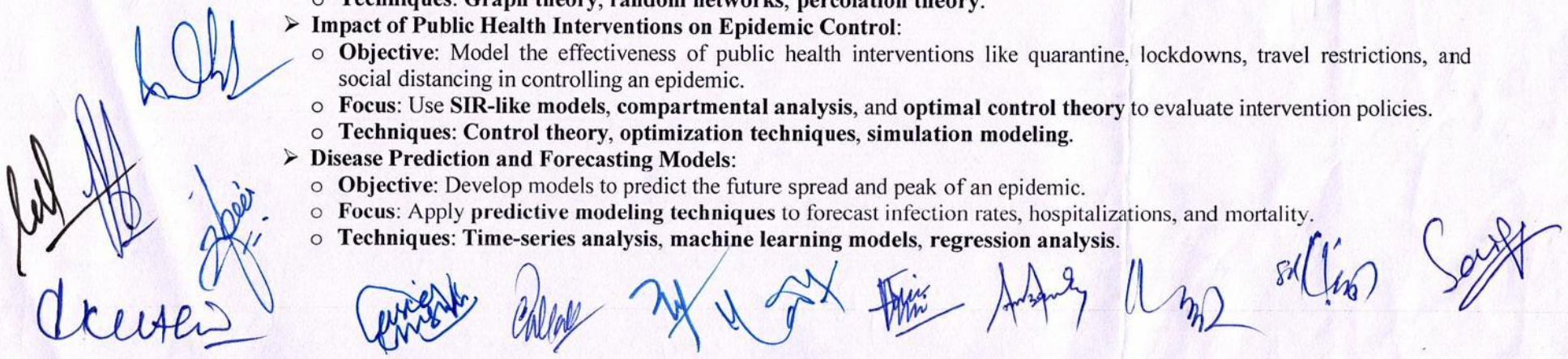
   <u>(Suggested topics)</u>

   - **Optimization in Supply Chain and Logistics**:
     - **Objective**: Develop mathematical models to optimize inventory, transportation, and distribution networks.
     - **Focus**: Using techniques like **linear programming (LP)**, **network flow models**, and **queuing theory** to minimize transportation costs and improve delivery efficiency.

- **Energy Consumption Optimization**:
  - **Objective**: Model energy consumption patterns for residential or industrial sectors and optimize energy usage.
  - **Focus**: Use **linear programming** or **integer programming** to minimize energy costs while meeting demand and environmental constraints.
- **Epidemic Spread Modeling and Control**:
  - **Objective**: Model the spread of infectious diseases (e.g., COVID-19) and develop strategies for containment.
  - **Focus**: Apply **differential equations**, **compartmental models (SIR model)**, and **optimization models** to study the spread and control strategies.
- **Agricultural Production and Resource Allocation**:
  - **Objective**: Model crop production processes and optimize resource use such as water, labor, and fertilizers.
  - **Focus**: Develop **linear programming models**, **growth models**, and **constraint-based optimization models** for efficient resource allocation in farming.
- **Climate Change and Environmental Modeling**:
  - **Objective**: Develop models to predict environmental changes due to climate change and optimize the use of resources for sustainability.
  - **Focus**: Apply **system dynamics modeling**, **climate models**, and **optimization techniques** for sustainable development and conservation strategies.
- **Modeling Species Population Growth**:
  - **Objective**: Develop mathematical models to describe the growth and decline of animal or plant populations over time.
  - **Focus**: Use models like **exponential growth**, **logistic growth**, and **Lotka-Volterra equations** to simulate species populations in various environments.
  - **Techniques**: **Ordinary differential equations (ODEs)** and **discrete models** (e.g., difference equations).
- **Predator-Prey Dynamics**:
  - **Objective**: Model the interactions between predator and prey populations to understand their cyclical dynamics.
  - **Focus**: Apply **Lotka-Volterra models**, **system dynamics**, and **stochastic processes** to analyze predator-prey equilibrium and stability.
  - **Techniques**: **Nonlinear differential equations**, **phase plane analysis**.
- **Human Population Growth and Resource Constraints**:
  - **Objective**: Model human population dynamics under different resource constraints such as food, water, and healthcare.
  - **Focus**: Explore **logistic growth models**, **carrying capacity**, and **demographic transition models**.
  - **Techniques**: **Agent-based models (ABM)**, **game theory** for resource allocation.
- **Urbanization and Population Density Models**:
  - **Objective**: Develop models that predict the effects of urbanization on population distribution, density, and migration.
  - **Focus**: Use **spatial models**, **mobility models**, and **population migration theories** to simulate the movement and growth of urban populations.
- **Risk and Resource Allocation in Disaster Management**:
  - **Objective**: Use mathematical modeling and operations research to optimize resource allocation during natural disasters or emergency response scenarios.
  - **Focus**: Develop models combining **simulation**, **linear programming**, and **network optimization** to allocate resources like food, water, and medical supplies efficiently.

Dr. Javid Iqbal

- **Smart Grid Optimization**:
  - **Objective**: Optimize energy distribution in smart grids, considering both supply and demand fluctuations.
  - **Focus**: Combine **mathematical modeling** (e.g., system dynamics) with **operations research** (e.g., LP or mixed-integer programming) to optimize energy production, storage, and distribution.
  - **Techniques**: **Partial differential equations (PDEs), geographical information systems (GIS)** for spatial modeling.
- **Ecological Niche Modeling**:
  - **Objective**: Model the distribution of species across different ecological niches, considering environmental factors and competition.
  - **Focus**: Use **niche models** to predict how environmental changes (like climate change) affect species distribution.
  - **Techniques**: **Environmental modeling**, **climate simulations**, and **logistic regression**.
- **SIR (Susceptible-Infected-Recovered) Model for Infectious Diseases**:
  - **Objective**: Develop and simulate the **SIR model** to study the spread of infectious diseases in populations.
  - **Focus**: Analyze the dynamics of disease spread, intervention strategies, and herd immunity thresholds.
  - **Techniques**: **Ordinary differential equations (ODEs)**, **numerical simulations**, **bifurcation analysis**.
- **Epidemic Modeling with Vaccination Strategies**:
  - **Objective**: Extend traditional **SIR models** by incorporating vaccination strategies to control disease outbreaks.
  - **Focus**: Investigate the impact of vaccination coverage and timing on disease spread.
  - **Techniques**: **Mathematical modeling**, **numerical methods** for solving differential equations, **optimization**.
- **Agent-Based Modeling of Epidemic Spread**:
  - **Objective**: Use **agent-based models (ABM)** to simulate the behavior of individuals within a population and their interactions during an epidemic.
  - **Focus**: Model individual behaviors (e.g., quarantine, vaccination, social distancing) and their collective impact on disease dynamics.
  - **Techniques**: **Agent-based modeling**, **Monte Carlo simulations**, **stochastic simulations**.
- **Network Models for Disease Spread**:
  - **Objective**: Use **network theory** to model the spread of diseases across social or geographical networks.
  - **Focus**: Study the impact of different network structures (e.g., social contacts, transportation systems) on disease transmission.
  - **Techniques**: **Graph theory**, **random networks**, **percolation theory**.
- **Impact of Public Health Interventions on Epidemic Control**:
  - **Objective**: Model the effectiveness of public health interventions like quarantine, lockdowns, travel restrictions, and social distancing in controlling an epidemic.
  - **Focus**: Use **SIR-like models**, **compartmental analysis**, and **optimal control theory** to evaluate intervention policies.
  - **Techniques**: **Control theory**, **optimization techniques**, **simulation modeling**.
- **Disease Prediction and Forecasting Models**:
  - **Objective**: Develop models to predict the future spread and peak of an epidemic.
  - **Focus**: Apply **predictive modeling techniques** to forecast infection rates, hospitalizations, and mortality.
  - **Techniques**: **Time-series analysis**, **machine learning models**, **regression analysis**.



4. **Lecture and Practical Breakdown**:
   - **Lectures, Tutorials, and Practical** sessions will be specified on each syllabus page, detailing the required hours for each type.
   - The number of hours required to complete theory/tutorial/practical, marks and other details are given on the top of the syllabus.
5. **Credit Weightage**:
   - Each credit carries a weightage of **25 marks**.
   - **Theory Papers (Major/Minor)**:
     - A 4-credit course: **20 internal marks** and **80 external marks**.
     - A 6-credit course: **4 credits for theory** and **2 credits for tutorials/practicals**.
   - **Tutorial Evaluation**:
     - The tutorial component will have **80% internal** and **20% external** weightage.
     - Internal evaluations may include **MCQs, Home Assignments, Group Discussions, Viva-Voce**, or other methods decided by the teacher concerned.
     - It is mandatory to share the **80% internal tutorial marks** with the external examiner during the final examination.
   - **Practical Evaluation**:
     - Practical exams will have **50% internal** and **50% external** weightage.
6. **Evaluation for Other Courses**:
   - For courses other than Major/Minor, the evaluation will be based solely on the **end-term examinations** (100% external marks).
   - **Skill Enhancement Courses (SEC)** will have a balanced evaluation of **50% internal** and **50% external marks**.

1. **Evaluation**:
   - **100% External Evaluation**: The internship will be evaluated based on the **learning outcomes**.
   - The evaluation will focus on how effectively the student applies the mathematical knowledge in real-life situations, the quality of their work, and their ability to solve practical problems using mathematical approaches.
2. **Outcome**:
   The internship aims to bridge the gap between theoretical learning and real-world applications, enhancing students' problem-solving, analytical thinking, and practical experience in using mathematics in various sectors.

Note: The external examiners for Projects/Internships/Practicals shall be appointed by the HOD Mathematics, University of Kashmir, Srinagar or Controller of Examination, University of Kashmir.

Signatures of the Board members:

1. ..... Prof MA Khanday
2. ..... Prof. S. Pirzada
3. ..... Prof MA Mir
4. ..... Prof Qayoom Bashir
5. ..... Prof Zahoor
6. ..... Prof. Iffat Mobeen
7. ..... Dr. Javid Iqbal
8. .....
9. .....
10. ..... Prof. TA Chishti
11. ..... Dr. Azeem Islam Bandey
12. ..... Dr. MSeer

Jammu and Kashmir Institute of Mathematical Sciences

5-Year Integrated Master's Programme (FYIMP) with Major in Mathematics

PROPOSED CREDIT FRAMEWORK FOR INTEGRATED 5-YEAR MASTER'S PROGRAMME (FYIMP) WITH MAJOR IN MATHEMATICS UNDER NEP-2020

SEMESTER I

Course Type	Course Code	Course Title	Total credit	Marks				Total Marks
				Internal		External		
				Theory	Tutorial /Practical	Theory	Tutorial /Practical	
CT1(Major)	IMTHMJDC0124	Differential Calculus	4 (Theory)+ 2(Tutorial)	20	40	80	10	150
CT5(Minor)	IMTHMNIM0124	Introduction to Mechanics	4 (Theory)+ 2(Practical)	20	25	80	25	150
AEC	IMTHAECS0124	Communication Skills	3(Theory)	---	---	75	---	75
MDC	IMTHMDIS0124	Introductory Statistics	3 (Theory)	---	---	75	---	75
VAC1	IMTHVADT0124	Digital And Technology Solutions	2 (Theory)	---	---	50	---	50
VAC2	IMTHVAEV0124	Environmental Science Education	2 (Theory)	---	---	50	---	50
SEC	IMTHSEIC0124	Introduction to Computer Basics	2 (Theory)	10		40		50
		TOTAL CREDITS	**24**					**600**

SEMESTER II

Course Type	Course Code	Course Title	Total credit	Marks				Total Marks
				Internal		External		
				Theory	Tutorial /Practical	Theory	Tutorial /Practical	
CT1(Major)	IMTHMJIC0224	Integral Calculus	4 (Theory)+ 2(Tutorial)	20	40	80	10	150
CT5(Minor)	IMTHMNEM0224	Electricity and Magnetism	4 (Theory)+ 2(Practical)	20	25	80	25	150
AEC	IMTHAEEL0224	English Language	3 (Theory)	---	---	75	---	75
MDC	IMTHMDEE0224	Electronics Equipment Maintenance Introduction to Electronics	3 (Theory)	---	---	75	---	75
VAC1	IMTHVAHW0224	Health and Wellness	2 (Theory)	---	---	50	---	50
VAC2	IMTHVAUI0224	Understanding India	2 (Theory)	---	---	50	---	50
SEC	IMTHSEWS0224	Basic Web Skills	2 (Theory)	10	---	40	---	50
		TOTAL CREDITS	**24**					**600**

Professor & Head
Department of Mathematics
University of Kashmir
Prof. MA Khanday

SEMESTER III

Course Type	Course Code	Course Title	Total credit	Marks				Total Marks
				Internal		External		
				Theory	Tutorial /Practical	Theory	Tutorial /Practical	
CT1(Major)	IMTHMJMT0324	Matrix Theory	4 (Theory)+ 2(Tutorial)	20	40	80	10	150
CT2(Major)	IMTHMJCE0324	Theory of Complex functions and Equations	4 (Theory)	20	---	80	---	100
CT5(Minor)	IMTHMNTK0324	Thermodynamics and Kinetic Theory of Gases	4 (Theory)+ 2(Practical)	20	25	80	25	150
AEC	IMTHAEUL0324	Urdu Language	3 (Theory)	---	---	75	---	75
MDC	IMTHMDIE0324	Introductory of Economics	3 (Theory)	---	---	75	---	75
SEC	IMTHSEIP0324	Introduction to Programming	2 (Theory)	10	---	40	---	50
		TOTAL CREDITS	**24**					**600**

SEMESTER IV

Course Type	Course Code	Course Title	Total credit	Marks				Total Marks
				Internal		External		
				Theory	Tutorial /Practical	Theory	Tutorial /Practical	
CT1(Major)	IMTHMJRA0424	Real Analysis	4 (Theory)+ 2(Tutorial)	20	40	80	10	150
CT2(Major)	IMTHMJDE0424	Differential Equations	4 (Theory)+ 2(Tutorial)	20	40	80	10	150
CT3(Major)	IMTHMJAA0424	Abstract Algebra	4 (Theory)	20	---	80	---	100
CT4(Major)	IMTHMJNA0424	Numerical Analysis	4 (Theory)	20	---	80	---	100
CT5(Minor)	IMTHMNWO0424	Wave and Optics	4 (Theory)+ 2(Practical)	20	25	80	25	150
		TOTAL CREDITS	**26**					**650**

Prof. M A Khanday
Professor & Head
Department of Mathematics
University of Kashmir

SEMESTER V

Course Type	Course Code	Course Title	Total credit	Marks				Total Marks
				Internal		External		
				Theory	Tutorial /Practical	Theory	Tutorial /Practical	
CT1(Major)	IMTHMJPS0524	Plane and Solid Geometry	4 (Theory)+ 2(Tutorial)	20	40	80	10	150
CT2(Major)	IMTHMJMM0524	Mathematical Modelling & Operations Research	4 (Theory)+ 2(Internship)	20	---	80	*50	150
CT3(Major)	IMTHMJAC0524	Advanced Calculus	4 (Theory)	20	---	80	---	100
CT4(Major)	IMTHMJLA0524	Linear Algebra	4 (Theory)	20	---	80	---	100
CT5(Minor)	IMTHMNCP0524	C-Programming	4 (Theory)+ 2(practical)	20	25	80	25	150
		TOTAL CREDITS	**26**					**650**

SEMESTER VI

Course Type	Course Code	Course Title	Total credit	Marks				Total Marks
				Internal		External		
				Theory	Tutorial /Practical	Theory	Tutorial /Practical	
CT1(Major)	IMTHMJMS0624	Metric Space	4 (Theory)+ 2(Tutorial)	20	40	80	10	150
CT2(Major)	IMTHMJCA0624	Complex Analysis	4 (Theory)+ 2(Tutorial)	20	40	80	10	150
CT3(Major)	IMTHMJTN0624	Theory Of Numbers	4 (Theory)	20	---	80	---	100
CT4(Major)	IMTHMJDM0624	Discrete Mathematics	4 (Theory)	20	---	80	---	100
CT5(Minor)	IMTHMNIMS0624	Introduction to MATLAB & Basic Operations	4 (Theory)+ 2(Practical)	20	25	80	25	150
		TOTAL CREDITS	**26**					**650**

Note: Number of lectures required for 1 credit: Theory/Tutorial (15), Practical (30).

Professor & Head
Department of Mathematics
University of Kashmir

PROGRAMME OUTCOMES

1) **Disciplinary Knowledge:** Being able to demonstrate comprehensive knowledge and coherent understanding of both the theoretical and applied components of mathematics as well as chosen interdisciplinary areas of study in a broad multidisciplinary context; ability to connect relevant disciplines, as well as recent innovations, with the learning disciplines of choice.
2) **Communication Skills:** Capability to express various mathematical ideas clearly through computational methods, graphical methods, examples and their geometrical representations; ability to use mathematics effectively as a precise language of communication in other fields; ability to pay close attention, read texts and research papers critically, and communicate complicated information clearly and concisely to a variety of organisations and audiences.
3) **Moral and Ethical Awareness/Reasoning:** Ability to recognise ethical issues that are pertinent to one's work and pledge not to engage in unethical behaviour such as plagiarism, copyright and infringement of intellectual property rights; ability to appreciate recent developments in various fields and one's research with honesty and integrity in all aspects.
4) **Multicultural Competence:** Ability to co-relate and compare recent developments in various branches of mathematics in a variety of organisations worldwide; ability to collaborate research in various fields of mathematics with other researchers from a variety of communities and organisations; ability to effectively participate in a multicultural group or society and interact politely with diverse groups, and the acquisition of knowledge of the values and beliefs of multiple cultures, and a global viewpoint to honour diversity.
5) **Information/Digital Literacy:** Ability to access, assess and utilize Information and Communications Technology (ICT) tools. Ability to understand, read and write programming language/packages/modules (MATLAB; C) for computation, simulation, graphs and solutions.
6) **Reflective Thinking:** An understanding of how a researcher or an investigator influences and shapes the information one creates; ability to formulate appropriate questions pertaining to the ideas in various branches of mathematics in order to propose new solutions using the domain knowledge of mathematics; ability to interpret the findings and use them to solve a variety of problems found in numerous fields of mathematics and real-life.
7) **Cooperation/Teamwork:** Ability to collaborate with diverse teams in an effective and respectful manner; capacity to cooperate with people from varied backgrounds in the interests of a common goal.
8) **Research Related Skills:** The ability to formulate appropriate questions, problems, and hypotheses by analysing and interpreting the ideas from various branches of mathematics; ability to demonstrate the results, theories, techniques and proofs using the concepts of various fields of mathematics; ability to develop methodology and design research proposals.
9) **Problem Solving:** Ability to work independently and do in-depth study to find ways that mathematics is used in various industries and in daily life to improve job possibilities in a wide range of fields and academic study; ability to use innovative, imaginative, lateral thinking, interpersonal skills, and emotional intelligence; ability to tackle various challenges in both familiar and unfamiliar circumstances, then apply what they've learned to actual scenarios.
10) **Critical Thinking:** Capability to analyse and synthesise theoretical and applied problems, as well as acquire knowledge and skills through logical reasoning, analytical thinking and evaluations; ability to find gaps and logical faults in arguments; inculcate a healthy attitude to be a lifelong learner.

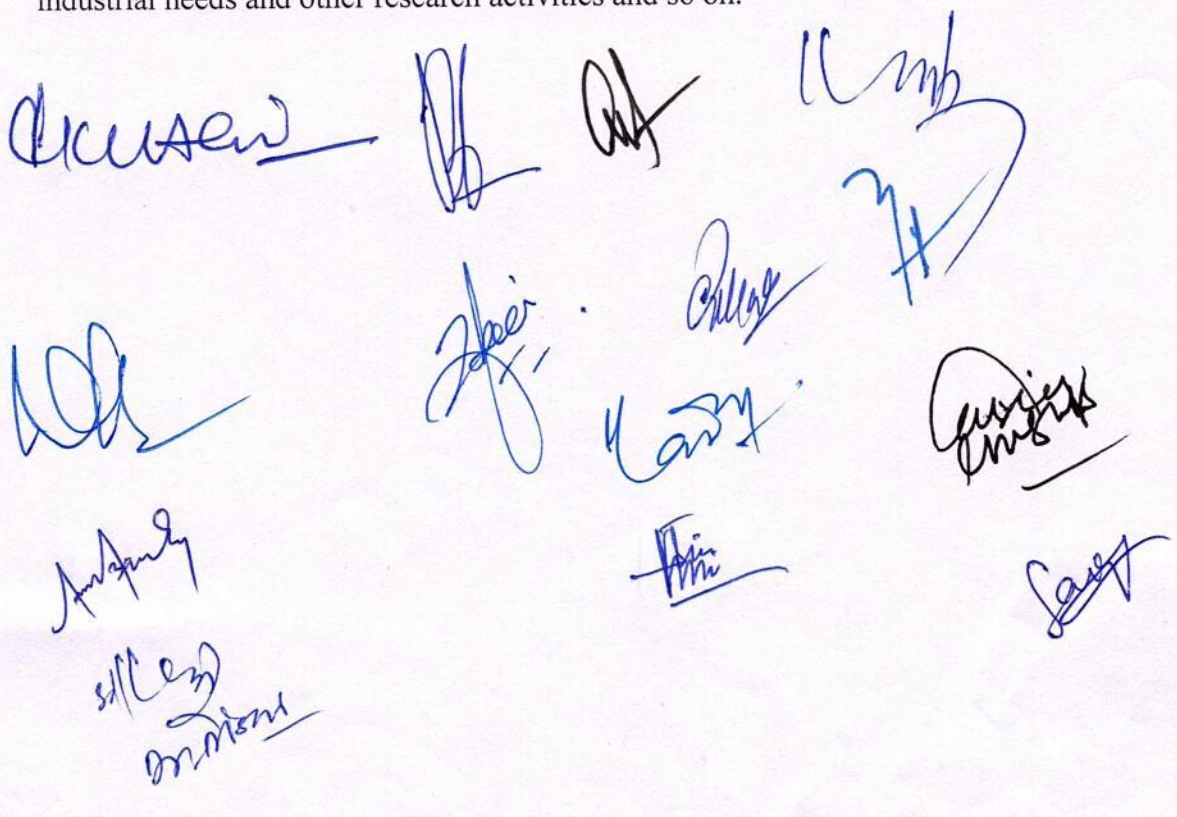
Programme Specific Outcomes

The Programme Specific Outcomes of FYIMP in Mathematics are listed in the following. After completing the programme the students will be able to:

- Demonstrate the acquisition of comprehensive knowledge and coherent understanding in chosen elective and core subjects in mathematics.
- Apply mathematical techniques and tools, such as mathematical modelling, computational methods, and statistical analysis, to solve real-world problems in various fields.
- Possess strong analytical and critical thinking skills, enabling them to construct rigorous logical arguments, develop proofs, and solve complex mathematical problems.
- Proficient in using modern mathematical software and computational tools such as MATLAB, C, and other relevant technologies to analyse data and solve mathematical problems.
- Communicate mathematical ideas and solutions to a variety of audiences, including mathematicians, scientists, engineers, and non-specialists, both orally and in writing.
- Formulate research questions, literature review, methodology, presentation of findings, and demonstrate dedication to lifelong learning and professional development.
- Utilize the skills that are necessary for success in national level competitive exams, pursuing doctoral research degree, teaching and others.

Teaching Learning Process

The outcome-based approach demands a considerable transition from teacher centric to learner centric pedagogies, as well as from passive to active/participatory pedagogies, especially in the context of undergraduate study. This course promotes the systematic and sequential acquisition of knowledge and skills. It also focuses on practical abilities, as well as an awareness of the link between theory and practice. Teaching strategies involve discussions, presentations, use of required textbooks, e-learning tools, other self-study materials; project, internship, exploring industrial needs and other research activities and so on.



Semester-I
5-Year Integrated Master's Programme (FYIMP) with Major in Mathematics

IMTHMJDC0124: Differential Calculus | **Ext. Marks: Theory (80) and Tutorial (10)**
Credits: 4 Theory(60H) + 2 Tutorial(30H) | **Int. Marks: Theory(20) and Tutorial (40)**

Course Outcomes: To ensure that students gain a thorough understanding of the principles and applications of derivatives and their related concepts. These outcomes are intended to provide students with a solid foundation in differential calculus, enabling them to apply the techniques to various fields such as engineering, physics, economics, and other applied sciences

Theory: 4 Credits

Unit-I
Limits and infinitesimals, continuity $\varepsilon - \delta$ definition, types of discontinuities of function, differentiability of functions, successive differentiation and Leibnitz theorem, tangents and normals (polar coordinates only), maxima and minima of functions.

Unit-II
Bounded functions, properties of continuous functions on closed intervals, intermediate value theorem, Darboux theorem. Rolle's theorem and mean value theorems (with proofs) and their geometrical interpretation, Taylor's theorem with Lagrange's and Cauchy's form of remainder, Taylor's series, Maclaurin's series.

Unit-III
Indeterminate forms, partial differentiation, total differentiation, homogenous functions and Euler's theorem, envelope of a family of curves involving one and two parameters, curvature, radius of curvature, pedal equations.

Unit-IV
Lengths of arcs, asymptotes, branches of a curve, asymptotes parallel to axes, oblique asymptotes, asymptotes by inspection, method of expansion and approximation. singular points (double points only), tracing of cartesian equations of the form $y = f(x)$, $y^2 = f(x)$.

Tutorial: 2 Credits

Unit-V
Examples of discontinuous functions, examples on nth derivative of product of two functions, bounds of function (supremum and infimum).

Unit–VI
Involutes and evolutes, oblique asymptotes of an nth degree curve, concavity and convexity with examples.

Books Recommended:

1. T.M. Apostal, Calculus: Vol.-I, Wiley, 1975.
2. S. Balachandra Rao and C. K. Shantha, Differential Calculus, New Age Publication, 1992.
3. S. Lang, A First Course in Calculus, Springer-Verlag, 1998.
4. H. Anton, I. Birens and S. Davis, Calculus, Wiley, 2002.
5. S. D. Chopra, M. L. Kochar and A. Aziz, Differential Calculus, Kapoor Sons, 2016.

Semester-I
5-Year Integrated Master's Programme (FYIMP) with Major in Mathematics

IMTHMNIM0124: Introduction to Mechanics **Ext. Marks: Theory (80) and Practical (25)**
Credits: 4 Theory(60H)+ 2 Practicals(60H) **Int. Marks: Theory (20) and Practical (25)**

Course Outcomes: The course provides a foundational understanding of the principles governing motion and forces. Students shall be able to analyze and solve problems related to the motion of objects and the forces acting on them, with applications in physics and engineering.

Theory: 4 Credits

Unit-I
Fundamentals of Dynamics: Review of Newton's Laws of Motion. Reference frames. Inertial frames; Non-Inertial Systems: Non-inertial frames and fictitious forces. Uniformly rotating frame. Laws of Physics in rotating coordinate systems. Centrifugal force. Coriolis force and its applications. Work and Energy: Work and Kinetic Energy Theorem. Conservative and non- conservative forces. Potential Energy. Energy diagram. Stable and unstable equilibrium. Elastic potential energy, Force as gradient of potential energy. Work and Potential energy, Work done by non-conservative forces. Law of conservation of Energy.

Unit-II
Dynamics of a system of particles. Centre of Mass. Principle of conservation of momentum. Impulse. Momentum of variable-mass system: motion of rocket. Collisions: Elastic and inelastic collisions between particles. Centre of Mass and Laboratory frames. Elasticity: Relation between Elastic constants. Twisting torque on a Cylinder or Wire. Fluid Motion: Kinematics of Moving Fluids: Poiseuille's Equation for Flow of a Liquid through a Capillary Tube.

Unit-III
Oscillations: S H M: Simple Harmonic Oscillations. Differential equation of SHM and its solution. Kinetic energy, potential energy, total energy and their time-average values. Damped oscillation. Forced oscillations: Transient and steady states; Resonance, sharpness of resonance; power dissipation and Quality Factor.

Unit-IV
Law of Gravitation, Gravitational Potential, inertial and gravitational mass, Potential and filed due to a spherical shell and solid sphere, Motion of a particle under central force field, Kepler's laws of planetary motion, Derivation of Newton's Law of gravitation from Kepler's law, Satellites: Escape Velocity and Orbital Velocity, Geosynchronous orbits, weightlessness, Basic idea of Global Positioning System (GPS).

List of Practicals: (Any Five)

1. To determine g and velocity for a freely falling body using Digital Timing Technique
2. To determine Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).
3. To determine the Young's Modulus of a Wire by Optical Lever Method.
4. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.
5. To determine the elastic Constants of a wire by Searle's method.
6. To determine the value of g using Bar Pendulum.
7. To determine the value of g using Kater's Pendulum.

Books Recommended:

1. D. Kleppner, R.J. Kolenkow, An introduction to mechanics, McGraw-Hill, 1973.
2. Ronald Lane Reese, University Physics, Thomson Brooks/Cole, 2003.
3. G.R. Fowles and G.L. Cassiday, Mechanics, Cengage , 2005.
4. C.Kittel, W.Knight, et.al. Mechanics, Berkeley Physics, Vol.-I, McGraw-Hill, 2007.
5. Resnick, Halliday and Walker, Fundamentals of Physics, Wiley, 2008.
6. R.P.Feynman, R.B.Leighton, M.Sands, Feynman Lectures, Vol.-I, Pearson, 2008.

Semester-I
5-Year Integrated Master's Programme (FYIMP) with Major in Mathematics

IMTHAECS0124: Communication Skills
Credits: 3 Theory(45H) **Ext. Marks: Theory (75)**

Course outcomes: To develop effective communication abilities that are essential for both academic and professional success. These outcomes aim to equip students with the skills require for effective communication in diverse setting and to contribute meaningfully to their personal and professional growth.

Theory: 3 Credits

Unit I: Communication

- Introduction to Communication
- Definition and Scope
- Process of Communication
- Barriers to Communication (semantic/linguistic, physical, psychological, socio-cultural)/ Overcoming Barriers
- Verbal/Non-Verbal Communication

Unit II: Soft Skills

- Introduction to Soft Skills
- Personality Development/Emotional Intelligence
- Time Management/leadership Skills
- Interpersonal relations/Public Speaking
- Facing Interviews/ Group Discussion/Presentation Skills

Unit III: Writing Skills

- Letter Writing- Formal and Informal
- CV, Email, Message
- Minutes, Report Writing
- Notice, Memoranda
- Short Speech

Note: Adequate practice to be given in the class to improve speaking and writing competence.

Books Recommended:

1. Step Ahead with English Published by Orient BlackSwan, 2020.

Semester-I
5-Year Integrated Master's Programme (FYIMP) with Major in Mathematics

IMTHMDIS0124: Introductory Statistics
Credits: 3 Theory (45H) **Ext. Marks: Theory (75)**

Course Outcomes: To help students understand basic statistical concepts, methods, and techniques for analyzing and interpreting data. These objectives are aimed at providing students with a solid foundation in the basic principles of statistics, preparing them for more advanced statistical analysis and enabling them to apply these methods in real-world situations.

Theory: 3 Credits

Unit-I: Introduction to Statistics:
Introduction to Statistics and Basic Concepts: Meaning, origin, definition, functions, limitations and applications of Statistics. Primary and secondary data, different methods of collection of primary data with merits and demerits. Sources of secondary data. Classification: meaning, objectives, types of classifications- Chronological, Geographical, Qualitative and Quantitative classifications with illustrations. Formation of discrete and continuous frequency distributions. Tabulation: meaning, rules of tabulation, format of a statistical table and its parts. Diagrammatic and Graphical representation of Data: Diagrams, general rules of construction of diagrams. Types of Diagrams with simple illustrations. Graphs: Types of Graphs - Histogram, frequency Polygon, frequency curve and Ogives, simple problems, location of mode, median and partition values from the graphs. Difference between diagrams and graphs.

Unit-II: Measures of Central Tendency:
Meaning of central tendency and essentials of a good measure of central tendency. Types of measures of central tendency: Arithmetic mean, Median, Mode, Geometric mean and Harmonic mean - definition, merits and demerits. Properties of arithmetic mean. Problems on both grouped and ungrouped data for all the measures.

Unit-III: Measures of Dispersion:
Meaning and objectives of measures of dispersion. Essentials of a good measure of dispersion, absolute and relative measures of dispersion. Types of measures of dispersion- Range, Quartile deviation, Mean deviation and standard deviation with relative measures - definition, merits and demerits. Simple problems on ungrouped and grouped data.

Books Recommended:

1. S. C. Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics 10th edition, Sultan Chand and Sons, 2000.
2. A.M. Goon, M.K. Gupta and B.Dasgupta, Fundamental of Statistics, Vol-II, World Press, Kolkata, 2011.
3. S. C. Gupta, Fundamentals of Statistics, Himalaya Publishing House, 2018.
4. P. Mukhopadhaya, Applied Statistics, New Central Book Agency, 2019.
5. Gupta S. P. and V. K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand, 2020.

Semester-I
5-Year Integrated Master's Programme (FYIMP) with Major in Mathematics

IMTHVADT0124: Digital and Technological Solutions
Credits: 2 Theory(30H) **Ext. Marks: Theory (50)**

Course Outcomes: To provide students with the skills and knowledge needed to leverage digital technologies effectively, preparing them to be leaders in the development and implementation of technological solutions across various fields.

Theory: 2 Credits

Unit-I
Introduction and Evolution of Digital Systems. Role and Significance of Digital Technology. Information and Communication Technology and Tools. Computer System and it's working, Software and its types. Operating Systems: Types and Functions. Problem Solving: Algorithms and Flowcharts.
Communication Systems: Principles, Model and Transmission Media. Computer Networks and Internet: Concepts and Applications, WWW, Web Browsers, Search Engines, Messaging, Email, Social Networking. Computer Based Information System: Significance and Types. E-commerce and Digital Marketing: Basic Concepts, Benefits and Challenges.

Unit-II
Digital India and e-Governance: Initiatives, Infrastructure, Services and Empowerment. Digital Financial Tools: Unified Payment Interface, Aadhar Enabled Payment System, USSD, Credit /Debit Cards, e-Wallets, Internet Banking, NEFT/RTGS and IMPS, Online Bill Payments and PoS. Cyber Security: Threats, Significance, Challenges, Precautions, Safety Measures and Tools, legal and ethical perspectives. Emerging Technologies and their applications: Overview of Cloud Computing, Big Data, Internet of Things, Virtual Reality, Blockchain and Cryptocurrency, Robotics, Machine Learning and Artificial Intelligence, 3-D Printing. Digital Signatures.

Text Book:

F S Masoodi, Z S Masoodi and K B Dar, Digital and Technological Solutions, BPB Publications.

Books Recommended:

1. Behrouz A. Forouzan, Data Communications and Networking, McGraw-Hill, 2007.
2. E. Balagurusamy, Fundamentals of Computers, McGraw-Hill, 2009.
3. Buvya, Broberg and Gosciniski, Cloud Computing: Principals and Paradigms, Wiley, 2010.
4. Russel and Norving, Artificial Intelligence: A Modern Approach, Pearson, 2010.
5. Samuel Greengard, The Internet of Things, MIT Press, 2015
6. C.S.V. Murthy, e-Commerce; Concepts, Models, Strategies, 2015.
7. V. Rajaraman, Introduction to Information Technology, 3rd Edition, PHI Learning, 2018.

Semester-I
5-Year Integrated Master's Programme (FYIMP) with Major in Mathematics

IMTHVAEV0124: Environmental Science Education
Credits: 2 Theory (30H) **Ext. Marks: Theory (50)**

Course Outcomes: This course is expected to inculcate a critical thinking on various dimensions of environment through knowledge, skill, critical thinking and problem-solving.

Theory: 2 Credits

Unit-I: Understanding the environment

1 Environment: concept, importance and components

2 Ecosystem: Concept, structure and function (food chain, food web, ecological pyramids and energy flow)

3 Ecosystem services: (Provisioning, regulating and cultural)

4 Biodiversity: levels, values and threats and conservation

5 Concept and objectives of environmental education, environmental ethics.

Unit-II: Natural resources and environmental pollution

1 Natural resources: Renewable and non-renewable (Global status, distribution and production)

2 Management of natural resources: Individual, community and government managed

3 Air, water and soil pollution: Causes, consequences and control

4 Solid waste management: Collection, segregation, transportation and disposal; 3R's

5 Climate change: Causes and consequences

Books Recommended:

1. Miller G. Tyler Miller, Jr., Environmental Science, Wadsworth Publishing Co., 1994.
2. K.D. Wagner, Environmental Management. W.B. Saunders Co. Philadelphia, 1998.
3. Mckinncv, M.L. and Schoch. R.M. Environmental Science systems and Solutions: Web Enhanced Edition, San Val, 1999.
4. D. K. Asthana, Text Book of Environmental Studies. S. Chand. 2006.
5. M. Basu, S. Xavier, Fundamentals of Environmental Studies, Cambridge University Press, 2017.
6. E. Bharucha, Textbook of Environmental Studies for Undergraduate Courses. Universities Press, 2019.

Semester-I
5-Year Integrated Master's Programme (FYIMP) with Major in Mathematics

IMTHSEIC0124: Introduction to Computer Basics **Ext. Marks: Theory (40)**
Credits: 2 Theory (40H) **Int. Marks: Theory (10)**

Course Outcomes: Understand basic programming logic and problem-solving techniques, develop simple programs in Python.

Theory: 2 Credits

Unit-I: Fundamentals of Computers
History and Evolution of Computers, Components of a Computer: Hardware and Software, Basic Input and Output Devices, Introduction to Operating Systems (Windows and Linux). Types of Software: System Software, Application Software, MS Word: Creating, Editing, Formatting Documents, Inserting Tables, Images, and Charts. Page Setup, Margins, and Alignment, Working with Styles and Templates Spell Check, Grammar Check, and Thesaurus, Mail Merge Function.

Unit-II: MS Office Suite
MS Excel Introduction to Spreadsheets, Cell Referencing (Relative, Absolute, Mixed) Data Entry, Sorting, and Filtering, Basic Formulas and Functions (SUM, AVERAGE, MAX, MIN), Creating Charts and Graphs, Pivot Tables and Data Analysis. MS PowerPoint Creating Presentations, Slide Layout, Design, and Themes, Inserting Multimedia. (Images, Audio, Video), Animation and Transition Effects, Presenting and Printing Slides. Creating Presentations, Slide Layout, Design, and Themes, Inserting Multimedia (Images, Audio, Video), Animation and Transition Effects, Presenting and Printing Slides.

Books Recommended:

1. V. Rajaraman and N. Adabala, Fundamentals of Computers, PHI Learning, 2014.
2. Michael Miller, Computer Basics: Absolute Beginner's Guide, Pearson, 2015.
3. Joan Lambert and Curtis Frye, Microsoft Office Step by Step–Microsoft Press, 2021.
4. Randy Nordell, Microsoft Office 365: In Practice, McGraw-Hill, 2022.

Semester-II
5-Year Integrated Master's Programme (FYIMP) with Major in Mathematics

IMTHMJIC0224: Integral Calculus **Ext. Marks: Theory(80) and Tutorial (10)**
Credits: 4 Theory(60H) + 2 Tutorial(30H) **Int. Marks: Theory(20) and Tutorial (40)**

Course Outcomes: After the successful completion of the course, students shall be able to apply various types of integrals to understand the dynamics of various real life situations.

Theory: 4 Credits

Unit-I
Integration by parts, integration of rational functions by partial fraction, integration of trigonometric functions like $\frac{1}{a+bcosx}$, $\frac{1}{a+bsinx}$, $\frac{1}{a+bcosx+csinx}$ etc, integration of irrational functions.

Unit-II
Reduction formulae for: $\int sin^n xdx, \int cos^n xdx, \int tan^n xdx, \int cot^n xdx, \int sec^n xdx, \int cosec^n xdx,$
$\int x^m(a+bx^n)^p dx, \int x^m sinnxdx, \int x^m cosnxdx, \int e^{mx}x^n dx, \int x^m(logx)^n dx, \int cos^m xcosnxdx.$

Unit-III
Definite integrals with properties, definite integral as limit of sum, fundamental theorem of calculus, summation of series, differentiation under an integral sign, beta and gamma function, definition and properties.

Unit-IV
Quadrature, area of a region bounded by a curve, x-axis (y-axis) and two ordinates (abscissa), sectorial areas bounded by a closed curve, lengths of plane curves, volumes and surfaces of solids of revolution.

Tutorial: 2 Credits

Unit–V
Reduction formula by the method of connections, reduction formula for $\int \frac{sinnx}{sinx}dx$, geometrical interpretation of definite integrals, problems based on the definite integrals.

Unit –VI
Relation between beta and gamma function and their applications, problems on beta and gamma functions, volume generated by the revolution of a sectorial area.

Books Recommended:

1. Frank Ayres Jr. and Elliot Mendelson, Schaums outline of Theory and problems of Differential and Integral Calculus, 1964.
2. T. M. Apostol, Calculus Vol.-I, Wiley, 1975.
3. S. Lang, A First Course in Calculus, Springer-Verlag, 1998.
4. H. Anton, I. Birens and S. Davis, Calculus, Wiley, 2002.
5. G.B. Thomas and R.L. Finney, Calculus, Pearson, 2007.
6. S. D. Chopra and M. L. Kochar, Integral Calculus, Kapoor Sons, 2016.

Semester-II
5-Year Integrated Master's Programme (FYIMP) with Major in Mathematics

IMTHMNEM0224: Electricity and Magnetism **Ext. Marks: Theory (80) and Practical (25)**
Credits: 4 Theory(60H)+ 2 Practicals(60H) **Int. Marks: Theory (20) and Practical (25)**

Course Outcomes: The course are designed to help students develop a strong understanding of the fundamental concepts and principles governing electric and magnetic fields, as well as their applications in real-world scenarios.

Theory: 4 Credits

Unit-I
Vector Analysis: Review of vector algebra (scalar and vector product), gradient, divergence, curl and their significance, vector Integration, line, surface and volume integrals of vector fields, Gauss-divergence theorem and Stoke's theorem of vectors (statement only). Electrostatics: Electrostatic Field, electric flux, Gauss's theorem of electrostatics. Differential form of Gauss Law.

Unit-II
Applications of Gauss theorem; Electric Field due to point charge, infinite line of charge, uniformly charged spherical shell and solid sphere, plane charged sheet, charged conductor. Electric potential as line integral of electric field, potential due to a point charge, electric dipole, uniformly charged spherical shell and solid sphere. Calculation of electric field from potential. Capacitance of an isolated spherical conductor. Parallel plate, spherical and cylindrical condenser. Energy per unit volume in electrostatic field.

Unit-III
Displacement vector. Gauss's theorem in dielectrics. Parallel plate capacitor completely filled with dielectric. Magnetism: Magneto statics: Biot-Savart's law and its applications: straight conductor, circular coil, solenoid carrying current. Divergence and curl of magnetic field. Magnetic vector potential. Ampere's circuital law. Magnetic properties of material: Magnetic intensity, magnetic induction, permeability, magnetic susceptibility. Brief introduction of dia, para and ferro-magnetic materials.

Unit-IV
Electromagnetic Induction: Faraday's laws of electromagnetic induction, Lenz's law, self and mutual inductance, L of single coil, M of two coils. Energy stored in magnetic field. Maxwell's equations and Electromagnetic wave propagation: Equation of continuity of current, Displacement current, Maxwell's equations, Poynting vector, energy density in electromagnetic field, electromagnetic wave propagation through vacuum and isotropic dielectric medium, transverse nature of EM waves.

List of Practicals: (Any Five)

1. Determination of unknown resistance by Carey Foster method.
2. Conversion of an ammeter to a voltmeter.
3. Conversion of a voltmeter to an Ammeter.
4. To determine an unknown Low Resistance using Potentiometer.
5. To determine the electrical equivalent of heat
6. To determine a low resistance by Carey Foster's Bridge.
7. To compare the capacitances using De'sauty's Bridge
8. B-H curve and hysteresis loss.

Books Recommended:

1. Edward M. Purcell, Electricity and Magnetism, McGraw-Hill Education, 1986.
2. D.J.Griffiths, Introduction to Electrodynamics, 3rd Edition, Benjamin cummings, 1998.
3. Feynman, Leighton, Sands, The Feynman lectures on Physics, Vol.-II, pearson, 2012.

Semester-II
5-Year Integrated Master's Programme (FYIMP) with Major in Mathematics

IMTHAEEL0224: English Language
Credits: 3 Theory(45H) **Ext. Marks: Theory (75)**

Course Outcomes: After completion of this course, students shall be able to use English effectively in academic, professional, and social contexts, fostering confidence and fluency in the language.

Theory: 3 Credits

Unit-I: Poetry

1 Robert Frost: "The Road Not Taken"

2 Nissim Ezekiel: "Night of the Scorpion"

Unit-II: Short Story

1 Mulk Raj Anand: "The Lost Child"

2 Henry Lawson: "The Loaded Dog"

Unit-III: Language in Use

1 Reading Comprehension

2 Paragraph Writing/ Essay Writing

3 Homonyms, Homophones/ Commonly misspelt words

4 Idioms and Phrases/ Phrasal verbs

5 Spellings and Sound Patterns in English/ One-Word substitution.

Book Recommended:

1. Step Ahead with English, Published by Orient BlackSwan, 2020.

Note: Exercises at the end of the literary pieces to be done in the class.

Semester-II
5-Year Integrated Master's Programme (FYIMP) with Major in Mathematics

IMTHMDEE0224: Introduction to Electronics

Credits: 3 Theory(45H) **Ext. Marks: Theory (75)**

Course Outcomes: After studying the course, the student shall explore the evolution of electronics, its impact on society and key components such as resistors, capacitors, inductors, semiconductors, and integrated circuits.

Theory: 3 Credits

Unit-I: Fundamentals of Electronics
What is Electronics and why to study it?; The Historical Evolution of Electronics and its Impact on Society and Innovation; Electric current and Voltage; Introduction to Basic Components of Electronics and their applications (Resistor, Capacitor, Inductor); Introduction to Semiconductor Devices and their applications (Diode, Transistor); Introduction to Integrated Circuits (ICs); Introduction to Electronic Equipment (Oscilloscope, Function Generator, Power Supply, Multimeter); Discovering Electronics around us.

Unit-II: Electronics in Contemporary World
Electronics for Signal conversion and Control: Rectification (Mobile charger); Amplification (Microphone and Loud Speaker); and Control (Inverters); Introduction to consumer Electronics and Electronic Home appliances: Radio, TV, Personal computer, Printer, Washing machine, Microwave ovens (A qualitative treatment only); Electronics in ICT: Introduction to Telephony, Telecom network spectrum, Mobile phones and Satellite communication.

Unit-III: Electronics in Smart World
Evolution of smart homes; Video monitoring, Security and alarms, CCTV; Role of Electronics in Education and Agriculture (Drones for disease detection and survey, Smart-irrigation); Electronics in Automation; Electronics in Healthcare: Digital Thermometers, BP measurement, Digital X-Ray, MRI, USG, ECG (Basic principle only).

Books Recommended:

1. F. M. Mims, Getting Started in Electronics, RadioShack, 2003.
2. S. P. Bali, Consumer Electronics, 1st Edition, Pearson, 2004.
3. E. L. Wolf, Quantum Nanoelectronics, 1st Edition, Wiley, 2009.
4. S. Cathleen, Electronics For Dummies, Wiley, 2013.
5. R. S. Khandpur, Handbook of Biomedical Instrumentation, 3rd Edition, McGraw-Hill, 2014.
6. P. Horowitz and W. Hill, The Art of Electronics, 3rd Edition, Cambridge University Press, 2015.
7. S. Gibilisco, Teach Yourself: Electricity and Electronics, 6th Edition, McGraw-Hill, 2016.
8. V. G. Yangalwar, Emerging Trends in Electronics, Nirali Prakahshan, 2020.
9. R. L. Boylested and L. Nashelsky, Electronic Devices and Circuit Theory, 11th Edition, Pearson, 2021.

Semester-II
5-Year Integrated Master's Programme (FYIMP) with Major in Mathematics

IMTHVAHW0224: Health and Wellness
Credits: 2 Theory(30H) **Ext. Marks: Theory (50)**

Course Outcomes: The course typically focus on fostering knowledge, skills, and attitudes that promote physical, mental, and social well-being.

Theory: 2 Credits

Unit-I. Introduction to health and wellness
Define and differentiate health and wellness. Importance of health and wellness Education. Historical background of yoga and its relevance in contemporary world. Need and importance of yoga. Asanas and meditation for healthy well-being. Prenatal yoga for women well-being. Yoga and stress management. Diet and nutrition for health and wellness. Essential components of balanced diet for healthy living with specific reference to the role of carbohydrates, proteins, fats, vitamins and minerals. Processed foods and unhealthy eating habits. Identification of suicidal tendencies. Substance abuse (Drugs, Cigarette, Alcohol), de-addiction, counselling and rehabilitation.

Unit-II. Management of health and wellness
Healthy foods for prevention of life-threatening diseases with special reference to cancer, Hypertension, Diabetes and Cardiovascular diseases. Physical Fitness and components of Physical Fitness. Advantages of Good Physique. Active and sedentary lifestyles and its implications. Postural deformities and its corrective measures. Psychological wellbeing and its importance in the field of Sports. Role of sleep in maintenance of physical and mental health.

Books Recommended:

1. C. Bouchard, S. N. Blair and W. L. Haskell, Physical Activity and Health, 2nd Edition, Human Kinetics, 2012.
2. A. Clow and S. Edmunds, Physical Activity and Mental Health, Human Kinetics 2014.
3. C. Nyambichu, Lifestyle Diseases: Lifestyle Disease Management, 2018.
4. E. Attached and M. Fernandez, Mental Health Workbook, Independently, 2021.
5. N. Lorick, Mental Health Workbook for Women: Exercises to Transform Negative Thoughts and Improve Well-Being, Callisto Media, 2022.

Semester-II
5-Year Integrated Master's Programme (FYIMP) with Major in Mathematics

IMTHVAUI0224 : Understanding India
Credits: 2 Theory (30H) **Ext. Marks: Theory (50)**

Course Outcomes: The course provides a comprehensive overview of the country's historical evolution, cultural richness, social structure, and political framework. It enables students to analyze India's economic development, address contemporary issues like urbanization and climate change, and explore its global role in politics, economy, and culture.

Theory: 2 Credits

Unit-I

1 Bharatavarsha: Concept, Origin and its Evolution;

2 The Idea of India: Unity in diversity and Composite culture.

3 Indian Education Systems: Vedic, Buddhist, Muslim; Modern Education.

4 India's Contribution to the World: Medicine- Charaka, Sushruta, Mathematics and Astronomy- Aryabhatta, Varahmihira, Ramanuja; India's Contribution to Philosphy: Sad Darshan.

5 Major Socio-Religious Reform Movements: Brahmo Samaj, Arya Samaj, Aligarh Movement.

Unit-II

1 India's struggle for Freedom: Revolt of 1857; Foundation and Role of Indian National Congress

2 Makers of Modern India: Raja Ram Mohan Roy, Rabindernath Tagore, Sir Syed Ahmad Khan, Dada Bhai Naoroji, M.K. Gandhi, J.L. Nehru, V.B. Patel, Abul Kalam Azad, B.R. Ambadekar

3 Contribution of Peasants, Tribal's, Working Classes and Women to Freedom Movement

4 Legacy of Indian National Movement: Secularism, Socialism, Democracy.

5 Making of Indian Constitution and its Salient Features.

Books Recommended:

1. H. Kabir, The Indian Heritage, Asia Publishing House, 1946.
2. M. S. Gore, Unity in Diversity: The Indian Experience in Nation-Building, Rawat, 2002.
3. R. Thapar, History of India, Tylor and Francis, 2016.
4. Dutt, and Sundharam, Indian Economy, 72th Edition, S. Chand, 2018.
5. I. C. Dhingra, The Indian Economy, 31st Edition, S. Chand, 2022.
6. S. K. Misra, V. K. Puri and Bharat Garg, Indian Economy. Himalaya Publishing House, 2023.
7. D. Basu, Introduction to the Constitution of India, 27th Edition, Lexis Nexis, 2024.
8. Government of India, Economic Survey(Annual), Economic Division, Ministry of Finance, New Delhi.
9. Ministry of Human Resource Development.

Semester-II
5-Year Integrated Master's Programme (FYIMP) with Major in Mathematics

IMTHSEWS0224: Basic Web Skills **Ext. Marks: Theory (40)**
Credits: 2 Theory(30H) **Int. Marks: Theory (10)**

Course Outcomes: The course equips students with foundational knowledge and practical abilities to navigate, utilize and contribute to the web effectively. Students shall learn essential web technologies, to create simple responsive web pages.

Theory: 2 Credits

Unit-I: Basics of HTML

Overview of HTML: Understanding its role in web development.
Basic Structure: Elements such as <!DOCTYPE >, < html >, < head > and <body>.
Common Tags: Headings (< h1 > to < h6 >), paragraphs (< p >), links (< a >), images (< img >), and lists (< u1 >, < o1 >, < li >). Attributes: Usage of attributes like href, src, alt, and title.
Semantic Elements: Introduction to < header >, < nav >, < section >, < article >, < aside > and < footer >.
Forms: Creating forms with < form >, < input >, < textarea >, < button > and associated attributes.
Tables: Constructing tables using < table >, < tr > < th > and < td >.

Unit-II: CSS and Web Development Basics

CSS Basics: Understanding the purpose of CSS in web design.
Selectors and Properties: Applying styles using selectors and properties.
Inline and Internal CSS: Methods to include CSS within HTML documents.
Basic Styling: Modifying text, colors, backgrounds, and layout properties.
Basic Web Development: Building Simple Web Pages using HTML and CSS, Adding Hyperlinks, Multimedia, and Formatting, Responsive Design Concepts, Hosting Web Pages on Free Hosting Services.

Books Recommended:

1. Jon Duckett, HTML and CSS: Design and Build Websites, Wiley, 2011.
2. Jennifer Niederst Robbins, Learning Web Design: A Beginner's Guide to HTML, CSS, JavaScript, and Web Graphics, O'Reilly, 2012.
3. Sufyan bin Uzayr, Master HTML and CSS: Along with 100 Projects, BPB Publications, 2021.

Semester-III
5-Year Integrated Master's Programme (FYIMP) with Major in Mathematics

IMTHMJTM0324: Matrix Theory **Ext. Marks: Theory(80) and Tutorials (10)**
Credits: 4 Theory(60H)+ 2 Tutorials(30H) **Int. Marks: Theory (20) and Tutorials (40)**

Course Objectives: The course provides a foundational understanding of matrices and their applications in various fields. The course emphasizes solving linear systems, understanding vector spaces, and utilizing matrices in transformations and real-world problems and develop critical problem-solving skills and mathematical tools for applications in engineering, physics, computer science, and data analysis.

Theory: 4 Credits

Unit-I
Commutative and associative laws in matrix operations, generalization of reversal law of transpose. Hermitan and Skew-Hermitan matrices, representation of a square matrix as $P + iQ$, where P and Q are both Hermitan, adjoint of a matrix. For a square matrix A, $A(adjA) = (adjA)A = |A|I$, necessary and sufficient condition for a square matrix to be invertible, generalization of reversal law for the inverse of matrices under multiplication.

Unit-II
The operation of transposing and inverting are commutative, trace of matrix, trace of AB = trace of BA and its generalization, partitioning of matrices, matrix polynomials and characteristic equation of a square matrix, Cayley-Hamilton theorem, eigen values and eigen vectors, minimal equation of matrix.

Unit-III
Rank of matrix, elementary row (column) transformations of a matrix do not alter its rank, rank of a matrix by elementary transformations, reduction of a matrix to the normal form, elementary matrices, every non-singular matrix is a product of elementary matrices, employment of only row(column) transformations, rank of product of two matrices, linear combination, linear dependence and linear independence of row (column) vectors, the columns of a matrix A are linearly dependent iff there exists a vector $X \neq 0$ such that $AX = 0$, the columns of a matrix A of order $m \times n$ are linearly dependent iff rank of $A < n$, the matrix A has rank r iff it has r linearly independent columns and any s-columns $(s > r)$ are linearly dependent(analogous results for rows).

Unit-IV
Linear homogeneous and non-homogeneous equations, the equation $AX = 0$ has a non-zero solution iff rank of $A < n$ (the number of its columns), the number of linearly independent solutions of the equation $AX = 0$ is $n - r$, where r is the rank of matrix A of order $m \times n$, the equation $AX = B$ is consistent iff two matrices A and $[A : B]$ are of same rank, inner product of two vectors, length of a vector, normal vectors, orthogonal and unitary matrices, a matrix P is orthogonal (unitary) iff its column vectors are normal and orthogonal in pairs.

Tutorial: 2 Credits

Unit–V
Problems based on Hermitian and Skew-Hermitian and inverse of matrices, problems on characteristic roots and characteristic polynomials, applications of Cayley Hamilton theorem for the inverse of a square matrix.

Unit–VI
System of equations and their solutions, examples of determination of orthogonal matrices and examples of system of homogenous and non-homogenous equations having unique, infinite and no solution.

Books Recommended:

1. Shanti Narayan and P.K. Mittal, A text book of matrices, S. Chand, 1957.
2. Rajendra Bhatia, Matrix Analysis, Springer, 1997.
3. S. Lipschutz, M. Lipson, Linear Algebra, Schaum's Outline, 4th-Edition, McGraw-Hill, 2009.
4. K. Hoffman and R. Kunze, Linear Algebra, Pearson, 2018.

Semester-III
5-Year Integrated Master's Programme (FYIMP) with Major in Mathematics

IMTHMJCE0324: Complex Trigonometry and Theory of Equations

Credits: 4 Theory(60H)

Ext. Marks: Theory (80)
Int. Marks: Theory (20)

Course Outcomes: The course introduces advanced concepts in trigonometry and algebra. They shall analyze polynomial equations, solve higher-degree equations and have a strong foundation to solve complex mathematical problems and apply these concepts in advanced mathematical and engineering contexts.

Theory: 4 Credits

Unit-I
Polar and exponential representation of complex number, De-Moivre's theorem, its applications in solving equations, roots of a complex number, roots of unity, triangle inequality and its generalization and its applications, expansion of $sinn\theta, cosn\theta$ in terms of powers of $sin\theta, cos\theta$, expansion of $sin^n\theta, cos^n\theta$ in terms of multiples of θ.

Unit-II
Complex functions: exponential, circular functions, logarithm of complex numbers, hyperbolic functions, relation between hyperbolic and circular functions, inverse circular and inverse hyperbolic functions of a complex variable and their properties, summation of trigonometric series: angles in A.P, difference method, C+iS method.

Unit-III
General properties of equations, synthetic division, relationship between roots and coefficients of an equation, formation of equations whose roots are function of given equation, transformation of equations, removal of terms of an equation, diminishing the roots of an equation by a given number, equations of squared differences.

Unit-IV
Symmetric functions, Newtons method of finding the sum of powers of the roots of an equation, solution of cubic and bi-quadratic equations by Cardan's and Descarte's method respectively, Descarte's rule of sign.

Books Recommended:

1. W. S. Burnside and A. W. Panton, Theory of Equations, Vol-I, Hodges Figgis and company, 1924.
2. C. C. Mac Duffee, Theory of Equations, Wiley, 1954.
3. M. R. Puri, Complex Trigonometry, Kapoor and Sons, 1977.
4. A. Aziz and N. Rather, Theory of equations, Kapoor and son's srinagar, 2011.

Semester-III
5-Year Integrated Master's Programme (FYIMP) with Major in Mathematics

IMTHMNTK0324 : Thermodynamics and Kinetic Theory of Gases

Ext. Marks: Theory (80) and Practical (25)

Credits: 4 Theory(60H)+ 2 Practicals(60H) **Int. Marks: Theory (20) and Practical (25)**

Course Outcomes: The course provides a foundational understanding of the principles governing energy, heat, and work. Students shall explore the laws of thermodynamics, thermodynamic processes, and applications in various systems

Theory: 4 Credits

Unit-I

Laws of Thermodynamics: Thermodynamic Description of system: Zeroth Law of thermodynamics and temperature. First law and internal energy, conversion of work into heat (Joules law), Conversion of heat into work, various thermodynamical processes, (isothermal, adiabatic and isochoric etc.), Applications of First Law: General Relation between Cp and Cv, Work Done during Isothermal and Adiabatic Processes, reversible and irreversible processes.

Unit-II

Second law and Entropy. Carnot's cycle and carnot's theorem, Entropy changes in reversible and irreversible processes, Entropy-temperature diagrams, Third law of thermodynamics, Unattainability of absolute zero. Thermodynamic Potentials: Enthalpy, Gibbs, Helmholtz and Internal Energy functions, Maxwell's relations and applications - Joule-Thompson Effect,Clausius-Clapeyron Equation, Expression for(Cp–CV),Cp/Cv, TdS equations.

Unit-III

Kinetic Theory of Gases: Derivation of Maxwell's law of distribution of velocities and its experimental verification, Mean free path (Zeroth Order), Transport Phenomena: Viscosity, Conduction and Diffusion (for vertical case), Law of equipartition of energy (no derivation) and its applications to specific heat of gases; mono-atomic and diatomic gases.

Unit-IV

Behavior of real gases: Real and ideal gas, Andrews experiment, Vander walls equation of state and critical constants, limitations of Vander walls equation, Boyles temperature and its relation to critical temperature, Inversion temperature, triple point of a substance. Liquefaction of Gases, Joule Thomson porous plug experiment, Liquefaction of gases by various cascade processes regenerative Joule Thomson Process, Liquefaction of hydrogen and helium.

List of Practicals: (Any five)

1. To determine Mechanical Equivalent of Heat, J, by Callender and Barne's constant flow method.
2. Measurement of Planck's constant using black body radiation.
3. To determine Stefan's Boltzmann's law/ to determine Stefan's Constant.
4. To determine the coefficient of thermal conductivity of copper by Searle's Apparatus.
5. To determine the efficiency of an electric Kettle.
6. To determine the coefficient of thermal conductivity of a bad conductor like card board by Lee's method.
7. To determine the temperature co-efficient of resistance by Platinum resistance thermometer.
8. To study the variation of thermo emf across two junctions of a thermo couple with temperature.

Books Recommended:

1. M. W. Zemasky and R.Dittman, Heat and Thermodynamics, McGraw-Hill, 1981.
2. F.W. Sears and G.L. Salinger, Thermodynamics, Kinetic theory and Statistical thermodynamics, Narosa, 1988.
3. C. Kittel and H. Kroemer, Thermal Physics, 2nd Edition, Freeman, 2012.
4. S. Garg, R.Bansal and C.Ghosh, Thermal Physics, McGraw-Hill, 1993.
5. Ronald Lane Reese, University Physics, Thomson Brooks/Cole, 2003.

Semester-III
5-Year Integrated Master's Programme (FYIMP) with Major in Mathematics

IMTHAEUL0324: Urdu Language
Credits: 3 Theory(45H) **Ext. Marks: Theory (75)**

متوقع تدریسی نتائج Expected Learning Outcomes:

یہ پرچہ کامیاب کرنے کے بعد طلبہ سے توقع کی جاتی ہے کہ انہوں نے اردو تقریر و تحریر میں عام طور پر در آنے والی کمیوں کی نشاندہی کرنے کی صلاحیت پیدا ہوئی ہوگی نیز انہوں نے معیاری انشا پر بھی قدرت حاصل کی ہوگی۔

یونٹ اوّل:

- جملہ اور جملہ کے اجزا * اقسام جملہ بلحاظ بناوٹ
- مرکب جملے کی اقسام * رموز واوقاف
- قواعد کی چند اصطلاحات کی تعریف اور مثالیں (مذکر، مونث، واحد، جمع، جمع الجمع)

یونٹ دوم:

- محاورات، ضرب الامثال، مترادفات، متضاد اور متشابہ (ہم معنی/ہم صورت) الفاظ کی تعریف، مثالیں اور استعمال
- تعلیمی، سائنسی، سماجی اور ادبی اقتباسات کی تفہیم

یونٹ سوم:

- خطوط نویسی۔ اصول اور نمونے
- مضمون نگاری۔ اصول اور نمونے

امدادی کُتب:

نمبر شمار	نام کتاب	مصنف	طابع/ناشر	سنہ اشاعت
1	قواعدِ اردو	مولوی عبدالحق	انجمنِ ترقی اردو ہند	2007
2	اردو املا	رشید حسن خان	نیشنل اکاڈمی، ۹ انصاری مارکیٹ، دلی	1974
3	ایم آئی ایل اردو	شعبہ اردو کشمیر یونیورسٹی	کے بی ٹی حضوری باغ سرینگر	2020
4	قواعد تذکیر و تانیث	جلیل مانک پوری	مکتبہ جامعہ لمیٹیڈ، نئی دہلی	1994
5	آسان اردو قواعد	م ق سلیم	دکن لٹریری ایسوی ایشن، حیدر آباد	2006

Semester-III
5-Year Integrated Master's Programme (FYIMP) with Major in Mathematics

IMTHMDIE0324 : Introductory of Economics
Credits: 3 Theory(45H) **Ext. Marks: Theory (75)**

Course Outcomes: The course provides a foundational understanding of economic principles and concepts. Students shall learn about microeconomics, macroeconomics, supply and demand, market structures, and the role of government in the economy. By the end of the course, students shall be able to analyze basic economic issues, interpret economic data, and apply economic reasoning to real-world problems in personal, business, and policy contexts.

Theory: 3 Credits

Unit I: Introduction
Definition and Scope of economics, Micro and Macroeconomics, Positive and Normative Economics, Scarcity, Choice and Opportunity Cost, Central Problems of an Economy, Economic Systems–Basic Economic Concepts.

Unit II: Introduction to Microeconomics
Demand–Determinants of Demand, Law of Demand and its Exceptions, Supply–Determinants and Law of Supply, Market Equilibrium, Utility–Concepts and Approaches, Total Utility, Marginal Utility, Indifference Curve–Assumptions and Properties, Budget Line, Consumer Preferences.

Unit III: Introduction to Macroeconomics
National Income–Concepts and Measurements, Circular Flow of Income, Price Indices–WPI, CPI and GDP deflator, Money–Types and Functions, Measures of Money Supply, Inflation–Meaning and Types, Stabilization policies-Fiscal and monetary policy.

Books Recommended:

1. P. Samuelson and W. Nordhas, Principles of Economics, 9th Edition, McGraw-Hill, 2010.
2. B. D. Bernheim and Michael D. Whinston, Microeconomics, McGraw-Hill, 2014.
3. N. Mankiw, Economics: Principles and Applications, 9th Edition, Cengage, 2020.
4. H. L. Ahuja, Advanced Economic Theory—Microeconomic Analysis, 20th Edition, S. Chand, 2020.
5. H. L. Ahuja, Macroeconomic-theory and Policy, 20th Edition, S. Chand, 2020.

Semester-III
5-Year Integrated Master's Programme (FYIMP) with Major in Mathematics

IMTHSEIP0324 : Introduction to Programming **Ext. Marks: Theory (40)**
Credits: 2 Theory (30H) **Int. Marks: Theory (10)**

Course Outcomes: The course provides foundational knowledge and skills in computer programming and shall be able to design and implement simple programs, understand programming logic, and apply computational thinking to solve real-world problems.

Theory: 2 Credits

Unit-I: Introduction to Programming Concepts

Introduction to Programming Concepts: Programming Languages: Definition and Types, Algorithms and Flowcharts, Compilers and Interpreters. Variables, Data Types, and Operators, Control Structures: If, Else, Loops (For, While). Functions and Modules: Creating reusable code blocks and organizing programs into modules. Introduction to Integrated Development Environments (IDEs): Utilizing tools for writing, testing, and debugging code.

Unit-II: Introduction to Python Programming:

Introduction to Python: Syntax and Structure, Writing and Executing Python Programs, Input/output Statements, Control Flow: Implementing conditional statements (if, elif, else) and loops (for, while) for decision-making and iteration. Functions and Modules, Lists, Tuples, and Dictionaries.Web Development Basics: A brief overview of web frameworks like Flask or Django for web application development.

Books Recommended:

1. Olivier Hersent, The Internet of Things: Key Applications and Protocols, Wiley, 2011.
2. Mark Lutz, Learning Python O'Reilly Media, 2013.
3. Al Sweigart, Automate the Boring Stuff with Python, No Starch Press, 2023.

Semester-IV
5-Year Integrated Master's Programme (FYIMP) with Major in Mathematics

IMTHMJRA0424: Real Analysis **Ext. Marks: Theory (80) and Tutorial (10)**
Credits: 4 Theory(60H)+ 2 Tutorials(30H) **Int. Marks: Theory (20) and Tutorial (40)**

Course Outcomes: After completion of this course the student shall be able to understand the notions like continuity, convergence in a generalized framework of metric spaces and shall be enabled to take a course on topology.

Theory: 4 Credits

Unit-I
Real numbers, cardinality, countable and uncountable sets, countability of rationals and of uncountability of reals, bounded and unbounded sets, l.u.b and g.l.b. of a set of real numbers, Archimedean property, Dedekind's property, $\mathbb{R}$ as an ordered field, completeness and the least upper bound property of $\mathbb{R}$.

Unit-II
Sequences of real numbers: bounds of a sequence, limit and convergence of a sequence, theorems on limit and convergence of sequences, bounded and monotonic sequences, sub-sequences, Cauchy's criteria for convergence of sequences, limit point of a sequence, nested interval theorem, Bolzano-Weierstrass theorem.

Unit-III
Infinite series, convergence and divergence of series, necessary condition for convergence of a series, Cauchy criteria for convergence of series, geometric series, series of positive terms, comparison test, Cauchy's root test, D-Alembert's ratio test, Raabe's test, Logarithmic test, Integral test and Gauss test, alternating series, Leibnitz test.

Unit-IV
Riemann-Integration, upper and lower sums, refinement of a partition, behavior of lower sums and upper sums under refinement, necessary and sufficient conditions for R-integrability of a bounded function, algebra of R-integrable functions, R-integrability of $|f|$ for which f is bounded and integrable on an interval, R- integrability of a function having a finite number of discontinuities and of continuous and monotone functions. Fundamental theorem of calculus, primitive of a R-integrable function, continuity and differentiability of the primitive.

Tutorial: 2 Credits

Unit V
Incompleteness of the set of rational numbers, limit inferior and limit superior of a sequence, examples of convergence and divergence of different sequences.

Unit VI
Absolute and conditional convergence, examples of convergent and divergent series. Lebesgue's criterion for R-integration.

Books Recommended:

1. R. Goldberg, Methods of Real Analysis, Oxford IBM Publication, 1970.
2. T. M. Apostol, Mathematical Analysis, Narosa Publications, 2002.
3. S. C. Malik, and S. Arora, Mathematical Analysis, New Age International, 2005.
4. W. Rudin, Principles of Mathematical Analysis, McGraw-Hill, Indian Edition, 2017.

Semester-IV
5-Year Integrated Master's Programme (FYIMP) with Major in Mathematics

IMTHMJDE0424: Differential Equations **Ext. Marks: Theory (80) and Tutorials(10)**
Credits: 4 Theory (60H)+ 2 Tutorials(30H) **Int. Marks: Theory (20) and Tutorial (40)**

Course Outcomes: After completion of this course the student shall be able to give mathematical solutions of physical problems using differential equations.

Theory: 4 Credits

Unit-I
Formation of a differential equations by elimination arbitrary constants, complete primitive, particular integral and singular solution of a differential equation, first order and first degree differential equations and their solutions for homogeneous, linear and Bernoulli's type differential equations, exact differential equations, necessary and sufficient condition for a differential equation Mdx+Ndy=0 to be exact.

Unit-II
Symbolic operators, homogenous and non-homogenous linear differential equations with constant and variable coefficients, equations of the second order, auxiliary equations with different cases, the complimentary function and particular integral, miscellaneous forms, (solvable for p, x and y), Clairaut's form.

Unit-III
Simultaneous and total differential equations, solution of equations of the form $dx/P = dy/Q = dz/R$ using the method of inspection and multiplier, a second integral based on first integral, geometrical interpretation of the simultaneous system of equations. Total differential equations $Pdx + Qdy + Rdz = 0$, method of integration when it is integrable, method of solution by treating one variable constant, condition for integrability (statement only).

Unit-IV
Partial differential equation, order and degree, linear and non-linear PDE, classification of first order PDE into linear, semi-linear, quasi-linear and non-linear, formation of partial differential equations by the elimination of arbitrary constants and functions, Lagrange's method, geometrical interpretation of the partial differential equation of the form $Pp + Qq = 0$.

Tutorial: 2 Credits

Unit V
Integrating factors, equations reducible to exact differential equations, equations reducible to Clairaut's form.

Unit VI
Second order partial differential equation and its classification into parabolic, elliptic and hyperbolic through illustrations.

Books Recommended:

1. D. A. Murray, Introductory Course in Differential Equation, Orient Longman, 1967.
2. Z. Ahsan, Differential equations and their applications, PHI, Pvt Ltd, New-Delhi, 2nd Edition, 2004.
3. S. L. Ross, Differential equations, 3rd Edition, Wiley, India, 2004.
4. H. T. H. Piaggio, Differential Equations, CBS Publishers and distributors, 2004.
5. K. S. Rao, Introduction to partial differential equations, PHI, 2011.

Semester-IV
5-Year Integrated Master's Programme (FYIMP) with Major in Mathematics

IMTHMJAA0424: Abstract Algebra **Ext. Marks: Theory (80)**
Credits: 4 Theory(60H) **Int. Marks: Theory (20)**

Course Outcomes: After completion of this course the student shall be able to use the abstract algebraic notions in other sciences.

Theory: 4 Credits

Unit-I
Equivalence relations and equivalence classes, integer modulo system, binary composition. Groups, examples and simple properties, general linear groups, symmetries and formation of groups from the equilateral triangle and square. Examples of non-abelian groups, subgroups and cosets, criteria of subgroups, order of an element.

Unit-II
Lagrange's theorem for finite groups, cyclic groups, equality for the order of a group and the order of its generator, permutation groups, Cayley's theorem, permutation as a product of disjoint cycles and transpositions, even and odd permutations, alternating groups A_n, order of an alternating group.

Unit-III
Group homomorphism and isomorphism, kernel of a homomorphism, fundamental theorem of homomorphism and theorems on isomorphism, product of subgroups and condition for the product to be a subgroup, counting principle, normal subgroups and their properties, quotient groups. Centre of a group and normalizer of an element in a group.

Unit-IV
Rings: Definition, examples of commutative and non-commutative rings, integral domains, zero divisors, subrings and ideals, definition of quasi-fields and fields, ring homomorphisms and isomorphism, kernel of a homomorphism, quotient rings, prime and maximal ideals, principal ideals and PIR's, relation between maximal and prime ideals, ideals of nilpotent and radical elements, fundamental theorem of ring homomorphism.

Books Recommended:

1. I. N. Herstein, Topics in Algebra, Wiley, 1975.
2. P.B. Bhattachariya, S.K. Jain, S. R. Nagpaul, Basic Abstract Algebra, Cambridge University Press, 1994.
3. Joseph Gallian, Contemporary Abstract Algebra, Narosa Publishers, 1999.
4. D. S. Dumit and R. M. Foote, Abstract Aldebra, Wiley, 2003.
5. Surjeet singh and Qazi Zameeruddin, Modern Algebra, S. Chand, 2021.

Semester-IV
5-Year Integrated Master's Programme (FYIMP) with Major in Mathematics

IMTHMJNA0424: Numerical Analysis **Ext. Marks: Theory (80)**
Credits: 4 Theory(60H) **Int. Marks: Theory (20)**

Course Outcomes: After the completion of this course students shall be able to apply computational methods to approximate solutions for complex mathematical and engineering problems improving accuracy and efficiency in problem-solving.

Theory: 4 Credits

Unit-I
Finite difference and interpolation, error estimation, finite differences forward, backward and central difference operator, and relation between them. Newton's difference formulae, Newton's divided difference formulas, Gauss forward and backward formulae, Lagrange's and Hermite interpolations formula.

Unit-II
Numerical solution of algebraic and transcendental equations, basic concepts on polynomial equations, roots of equations by bisection method, iterative method, Regula-falsi method, Newton – Raphson method, secant method, and their rate of convergnence.

Unit-III
Numerical differentiation and integration, numerical differentiation using Newtons forward and backward formulas, maxima and minima of a tabulated function, numerical integration, quadrature formula, trapezoidal rule, Simpsons $\frac{1}{3}$rd rule, Simpsons $\frac{3}{8}$rd rule, Weddle's rule.

Unit-IV
Numerical solution of an ordinary differential equation, Picard's method, Taylor's Series Method, Euler's Method, Modified Euler's Method, Runge-Kutta method, Predictor-Corrector method.

Books Recommended:

1. B. Bradie, A friendly introduction to Numerical Analysis, Pearson, India, 2007.
2. Kendall E. Atkinson, An introduction to numerical analysis, Cambridge University Press, 2008.
3. S. S. Sastry, Introductory Methods of Numerical Analysis, PHI New-Delhi, 2012.
4. M. K. Jain, S. R. K. Iyenger and R.K.Jain, "Numerical Methods for Scientific and Engineering Computation, New Age International Publishers, 2019.

Semester-IV
5-Year Integrated Master's Programme (FYIMP) with Major in Mathematics

IMTHMNWO0424 : Waves and Optics **Ext. Marks: Theory (80) and Practical (25)**
Credits: 4 Theory(60H)+ 2 Practicals(60H) **Int. Marks: Theory (20) and Practical (25)**

Course Outcomes: After the course completion student shall understand the principles of wave optics, analyze optical systems and apply concepts in areas like wave behavior, spectroscopy, and optical instruments.

Theory: 4 Credits

Unit-I
Superposition of two collinear Harmonic oscillations: Linearity and Superposition Principle. (1) Oscillations having equal frequencies and (2) Oscillations having different frequencies (Beats). Superposition of Two Perpendicular Harmonic Oscillations: Graphical and Analytical Methods. Lissajous Figures with equal an unequal frequency and their uses. Waves Motion- General: Transverse waves on a string. Travelling and standing waves on a string. Normal Modes of a string. Group velocity, Phase velocity. Plane waves. Spherical waves, Wave intensity.

Unit-II
Wave Optics: Electromagnetic nature of light. Definition and Properties of wave front. Huygens Principle. Interference: Interference: Division of amplitude and division of wavefront. Young's Double Slit experiment, Lloyd's Mirror and Fresnel's Biprism. Phase change on reflection: Stoke's treatment. Interference in Thin Films: parallel and wedge- shaped films. Fringes of equal inclination (Haidinger Fringes), Fringes of equal thickness (Fizeau Fringes). Newton's Rings: measurement of wavelength and refractive index. Michelson's Interferometer: Idea of Fraunhofer fringes (no theory needed), Determination of wavelength, Wavelength difference, Refractive index and Visibility of fringes.

Unit-III
Diffraction: Fraunhofer diffraction: Single slit; Double Slit. Multiple slits and Diffraction grating. Fresnel Diffraction: Half – period zones. Zone plate. Fresnel Diffraction pattern of a straight edge, a slit and a wire using half-period zone analysis. Polarization: Transverse nature of light waves. Plane polarized light – production and analysis. Circular and elliptical polarization.

Unit-IV
Sound: Intensity and loudness of sound - Decibels - Intensity levels - musical notes - musical scale. Acoustics of buildings: Reverberation and time of reverberation – Absorption coefficient-Sabine's formula-measurement of reverberation time-Acoustic aspects of halls and auditoria. LASER: Spontaneous emission, Stimulated Emission, Population Inversion, LASER and it's types , Application of Lasers.

List of Practicals: (Any Five)

1. To investigate the motion of coupled oscillators.
2. To determine the Frequency of an Electrically Maintained Tuning Fork by Melde's Experiment and to verify λ^2- T Law.
3. To study Lissajous Figures.
4. To determine the Refractive Index of the Material of a given Prism using Sodium Light.
5. To determine Dispersive Power of the Material of a given Prism using Mercury Light.
6. To determine wavelength of sodium light using Fresnel Biprism.
7. To determine the wavelength of sodium light using Newtons rings.
8. To determine the Resolving Power of a Plane Diffraction Grating.
9. To determine the resolving power of a prism.
10. To determine the magnifying power of a Telescope using a travelling microscope.
11. To determine the resolving power of a Telescope.

Books Recommended:

1 F. Jenkins and H. White, Fundamentals of Optics, McGraw-Hill, 1976.

2 M. Born and E. Wolf, Principles of Optics, 7th Edition, Cambridge University Press, 1999.

3 E. Hecht and A. R. Ganesan, Optics, 5th Edition, Pearson, 2019.

4 A. Ghatak, Optics, McGraw-Hill, 2024.

Semester-V
5-Year Integrated Master's Programme (FYIMP) with Major in Mathematics

IMTHMJPS0524: Plane and Solid Geometry **Ext. Marks: Theory (80) and Tutorial (10)**
Credits: 4 Theory(60H) + 2 Tutorial(30H) **Int. Marks: Theory (20) and Tutorial (40)**

Course Outcomes: The outcome of the course shall provide students an in-depth understanding of conic sections and three-dimensional geometry. The students will explore the properties, equations, and applications of parabolas and hyperbolas, as well as the geometric and algebraic representations of spheres and cylinders. By the end of the course, student shall be able to solve problems involving these geometric figures, analyze their relationships, and apply these concepts in fields such as physics, engineering, and architecture.

Theory: 4 Credits

Unit-I
Parabola, equation of tangent and normal, pole and polar, pair of tangents from a point, equation of a chord of a parabola in terms of middle point, parametric equation of parabola. Ellipse, tangents and normals, pole and polar, parametric equation of ellipse, diameters, conjugate diameter.

Unit-II
Hyperbola, equation of tangent and normal, pole and polar, equation of a chord of an ellipse in terms of middle point, parametric equation, Equation of hyperbola referred to asymptotes as axes, rectangular and conjugate diameter, general second degree equation in x and y, condition under which a general second degree equation represent a conic, determination of equation of the corresponding conic.

Unit-III
Sphere, radical plane, coaxial system, simplified form of the equation of two spheres, cone, vertex, guiding curve, generator, equation of cone with vertex as origin or a given vertex and guiding curve, condition that the general equation of the second degree should represent a cone, necessary and sufficient conditions for a cone to have three mutually perpendicular generators.

Unit-IV
Cylinder, equation of cylinder whose generators intersect a given conic and are parallel to given line, enveloping cylinder of a given sphere, types of conicoids, tangent and tangent planes, director sphere, normal to a sphere, pole and polar planes.

Tutorial: 2 Credits

Unit–V
Tangent and normal of parabola and ellipse in parametric forms with examples, tracing of parabola and ellipse.

Unit–VI
Tracing of hyperbola, plane and equation of planes in intercept and normal form, sphere, equation of sphere in general form, diameter form, intersection of sphere with plane.

Books Recommended:

1. S. L. Loney, The elements of coordinate geometry, McMillan and Company, London, 1895.
2. P. Balasubrahamanyam, K. G. Subramanian and G. R. Venkataraman, Coordinate geometry of two and three dimensions, McGraw-Hill,1994
3. Shanti Narayan, Analytical solid geometry, S. Chand and Company, 2007.
4. S. Pirzada and T. A. Chishti, Analytical solid geometry, Universities Press, Orient Blackswan, 2007.

Semester-V
5-Year Integrated Master's Programme (FYIMP) with Major in Mathematics

IMTHMJMM0524: Mathematical Modelling and Operations Research

Ext. Marks: Theory (80) and Internship (50)

Credits: 4 Theory(60H) + 2 Internship **Int. Marks: Theory (20)**

Course Outcomes: After completing this course, students shall acquire the skills to create, analyze, and validate mathematical models across fields such as physics, biology, economics, and engineering. They shall learn to apply differential equations, optimization techniques, and interdisciplinary approaches to solve real-world problems.

Theory: 4 Credits

Unit-I

Definition and Importance of Mathematical Modeling, Applications of mathematical modeling in various fields (physics, economics, biology, engineering). The role of assumptions in mathematical modeling; Types of models: Continuous vs. discrete models, deterministic vs. stochastic models, Identifying the problem and formulating the model, simplifying assumptions and model simplifications,formulation and solution. Verifying and validating the model.

Unit-II

Modeling with Differential Equations: Modeling Population Growth Exponential and logistic growth models, Predator-prey models (Lotka-Volterra equations). Modeling Chemical Reactions, Rate of reaction and concentration models; The law of mass action and applications in chemical kinetics. Modeling Physical Systems, Simple harmonic motion, Gravational laws.

Unit-III

Mathematical Modelling and communicable diseases, Epidemiological models (e.g., SIR models for infectious diseases). Economic models (e.g., supply-demand equilibrium, market behavior). Engineering models (heat transfer, mechanical vibrations). Interdisciplinary Modeling, Integrating models from multiple fields to solve complex problems (e.g., environmental modeling, climate change, and sustainability).

Unit-IV

Basic definition of Operations Research. Linear programming: formulation, graphical method, and simplex algorithm, nonlinear optimization: methods and applications. Constrained and unconstrained optimization problems. Applications of Optimization Models. Game theory and decision-making models.

Internship: 2 credits

Through the internship, the students have to earn the credits from any recognized organization/Industry/ Institute by gaining experiential learning through solving real life problems using mathematics. The other details are given in the curriculum.

Books Recommended:

1. M. R. Cullen, Linear Models in Biology, Wiley, 1985.
2. J. N. Kapur, Mathematical Model in Biology and Medicines, New Age International Publishers, 2000.
3. Hamdy, A. Taha, Operations Research – An Introduction, 9th Edition, Prentice Hall, 2010.
4. F. S. Hiller, G. J. Lieberman, Introduction to Operation Research-Concepts and Cases, McGraw-Hill, 2010.
5. M. A. Khanday, Introduction to Modeling and Bio-mathematics, Dilpreet Publishers, 2015.
6. Kanti Swarup, P. K. Gupta and M. M. Singh, Operation Research, S. Chand, 2019.

Semester-V
5-Year Integrated Master's Programme (FYIMP) with Major in Mathematics

IMTHMJAC0524: Advanced Calculus **Ext. Marks: Theory (80)**
Credits: 4 Theory(60H) **Int. Marks: Theory (20)**

Course Outcomes: This course equips students with a comprehensive understanding of functions of two variables, including limits, continuity, partial derivatives, and optimization techniques.

Theory: 4 Credits

Unit-I
Limit, continuity, partial derivatives of functions of two variables, conditions for the equality of mixed partials, maxima and minima, differentiation of functions of two variables, directional derivatives and their relationship, implicit differentiation, chain rule.

Unit-II
Double integral, partition of a rectangle, integration over a rectangle and region, conditions for integrability, differentiation under the integral sign, Green's theorem.

Unit-III
Line integrals, evaluation of line integral, transformation of line integral into double integral, surface integral, tripple integral, transformation of surface integral. Divergence theorem, Stokes theorem.

Unit-IV
Constrained extrema involving functions of two variables, Lagranges multipliers with examples, Fubini's theorem, change of variables.

Books Recommended:

1. David Widder, Advanced Calculus, Prentice Hall, 1989.
2. S. Dineen, Functions of two variable, Chapman and Hall, 1995.
3. Sudhir R. Ghorpade, B.V. Limaye: A Course in Multivariable Calculus and Analysis, Springer International Edition, 2010.
4. John. Petrovic, Advanced Calculus, 2nd Edition CRC press. 2020.

Semester-V
5-Year Integrated Master's Programme (FYIMP) with Major in Mathematics

IMTHMJLA0524 : Linear Algebra **Ext. Marks: Theory (80)**
Credits: 4 Theory(60H) **Int. Marks: Theory (20)**

Course Outcomes: After completion of this course the student shall be able to deal with different spaces through linear transformations.

Theory: 4 Credits

Unit-I
Similar matrices, determination of diagonal matrices, the necessary and sufficient conditions for a square matrix of order n to be similar to a diagonal matrix, Orthogonal diagonalization of symmetric matrices, triangular form over $\mathbb{C}$ and $\mathbb{R}$, Schur's theorem, normal matrices.

Unit-II
Quadratic forms, reduction by orthogonal transformation of real quadratic forms, necessary and sufficient condition for a quadratic form to be positive definite, a real symmetric matrix A is positive definite if and only if it exists and is positive definite and symmetric, a real symmetric matrix A is positive definite if all its eigen values are positive, perturbation of roots of polynomials, companion matrix, Hadamard's theorem.

Unit-III
Vector space, examples, subspaces, algebra of subspaces, linear dependence and linear independence, linear span, basis and dimension of vector spaces, quotient space.

Unit-IV
Linear transformation, null space, range space, rank-nullity theorem, algebra of linear transformations, singular and non singular transformations, matrix representation of a linear transformation.

Books Recommended:

1. A. R. Rao and P. Bhimasankaram, Linear Algebra, 2nd Edition, Hindustan Book Agency, 2000.
2. S. Lipschutz, M. Lipson, Linear Algebra, Schaum's Outline, 2009.
3. K. Hoffman and R. Kunze, Linear Algebra, Pearson, 2018.
4. Stephen. H. Friedberg, Linear Algebra, Pearson, 2022.
5. Gilbert Strang. Linear Algebra and its applications, 4th Edition, Cengage, 2005.

Semester-V
5-Year Integrated Master's Programme (FYIMP) with Major in Mathematics

IMTHMNCP0524 : C-Programming **Ext. Marks: Theory (80) and Practical (25)**
Credits: 4 Theory(60H)+2 Practicals(60H) **Int. Marks: Theory (20) and Practical (25)**

Course Outcomes: After completion of the course the students shall understand the basics of C-programming, including syntax, structure, and data types and shall gain the ability to implement decision-making, looping, and control structures and shall be able to develop skills in creating functions, handling arrays, strings, and to apply knowledge of structures, unions, and dynamic memory allocation effectively.

Theory: 4 Credits

Unit-I
Introduction to C - Programming, Fundamentals of C Importance and applications of C, Structure of a C program, Setting up the development, Environment (e.g., GCC compiler).Basic Syntax and Structure, Header files and pre-processor directives, The main() function, Compiling and running a simple C program. Data Types and Variables, Primitive data types (int, float, char, double), Declaring and initializing variables, Constants and literals. Input and Output Operations, Using printf() and scanf(), Format Specifiers.

Unit-II
Decision control structure in C, Control Structures : Conditional statements (if, else if, else, switch statements) Looping constructs (for, while, do-while loops), Using break and continue, Looping Control structure (for, while, do-while loops), Loop use of jumping statements (break, continue, goto).

Unit-III
Functions, Arrays and Strings Concept of library functions, user defined functions, passing arguments, Function prototype, calling a function static functions, recursion Arrays and strings: declaring and initialization passing pointers to a function, matrices as 2d array multi- dimensional arrays.

Unit-IV
Structures, Unions and Dynamic Memory Allocation, Defining and accessing structure, structure as function arguments an arrays of structures defining and accessing union, Dynamic Memory allocation: introduction to dynamic memory allocation (malloc calloc realloc).

List of Programs: (Any Ten)

1. Hello World Program: Write a program that prints "Hello, World!" to the console.
2. Simple Calculator: Create a program that takes two integers as input and performs basic arithmetic operations (addition, subtraction, multiplication, division).
3. Area of a Circle: Calculate the area of a circle given its radius.
4. Temperature Conversion: Convert a temperature from Celsius to Fahrenheit.
5. Even or Odd: Determine if a given integer is even or odd.
6. Leap Year Checker: Check if a given year is a leap year.
7. Simple Interest Calculator: Compute simple interest given principal, rate, and time.
8. ASCII Value Finder: Display the ASCII value of a given character.
9. Grade Calculator: Assign a grade (A, B, C, etc.) based on a student's score using if-else statements.

10. Number Sign Checker: Determine if a number is positive, negative, or zero.
11. Simple Menu-Driven Program: Implement a menu-driven program using switch-case statements.
12. Largest of Three Numbers: Find the largest among three numbers using nested if-else.
13. Vowel or Consonant: Check if a given character is a vowel or consonant.
14. Calculator Using Switch Case: Develop a simple calculator that performs basic operations based on user choice.
15. Sum of Natural Numbers: Calculate the sum of the first N natural numbers using a for loop.
16. Factorial Calculation: Compute the factorial of a given number using a while loop.
17. Multiplication Table: Display the multiplication table of a given number up to 10.
18. Fibonacci Series: Generate the Fibonacci series up to N terms.
19. Prime Number Checker: Check if a given number is prime.
20. Reverse a Number: Reverse the digits of a given number.

Books Recommended:

1. David Griffiths and Dawn Griffiths, Head First C, O'Reilly Media, 1989.
2. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language – Prentice Hall, 1999.
3. K. N. King, C Programming: A Modern Approach, W.W. Norton and Company, 2000.
4. E. Balagurusamy, Programming in ANSI C, McGraw-Hill Education, 2001.
5. Yashavant Kanetkar, Let Us C, BPB Publications, 2013.

Semester-VI
5-Year Integrated Master's Programme (FYIMP) with Major in Mathematics

IMTHMJMS0624 : Metric Space **Ext. Marks: Theory (80) and Tutorial (10)**
Credits: 4 Theory(60H)+ 2 Tutorials(30H) **Int. Marks: Theory (20) and Tutorial (40)**

Course Outcomes: After completion of this course the student shall be able to understand the notions like continuity, convergence in a generalized framework of metric spaces and shall be enabled to take a course on topology.

Theory: 4 Credits

Unit-I
Inequalities: Arithmetic and Geometric mean inequalities, Cauchy's Schwarz inequality, Holders inequality and Minkowski's inequality, Jenson's inequality with illustrative problems. Metric space and examples, open and closed sets, closure and interior, and their results, Cauchy and convergent sequences, complete metric space.

Unit-II
Completion of a metric spaces, construction of real numbers as the completion of rationals. $\mathbb{R}^n$ as a (complete) metric space under certain natural metrics, Cantor's intersection theorem, continuous functions, definition, characterizations and examples, Baire's category theorem.

Unit-III
Compactness in metric spaces, Bolzano-Weierstrass property, the Lebesgue number for an open covering, sequentially compact and totally bounded metric spaces, Heine-Borel theorem, uniform continuity and uniform continuity of continuous maps on a compact metric space.

Unit-IV
Connectedness, definition and examples, connected sets under continuous maps, characterization in terms of continuous maps into the discrete space N, connected subsets of $\mathbb{R}$, intermediate value theorem, Arzela-Ascoli theorem in $C[a, b]$.

Tutorial: 2 Credits

Unit-V
Examples of complete, incomplete metric spaces, counter examples to show when Cantor intersection theorem fails, application of Baire's category theorem.

Unit-VI
Examples of continuous and uniform continuous functions, invariance domain theorem for $\mathbb{R}$, equicontinuous families of continuous functions on a metric space with examples.

Books Recommended:

1. E. T. Copson, Metric spaces, Cambridge University Press, 1968.
2. G. F. Simon, Introduction to Topology and Modern Analysis, McGraw-Hill Publication, 2000.
3. S. Shirali, H. L. Vasudeva, Metric Spaces, Springer, 2005
4. S. P. S. Kainth, A Comprehensive Text Book on Metric Spaces, Springer, 2023.

Semester-VI
5-Year Integrated Master's Programme (FYIMP) with Major in Mathematics

IMTHMJCA0624: Complex Analysis **Ext. Marks: Theory (80) and Tutorials (10)**
Credits: 4 Theory(60H)+ 2 Tutorials(30H) **Int. Marks: Theory (20) and Tutorials (40)**

Course Outcomes: This course focuses on developing a deep understanding of complex numbers, analytic functions and the theoretical foundations of complex analysis.

Theory: 4 Credits

Unit-I
Complex function, continuity and differentiability of complex functions, analytic function, singular point, Cauchy-Riemann equations, conjugate functions, harmonic functions, necessary condition for a function to be analytic, sufficient condition for a function to be analytic.

Unit-II
Complex Integrals, contour, simply and multiply connected domain, complex line integral, an upper bound for contour integral, Cauchy's integral theorem, Cauchy's Integral formula, Cauchy's Integral formula for first and higher derivatives, applications of Cauchy's Integral formula for evaluation of complex integrals, Morera's Theorem, Cauchy's Inequality.

Unit-III
Entire function, Liouville's theorem and its generalization, fundamental theorem of algebra, maximum modulus principle, minimum modulus principle, Schwarz lemma and its generalizations.

Unit-IV
Zeros of an analytic function and their isolated character, Identity theorem, Taylor's theorem, Laurant's theorem, argument principle, Rouche's theorem, singularity, removable singularity and Riemann's theorem on removable singularity.

Tutorial: 2 Credits

Unit-V
Polar form of a C-R equation, construction of an analytic function, problems on complex integration.

Unit-VI
Types of singularities and their classification, problems on Taylor's and Laurent's series, applications of Rouche's theorem.

Books Recommended:

1. E. C. Titchmarsh, Theory of functions, 2nd Edition, Oxford University Press, 1939.
2. Richard A. Silverman, Introductory complex Analysis, Dover publication, 1984.
3. J. B. Conway, Functions of complex variable-1, 2nd Edition, Springer, 1995.
4. L. V. Ahlfors, Complex analysis, 3rd Edition, McGraw-Hill, 2000.
5. J. E. Brown and R. V. Churchill, Complex Variables and Applications, 8th Edition, McGraw-Hill, 2009.

Semester-VI
5-Year Integrated Master's Programme (FYIMP) with Major in Mathematics

IMTHMJTN0624 : Theory of Numbers **Ext. Marks: Theory (80)**
Credits: 4 Theory(60H) **Int. Marks: Theory (20)**

Course Outcomes: After completion of this course the student develop a solid foundation in number theory, focusing on divisibility, prime numbers, GCD, LCM, and key concepts such as congruences, Fermat numbers, and perfect numbers.

Theory: 4 Credits

Unit-I
Divisibility, the division algorithm and its uniqueness, GCD, LCM, their properties, radix representation, prime numbers, Euclid's first theorem, fundamental theorem of arithmetic, linear diophantine equations, necessary and sufficient condition for the solvability of linear diophantine equation.

Unit-II
Sequence of primes, Euclid's second theorem, infinitude of primes of the form 4n+3 and 6n+5, no polynomial with integral coefficients can represent primes for all integral values of x, gaps in the sequence of primes, Fermat numbers and their properties, congruence and its properties.

Unit-III
Residue classes, complete and reduced residue system, their properties, Euler ϕ-function, $\phi(m,n) = \phi(m)\phi(n)$, where $(m,n) = 1$. Number theoretic functions, some properties on $\phi(n), \tau(n), \rho(n)$ and $\mu(n)$. Mobius inversion formula.

Unit-IV
Perfect numbers, necessary and sufficient condition for an even number to be perfect. Fermat theorem, Euler theorem, Wilson theorem, Chinese remainder theorem, Farey fractions.

Books Recommended:

1. G. H. Hardy and E. M. Wright, An introduction to the theory of numbers, 5th Edition, Oxford Science publications, 1980.
2. Niven, Zuckerman and H. L. Montgomery, An Introduction to Theory of Numbers, Wiley, 1991.
3. E. Landau, Elementary number theory, 2nd Edition, American Math Soc, 1999.
4. Thomas Koshy, Elementary number theory with applications, 2nd Edition, Academic press, 2007.
5. David M. Burton, Elementary Number Theory, 7th Edition, McGraw-Hill, 2023.

Semester-VI
5-Year Integrated Master's Programme (FYIMP) with Major in Mathematics

IMTHMJDM0624: Discrete Mathematics **Ext. Marks: Theory (80)**
Credits: 4 Theory(60H) **Int. Marks: Theory (20)**

Course Outcomes: This course develops critical thinking and problem solving skills which are essential in the fields like computer science, data science and in artificial intelligence.

Theory: 4 Credits

Unit-I
Counting principle, counting set of pairs two way counting, stirling numbers of 2nd kind, simple recursion formula satisfied by S(n,k) and direct formula for S(n, k) for k=1,2,...,n, pigeonhole principle and its strong form, its applications to geometry, principle of inclusion and exclusion, its applications, de-arrangements, explicit formula for d_n, various identities involving d_n, deriving formula for Euler phi function.

Unit-II
Recurrence relations, definition of homogeneous, non-homogeneous, linear, non linear recurrence relations, recurrence relations in counting problems, homogeneous as well as non-homogeneous, recurrence relations of 2nd degree algebraic method, partially ordered sets, Zorn's Lemma, Peano's axiom, well ordering principle, axiom of choice, weak and strong principles of mathematical induction.

Unit-III
Introduction to graphs, paths and cycles, operations on graphs, bipartite graphs and Konig's theorem, Euler graphs and Euler's theorem, Hamiltonian graphs and Dirac's theorem, degree sequences.

Unit-IV
Trees and their properties, binary and spanning trees, degrees in trees, Cayley's theorem, fundamental cycles, cut vertex and cut edge in a graphs, planar graphs and Euler's formula, incidence matrix, adjacency matrix of a graph.

Books Recommended:

1. V. Balakrishnan, Introductory Discrete Mathematics, Dover Publications INC, 2000.
2. F. Harary, Graph theory, Narosa, 2001.
3. S. Lipschutz, M. L. Lipson, Discrete Mathematics, Schaum's Outlines Series, 2009.
4. S. Pirzada, An Introduction to Graph Theory, Universities Press, Orient BlackSwan, 2012.
5. R. Balakrishnan, K. Ranganathan, A text book of Graph theory, Springer-Verlag, 2012.
6. Allen Tukker, Applied Combinatorials, Wiley, 2012.

Semester-VI
5-Year Integrated Master's Programme (FYIMP) with Major in Mathematics

IMTHMNIM0624 : Introduction to MATLAB and Basic Operations

Ext. Marks: Theory (80) and Practical (25)

Credits: 4 Theory(60H)+2 Practicals(60H) **Int. Marks: Theory (20) and Practical (25)**

Course Objective: : After the completion of this course, students have a comprehensive understanding of MATLAB's interface and fundamental operations and to be able to apply control structures, write functions, and handle file input/output to build reusable code modules and to develop proficiency in working with MATLAB data structures, matrices, and advanced plotting techniques, to gain skills in data analysis, optimization, and curve fitting, essential for real-world applications and research.

Theory: 4 Credits

Unit-I
Introduction to MATLAB and Basic Operations, introduction to MATLAB interface, MATLAB workspace, command window, editor, and command history. Basic commands (clc, clear, close all).Variables and Data Types, Scalar, vectors, and matrices. Data types: double, integer, string, and logical. Basic Arithmetic and Operations, Addition, subtraction, multiplication, division, exponentiation. Element-wise operations (e.g., $.*, .^{\prime}./$).Basic Plotting and Visualization, plot(), bar(), scatter(), and histogram(). Customizing plots: labels, title, grid, legend.

Unit-II
Control Flow and Functions, Control Flow Structures, Conditional statements: if, else, elseif, switch. Loops: for and while loops. Functions and Scripts, Writing and calling functions in MATLAB. Function inputs, outputs, and variable scope. Difference between scripts and functions. MATLAB File I/O, Reading from and writing to files (text and CSV files). fopen(), fclose(), fscanf(), fprintf().

Unit-III
Advanced Data Structures and Operations Matrices and Linear Algebra, Matrix operations: addition, multiplication, transpose, inverse. Solving linear systems of equations ($Ax = b$). Working with Cell Arrays and Structures Introduction to cell arrays and structures. Accessing and manipulating elements in cell arrays and structures. Advanced Plotting, 3D plotting: mesh(), surf(), contour(). Multiple plots in one figure, subplots.

Unit-IV
Data Analysis, Optimization, and Applications Basic Data Analysis, Descriptive statistics: mean, median, standard deviation. Data filtering and manipulation with logical indexing. Optimization and Curve Fitting, Simple optimization problems using fminbnd and fminunc. Curve fitting using polyfit(), fit(), and related functions.

List of programs in MATLAB: (Any Ten)

1. Basic Arithmetic Operations: Create a script to perform addition, subtraction, multiplication, division, and exponentiation on two user-defined numbers.
2. Element-wise Operations: Write a program to demonstrate element-wise multiplication and division on two vectors.
3. Matrix Creation and Manipulation: Develop a script to create a 3×3 matrix, then compute its transpose and inverse.
4. Plotting a Sine Wave: Generate a plot of the sine function over one period with appropriate labels and title.
5. Bar Graph of Random Data: Create a bar graph representing a set of random data points.

6. Scatter Plot of Two Variables: Plot a scatter diagram for two sets of random data to visualize their relationship.
7. Histogram of Data Distribution: Generate a histogram to display the distribution of a dataset.
8. Conditional Statement Example: Write a script that checks if a number is positive, negative, or zero using if-else statements.
9. For Loop Demonstration: Create a program that calculates the factorial of a user-input number using a for loop.
10. While Loop Example: Develop a script to sum natural numbers until the sum exceeds a user-defined value using a while loop.
11. User-Defined Function: Write a function that takes a vector as input and returns its mean and standard deviation.
12. Script vs. Function: Create a script that calls a function to compute the roots of a quadratic equation.
13. Reading from a Text File: Develop a program to read numerical data from a text file and compute its average.
14. Writing to a CSV File: Write a script that generates random data and saves it to a CSV file.
15. Matrix Multiplication: Create a program to multiply two matrices and verify the result.
16. Solving Linear Equations: Develop a script to solve a system of linear equations using matrix inversion.
17. Cell Array Example: Write a program that stores different types of data in a cell array and accesses each element.
18. Structure Array Example: Create a structure array to store information about a list of students (name, age, grade) and display it.
19. 3D Surface Plot: Generate a 3D surface plot of the function $z = sin(x) * cos(y)$.
20. Multiple Plots in One Figure: Develop a script to plot multiple functions (e.g., sine and cosine) in the same figure with legends.

Books Recommended:

1. R. Pratap, MATLAB for Scientists and Engineers, Oxford University Press, 1999.
2. Jim Sizemore and John Paul Mueller, MATLAB, Dummies, 2000
3. Amos Gilat MATLAB: An Introduction with Applications, Wiley, 2011.
4. Holly Moore, MATLAB for Engineers, Pearson, 2011.
