240|MAT|MIC01-A

Session: 2024-25	
Part A- Introduction	
Subject	Mathematics
Semester	II
Name of the Course	Basic Analysis
Course Code	MIC-2
Course ID	
Course Type: (CC/ MIC/ MDC/VOC/ AEC/ VAC/SEC)	MIC
Pre-requisite for the course (if any)	Mathematics as a subject at 4.0 level (Class XII)
Course Learning Outcomes(CLOs)	After completing this course, the learner will be able to: 1. Gain knowledge about Set and Function defined on set. 2. Learn about bounds of set, completeness property of real numbers. 3. Gain knowledge about open set, closed set and their properties. 4. Learn about denumerability of subsets of real numbers.

	Theory	**Practical**	**Total**
Credits	1	1	2
Contact Hours	1	2	3
Internal Assessment Marks	5	5	10
End term Examination Marks	20	20	40
Examination Time	2 Hours	2 Hours	50

Part B - Contents of the Course
Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking Course Learning Outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will contain 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question.

Unit	Topics	Contact Hours
I	Sets, Operation on sets, Relations and Functions, Bounded and Unbounded sets: Supremum, Infimum, Field structure and ordered structure.	4
II	The real number system as a complete ordered field, Archimedean property of real numbers, Representation of real numbers as points on straight line, Absolute value of a real number.	3
III	Neighborhood, interior point, interior of a set, isolated point, open sets, limit points, closed set, dense set, closure of a set, their properties.	4
IV	Bolzano-Weierstrass theorem, Denumerable and non-denumerable sets, Denumerability of integers, rationals and non-denumerability of real numbers.	4
Practical		
The practical component of the course has one parts of Problem Solving- Questions related to the practical applications based on following problems will be worked out and record of those will be maintained in the Practical Note Book: 1. Practical problems to find union, intersection and complement of a set. 2. Practical Problems on finding lub and glb of a set. 3. Problem demonstrating that the set of rational numbers is not order complete. 4. Practical problems using absolute value of real number. 5. Practical problems to find interior point, isolated point and limit points of a set. 6. Problem solving to find limit point of a set using Bolzano Weierstrass Theorem. 7. Practical problem to demonstrate the non-denumerability of the set of irrationals.	**30**

Suggested Evaluation Methods

Internal Assessment:	End Term Examination:
➢ **Theory 5** • Class Participation: 2 • Mid-Term Exam: 3 ➢ **Practicum 5** • Seminar/Demonstration/Viva-voce/Lab records etc.: 5	➢ **Theory 20** Written Examination ➢ **Practicum 20** Lab record, viva- voce, write up and execution of the program

Part C - Learning

1. C. Aliprantis & O. Burkinshaw (1998), *Principles of Real Analysis (3rd edition)*. Academic D Pres.
2. R. G. Bartle & D. R. Sherbert (2015). *Introduction to Real Analysis (4th edition)*. Wiley India.
3. G. G. Bilodeau, P. R. Thie & G. E. Keough (2015). *An Introduction to Analysis (2nd edition)*. Jones and Bartlett India Pvt. Ltd.
4. E. Hewitt & K. Stromberg (2013), *Real and Abstract Analysis*. Springer-Verlag.
5. K. A. Ross (2013). *Elementary Analysis: The Theory of Calculus (2nd edition)*. Springer.
6. W. Rudin (2023), *Principles of Mathematical Analysis* (3rd edition). Tata McGraw Hill.
7. R. R. Goldberg (1970). *Real Analysis*. Oxford & I. B. H. Publishing.
8. S Narayan & P. K. Mittal (2005). *A Course in Mathematical Analysis*. S. Chand and company, New Delhi.
9. S. C. Malik & S. Arora (1992), *Mathematical Analysis-(2nd edition)*. Wiley Eastern Ltd.

Estimating minimum energy of a confined particle using uncertainty principle; Energy-time uncertainty principle application to virtual particles and range of interaction. Two slit interference experiment with photons, atoms and particles; linear superposition principle as a consequence.

Unit-III

Matter waves and wave amplitude; Schrodinger equation for non-relativistic particles; Momentum and Energy operators; stationary states; physical interpretation of a wave function, probabilities and normalization; Probability and probability current densities in one dimension.

Unit-IV

Solution of Schrodinger equation for one-dimensional problems: One dimensional infinitely rigid box- energy eigenvalues and eigenfunctions, normalization; Quantum dot as an example; Quantum mechanical scattering and tunnelling in one dimension-across a step potential & rectangular potential barrier.

Reference Books:

1. Concepts of Modern Physics, Arthur Beiser, 2002, McGraw-Hill.
2. Introduction to Modern Physics, Rich Meyer, Kennard, Coop, 2002, Tata McGraw Hill
3. Modern Physics, Knneth S.Krane, JOHN WILEY & SONS, INC.

240/PHY(1)/MI202-A

COURSE ID: 24[illegible]

PHYSICS-II

Marks (External): 35
Marks (Internal Assessment): 15

Credits: 2 (30 lectures)
Time: 2 Hrs

Note: The paper setter is to set nine questions in all. Question no. 1 (compulsory based on the entire syllabus) will consist of five short answer type questions. The rest of the eight questions are to be set uniformly, with two questions from each unit selected. A student is required to attempt five questions, selecting one from each unit along with compulsory question no 1. The question paper shall contain 20% numerical problems in the relevant papers.

Course Objective: The course is based on imparting basic knowledge of atomic spectra, lases, and introductory quantum mechanics. It also includes some basic applications of Quantum mechanics also.	**Course Outcome:** After completion of this course, students will be able to understand the basic atomic spectra and its applications. Student will be able to grasp the basic ideas of quantum mechanics and its application.

Unit I

Atomic Structure: Rutherford's scattering experiment, Rutherford Model, Nuclear dimensions, Failures of classical picture of atom, Atomic spectra: emission and absorption, Bohr's model of atom: energy levels and spectra, correspondence principle, Franck-Herts experiment.

Unit II

Basics of Laser: Introduction to Stimulated and spontaneous emission introduction to LASER, Important properties of laser light, Principle of laser- Light amplification, population inversion and pumping; Working of laser- schematic diagram for functioning of laser, three level and four level Laser systems

Unit III

Introductory Quantum Mechanics: The wave equation, Postulates of quantum mechanics, Probability amplitude, Schrodinger equation in time-dependent form, Linearity and superposition, expectation values, operators, Schrodinger equation in time-independent form, Orthogonalization and normalization,

Unit IV

Application of Schrodinger wave equations: Particle in a box, Properties of wave functions, Particle in a finite potential well, Quantum tunneling process and its applications (Conceptual),

References:

1. Concept of Modern Physics by Arthur Beiser, McGraw Hill Education.
2. Modern Physics (2nd edition), by S.L. Kakani and Shubhra Kakani, Viva Books, New Delhi.
3. Semiconductor Devices - Physics and Technology by S.M. Sze, Wiley (1985)
4. Laser and Non-linear optics by B. B. Laud., Wiley Eastern Limited (1985)
5. Semiconductor Electronics by A. K. Sharma, New Age International Publisher (1996)

Multidisciplinary Course

Course ID - 240/PHYP/MD201
PHYSICS IN EVERYDAY LIFE

Marks (Theory): 50 **Credits : 3 (45 lectures)**
Marks (Internal Assessment) : 25 **Time : 3 Hrs**

Note: The paper setter is to set nine questions in all. Question no. 1 (compulsory based on the entire syllabus) will consist of five short answer type questions, each of two marks. The rest of the eight questions are to be set uniformly, with two questions from each unit selected. A student is required to attempt five questions, selecting one from each unit along with compulsory question no 1. The question paper shall contain 20 % numerical problems in the relevant papers.

Course Objective: To introduce some concepts of reflection, refraction, interference, scattering, law of motion, hydroelectric power generation and universe for day to day applications.	**Course Outcome:** After completion of this course, students will be able to apply and visualize the laws of physics to everyday life.

8. To study the variation in current and voltage in a series LCR circuit and hence determine the resonant frequency of the circuit
9. To study the variation in current and voltage in a parallel LCR circuit and hence determine the resonant frequency of the circuit
10. To study the effect of voltmeter resistance on voltage measurement.

References:

1. A text book in Electrical Technology - B L Theraja - S Chand and Co. Performance and design of AC machines - M G Say ELBS Edn.
2. Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill. Logic circuit design, Shimon P. Vingron, 2012, Springer.
3. Digital Electronics, Subrata Ghoshal, 2012, Cengage Learning.
4. Electronic Devices and circuits, S. Salivahanan & N. S.Kumar, 3rd Ed., 2012, Tata Mc-Graw Hill.

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SEMESTER-II

Minor Courses

Course ID - 240[illegible]

Modern Physics

Max. Marks: 35 **Credit 2 (30 Hrs)**

Internal Assessment: 15 **Time: 3 hrs**

***Note:** The paper setter is to set **Nine** questions. Question no. 1 (compulsory based on the entire syllabus) will consist of short answer type questions. The rest of the **eight** questions will be set uniformly, with two questions from each unit selected. A student is required to attempt **five** questions, selecting one from each unit along with compulsory question no 1. The question paper shall contain 20 % numerical problems in the relevant papers.*

Course Objective: This course aims to introduce students to the foundational concepts of quantum mechanics. It covers the quantum theory of light, wave-particle duality, the Heisenberg uncertainty principle, and the Schrödinger equation. Students will gain an understanding of particles' behaviour at the quantum level and learn to apply quantum mechanical principles to solve problems.	**Course Outcome:** Upon successfully completing this course, students will be able to understand the quantum theory of light, describe wave-particle duality and the Heisenberg uncertainty principle, solve the Schrödinger equation for simple systems and interpret wave functions in terms of probabilities and normalization.

Unit-I

Blackbody Radiation (observations and models), Plank's proposition and quantum theory of light, Photoelectric effect, X-rays, X-ray production, Compton scattering, Pair Production, De Broglie Waves, Davisson-Germer experiment. Wave description of particles by wave packets. Group and Phase velocities and the relation between them. Two-Slit experiment with electrons, Probability, Wave amplitude and wave functions, Rutherford Model, Hydrogen spectra and Bohr model of atom.

Unit-II

Position measurement- gamma-ray microscope thought experiment; Wave-particle duality, Heisenberg uncertainty principle (Uncertainty relations involving Canonical pair of variables,

Estimating minimum energy of a confined particle using uncertainty principle; Energy-time uncertainty principle application to virtual particles and range of interaction. Two slit interference experiment with photons, atoms and particles; linear superposition principle as a consequence.

Unit-III

Matter waves and wave amplitude; Schrodinger equation for non-relativistic particles; Momentum and Energy operators; stationary states; physical interpretation of a wave function, probabilities and normalization; Probability and probability current densities in one dimension.

Unit-IV

Solution of Schrodinger equation for one-dimensional problems: One dimensional infinitely rigid box- energy eigenvalues and eigenfunctions, normalization; Quantum dot as an example; Quantum mechanical scattering and tunnelling in one dimension-across a step potential & rectangular potential barrier.

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3. Modern Physics, Knneth S.Krane, JOHN WILEY & SONS, INC.

COURSE ID: 240/PHYP/ MI202

PHYSICS-II

Marks (External): 35 **Credits: 2 (30 lectures)**
Marks (Internal Assessment): 15 **Time: 2 Hrs**

Note: The paper setter is to set nine questions in all. Question no. 1 (compulsory based on the entire syllabus) will consist of five short answer type questions. The rest of the eight questions are to be set uniformly, with two questions from each unit selected. A student is required to attempt five questions, selecting one from each unit along with compulsory question no 1. The question paper shall contain 20% numerical problems in the relevant papers.

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Unit I

Atomic Structure: Rutherford's scattering experiment, Rutherford Model, Nuclear dimensions, Failures of classical picture of atom, Atomic spectra: emission and absorption, Bohr's model of atom: energy levels and spectra, correspondence principle, Franck-Herts experiment.