Tamil Nadu Open University
Regulations and Overview for M.Sc., Physics (Semester) in ODL System

[w.e.f Academic Year 2020-2021]

Department of Physics

School of Science

Tamil Nadu Open University

Chennai- 600 015

MASTER OF SCIENCE IN PHYSICS
REGULATIONS

1. Introduction

The M.Sc in Physics program will have courses that cover both fundamental and advanced topics in Physics. It aims at training the students to be efficiently capable in working in academics, research and other frontiers in science and technology. The course includes theoretical and experimental courses to fulfil the criteria for the awarding of the degree. A number of elective specialized courses will also be offered to the students to build a strong foundation in the areas of their research interest. Total credits to be completed for this program is 72.

2. Progrmme Objectives

This Programme is meant to systematize and give a method and structure to learner experiences. The recent developments in physical sciences, has been included in the enriched curricula to meet out the present day needs of academic and Research, Institutions and Industries. After completing this Programme the learner,

PO 1: will have knowledge of fundamental laws and principles of physics along with their applications in diverse areas.

PO 2: will develop teaching and research skills which might include advanced Laboratory techniques, numerical methods, computer interfacing etc.

PO 3: will become effective teacher and/or researcher; and will be able to exhibit good scientific knowledge and temperament in diverse fields /environment.

PO 4: will develop the skill to plan, execute and report on experimental and/or theoretical physics problems with effective scientific approach in future endeavour.

3. Programme Specific Outcomes

While studying M.Sc., Physics Programme, the learner shall be able to

PSO 1: provide well defined study of theoretical and experimental physics to impart in depth understanding in fundamental aspects of all core areas of Physics

PSO 2: acquire core as well as specialized/disciplinary knowledge in physics including the major premises of Classical Mechanics, Mathematical Physics, Quantum Mechanics, Linear and Integrated Electronics, Electromagnetic Theory, Condensed Matter Physics, Thermodynamics and statistical mechanics, Spectroscopy, Nuclear Physics, Numerical Methods, Microprocessor and Microcontrollers, Elements of Nanoscience and Nanotechnology and Instrumental Methods of Analysis.

PSO 3: equip the student to pursue research and development in any areas of theoretical, experimental, and computational physics.

PSO 4: learn how to design and conduct experiments demonstrating them understanding of scientific methods/processes/phenomena; and have an understanding of analytical methods required to interpret and analyze results and draw conclusions.

PSO 5: bridge the gap between text book knowledge and practical problems through well-designed laboratory sessions.

PSO 6: develop written and oral communications skills in communicating physics-related topics; and realize and develop an understanding of the impact of science particularly physics on the society.

PSO 7: apply conceptual understanding and critical thinking of the physics to general real- world situations; and learn to analyze physical problems and develop correct solutions using theoretical and experimental techniques / tools and skills.

4. Programme Learning Outcomes

PLO 1: Knowledge: capability of demonstrating comprehensive disciplinary knowledge gained during course of study.

PLO 2: Research: Aptitude and Investigation ability of critical thinking, analytical reasoning and research-based knowledge including design of experiments, analysis and interpretation of data to provide conclusions.

PLO 3: Communication: ability to communicate effectively on general and scientific topics with the scientific community and with society at large

PLO 4: Problem Solving: capability of applying knowledge to solve scientific and other problems using theoretical and practical techniques, skills, and tools.

PLO 5: Science and Society: ability to apply reasoning to assess the different issues related to society and the consequent responsibilities relevant to the professional scientific practices.

PLO 6: Life-Long Learning: aptitude to apply knowledge and skills that are necessary for participating in learning activities in day-to-day life.

PLO 7: Modern Tool Usage: ability to use and learn techniques, skill and modern tools for scientific practices.

PLO 8: Project Management: ability to demonstrate knowledge and understanding of the scientific principles and apply these to manage projects.

PLO 9: Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.

5. Structure of M.Sc Physics Programme:

Course	Course Code	Course Title	Evaluation			Credits
			CIA*	TEE**	Total	
I – Year - Semester I						
Core I	MPHS-11	Classical Mechanics	30	70	100	4
Core II	MPHS-12	Mathematical Physics – I	30	70	100	4
Core III	MPHS-13	Linear and Integrated Electronics	30	70	100	4
Core Practical-1	MPHS-P1	Practical – I	30	70	100	4
Elective -1	MPHSEL 1A	Numerical Methods	30	70	100	3
I – Year - Semester II						
Core IV	MPHS-21	Mathematical Physics – I	30	70	100	4
Core V	MPHS-22	Quantum Mechanics – 1	30	70	100	4
Core VI	MPHS-23	Electromagnetic Theory	30	70	100	4
Core Practical-2	MPHS-P2	Practical – II	30	70	100	4

Elective-2	MPHSEL 2A	Microprocessor and Microcontroller	30	70	100	3
II Year- Semester III						
Core VII	MPHS-31	Quantum Mechanics – II	30	70	100	4
Core VIII	MPHS-32	Thermodynamics and Statistical Mechanics	30	70	100	4
Core IX	MPHS-33	Condensed Matter Physics – I	30	70	100	4
Core Practical-3	MPHS-P3	Core Practical – III	30	70	100	4
Elective-3	MPHSEL 3A	Physics of Nanomaterials	30	70	100	3
II Year -Semester IV						
Core X	MPHS-41	Spectroscopy	30	70	100	4
Core XI	MPHS-42	Nuclear Physics	30	70	100	4
Core XII	MPHS-43	Condensed Matter Physics – II	30	70	100	4
Core Practical-2	MPHS-P4	Practical -IV	30	70	100	4
Elective-4	MPHSEL 4A	Instrumental Methods of Analysis	30	70	100	3
		Total	**600**	**1400**	**2000**	**72**

6. Scheme of Examinations:

The examination for the M.Sc. Degree shall consist of theory and practical papers.

(i) Theory Examinations: The theory examination shall be of three hours duration to each paper and conducted at the end of each year. The candidates who failing in any subject(s) will be permitted to appear for each failed subject(s) in the subsequent examinations.

(ii) Practical Examinations: The practical examinations shall be of three hours duration to each practical and conducted at the end of each year. The candidates who failing in any practical(s) will be permitted to appear for each failed practical(s) in the subsequent examinations.

(Note: Those who fail in the practical examination should appear only for practical examinations not need to appear for the practical counselling classes again. The

marks once awarded for records will remain the same and will be declared to have passed in that course.)

Question Pattern:

Course Name: Course Code:

Time: 3 Hours Maximum Marks: 70

PART - A (5 × 5 = 25 Marks)

Answer any Five questions out of Eight Questions in 300 words

All questions carry equal marks

1. From Block - I
2. From Block - II
3. From Block - III
4. From Block - IV
5. From Block - V
6. From any Block
7. From any Block
8. From any Block

PART - B (3 × 15 = 45 Marks)

Answer any Three questions out of Five Questions in 1000 words.

All questions carry equal marks.

9. From Block - I
10. From Block - II
11. From Block - III
12. From Block – IV
13. From Block – V

Passing Minimum:

For theory examination: The candidate shall be declared to have passed the examination if the candidate secures not less than 32 marks in the Term End Examinations (TEE) of each theory paper and secures not less than 13 marks in the

Continuous Internal Assessment(CIA)and overall aggregated marks is 50 in both the external and internal taken together.

Continuous Internal Assessment (CIA)		Term End Examination (TEE)		Overall Aggregated Marks	Maximum Marks
Minimum Pass Mark	Maximum Mark	Minimum Pass Mark	Maximum Mark	CIA + TEE	
13	30	32	70	50	100

For Practical examination: The candidate shall be declared to have passed the examination if the candidate secures not less than 30 marks in the External Practical Examinations and secures not less than 10 marks in the Continuous Internal Assessment (CIA) (Record Marks + Practical Counselling Class Attendance) and overall aggregated marks is 40 marks in both external and internal taken together. However submission of record notebook is a must.

Pattern of Question Paper for Practical Examinations;

Each set of question paper should contain SEVEN questions and the candidate has to choose one by lot.

Awarding of marks for Practical examinations.

Total Marks: 100 (External Practical 70 Marks +Internal (Record 20 Marks + Practical Counselling Class Attendance 10 Marks)

Distribution for 70 Marks:

Formula, circuit diagram and tabular column: 20 Marks

Observation: 35 Marks

Result: 5 Marks

Presentation: 10 Marks

Total: 70 Marks

M.Sc., Physics - Syllabus – I year – I Semester (Distance Mode)

COURSE TITLE : CLASSICAL MECHANICS

COURSE CODE : MPHS 11

COURSE CREDIT : 4

COURSE OBJECTIVES

While studying the **CLASSICAL MECHANICS**, the Learner shall be able to:

CO 1: Discuss the Classical Mechanics in Lagrangian formulation

CO 2: Review about the Hamilton's principle

CO 3: Represent Hamilton-Jacobi Method of Classical Mechanics

CO 4: Predict the kinematics of the rigid body through Euler equation.

CO 5: Describe in central force field and relativity

COURSE SYLLABUS

BLOCK I: LAGRANGIAN FORMULATION

Lagrangian formulation: System of particles-constraints and degrees of freedom-generalized coordinates, force and energy- Conservation laws-conservations of linear and angular- momenta-symmetric properties-homogeneity and isotropy-D'Alemberts principle of virtual work - Lagrange's equation of motion-nonholonomic systems- applications of Lagrange equations of motion: free particle in space-Atwood's machine.

BLOCK II: HAMILTON'S EQUATION AND CANONICAL TRANSFORMATION

Calculus of variation--principle of least action-Hamilton's principle-Hamilton`s function- Lagrange's equation from Hamilton's principle-Hamilton's principle for nonholonomic system- variational principle- Hamilton's equations from variational principle-Legendre transformation and Hamilton's equation of motion. Cyclic

coordinates and conservation theorem-Canonical transformations-Hamilton's canonical equations-Generating functions-Examples-Poisson brackets and its properties.

BLOCK III: HAMILTON-JACOBI THEORY AND SMALL OSCILLATIONS

Hamilton-Jacobi equation for Hamilton's principle function-Example: Harmonic oscillator problem-Hamilton's characteristic function-Action-angle variable-application to Kepler problem in action angle variables. Eigen value equation-Normal coordinates-Normal frequencies of vibration-vibrations of linear triatomic molecule.

BLOCK IV: KINEMATICS OF RIGID BODY

Independent coordinates of rigid body-orthogonal transformation-properties of transformation matrix-Euler angle and Euler's theorem-infinitesimal rotation-Coriolis force-angular momentum and kinetic energy of motion about a point-moment of inertia tensor-Non-inertial frames and pseudo forces-Euler's equations of motion-torque free motion of a rigid body-heavy symmetrical top.

BLOCK V: CENTRAL FORCE PROBLEM AND THEORY OF RELATIVITY

Reduction to the equivalent one body problem-Centre of mass-Equation of motion and first integral-classification of orbits - Kepler problem: Inverse-Square law of force-Scattering in a central force field - transformation of scattering to laboratory coordinates. Orbits of artificial satellites, Virial theorem – Lorentz transformation, Relativistic Mechanics, Relativistic Lagrangian and Hamiltonian for a particle, Space time and energy – Momentum vectors.

BOOKS FOR STUDY:

1. Classical Mechanics -H. Goldstein, C. Poole and J. Safko,Pearson Education Asia, New Delhi, Third Edition, 2002.

2. Classical Mechanics - G. Aruldhas, PHI Learning Private Limited, New Delhi, 2015.

BOOKS FOR REFERENCE:

1. Classical Mechanics -S. L. Gutpa, V. Kumar and H.V. Sharma, Pragati Prakashan, Meerut, 2016.
2. Classical Mechanics of Particles and Rigid Bodies -K.C. Gupta, New Age International Publishers,New Delhi, Third edition,2018.
3. Classical Mechanics -N.C. Rana and P.J. Joag, Tata McGraw Hill, New Delhi, 2015.
4. Classical Mechanics -J. C. Upadhaya, Himalaya Publishing House Pvt. Ltd, Bangalore, Second edition, 2017.
5. Classical Mechanics, B.D.Gupta and Satya Prakash, Keder Nath Publishers, Meerut, Revised Edition, 2015.
6. Introduction to Classical Mechanics, R.G.Takwale and P.S.Puranik, Tata Mc Graw Hill, New Delhi, 1989.

Web Resources

1. https://www.youtube.com/watch?v=sCZ80l6UarM
2. https://www.youtube.com/watch?v=hA6VEKq4hdg
3. https://www.youtube.com/watch?v=QNtGWkkvnQs
4. https://www.youtube.com/watch?v=4RiRAIelAAQ
5. https://www.youtube.com/watch?v=3plEkkgB32c
6. https://www.youtube.com/watch?v=jvBas8yUgNI
7. https://www.youtube.com/watch?v=4anjaibsFFg
8. https://www.youtube.com/watch?v=_4Z1IAFOv94
9. https://www.youtube.com/watch?v=xz7jLnWcxMs
10. https://www.youtube.com/watch?v=OWTaGzLeRpE
11. https://www.youtube.com/watch?v=aE4hbKhKkiM
12. https://www.youtube.com/watch?v=eJy_a7Jcx1s

13. https://www.youtube.com/watch?v=vgLq90cOI_M
14. https://www.youtube.com/watch?v=9H66UA51COI
15. https://www.youtube.com/watch?v=roZNK0gQO_g
16. https://www.youtube.com/watch?v=8uA_nhiLShc
17. https://www.youtube.com/watch?v=lV8YzK_fDF4
18. https://www.youtube.com/watch?v=4k-VwuH4aaY
19. https://www.youtube.com/watch?v=_dXwTxj2hVE
20. https://www.youtube.com/watch?v=T2qUFFtL7TA
21. https://www.youtube.com/watch?v=huoY4JJp-uk
22. https://www.youtube.com/watch?v=0C1cbjA0HmU
23. https://www.youtube.com/watch?v=KB9o8OvdN4U
24. https://www.youtube.com/watch?v=1UzD-i7fXnc
25. https://www.youtube.com/watch?v=vQi-MlJsqV0
26. https://www.youtube.com/watch?v=EuUcBonCoA4
27. https://www.youtube.com/watch?v=MULe4xv3lVk
28. https://www.youtube.com/watch?v=ZMa-xKcM2L8
29. https://www.youtube.com/watch?v=s8KAz6_AfZo
30. https://www.youtube.com/watch?v=HXCXMZ9n8qM
31. https://www.youtube.com/watch?v=towu4x8qI4c
32. https://www.youtube.com/watch?v=ohXK7m24Swo
33. https://www.youtube.com/watch?v=rvz0b0-qyfc
34. https://www.youtube.com/watch?v=XEMLIRPy2kI
35. https://www.youtube.com/watch?v=gxpC9Fp9ZjQ
36. https://www.youtube.com/watch?v=iju2GtY7vfQ
37. https://www.youtube.com/watch?v=zmZQQtypWOk
38. https://www.youtube.com/watch?v=hTFqzKJawg0
39. https://www.youtube.com/watch?v=1_vsXLZFReE
40. https://www.youtube.com/watch?v=Wrr4d2De5IE

COURSE LEARNING OUTCOMES

After completion of the **CLASSICAL MECHANICS**, the Learner will be able to:

CLO 1: Interpret the notion of degrees of freedom, identify them for a given

mechanical system and DÁlembert's principle, Formulation of Lagrangian mechanics and problem solving with the help of it.

CLO 2: Describe the Canonical transformations and generating functions. Properties of Poisson's bracket.

CLO 3: Enable to solve Hamilton-Jacobi equations and use it for the solution of harmonic oscillator problem

CLO 4: Demonstrate an understanding of intermediate classical mechanics topics such as coordinate transformations, oscillatory motion, gravitation and other central forces, and Lagrangian mechanics

CLO 5: Evaluate the Central Force Problems and Relativistic Mechanics

M.Sc., Physics - Syllabus – I year – I Semester (Distance Mode)

COURSE TITLE : MATHEMATICAL PHYSICS- 1

COURSE CODE : MPHS 12

COURSE CREDIT : 4

COURSE OBJECTIVES

While studying the **MATHEMATICAL PHYSICS -1**, the Learner shall be able to:

CO 1: Develop an understanding of Vector Analysis and Inner Product

CO 2: Discuss various types of Matrices and Cayley-Hamilton's theorem

CO 3: Describe about Tensor Analysis and formulate, interpret and draw inferences from mathematical solutions.

CO 4: Solve the problems related to complex variables which contain real and imaginary parts.

CO 5: Give the basic knowledge of Group theory and enhance problem solving skills

COURSE SYLLABUS

BLOCK I: VECTOR ANALYSIS AND VECTOR SPACES

Concept of gradient, divergence and curl - Gauss's divergence theorem, Green's theorem and Stoke's theorem (statement and proof) - Orthogonal curvilinear coordinates - Expression for gradient, divergence, curl and Laplacian in cylindrical and spherical co-ordinates (Theory). Linearly dependent and independent sets of vectors - Inner product (problems)- Schmidt's orthogonalization process.

BLOCK II: MATRICES

Types of Matrices and their properties, Rank of a Matrix, Eigenvalue Equations and their solutions, Theorems on Matrices; Diagonalisation and Diagonalisation of different matrices; Cayley-Hamilton's theorem; Problems.

BLOCK III: TENSOR ANALYSIS

Definition of Tensors – Contravariant, covariant and mixed tensors – addition and

subtraction of Tensors – Summation convention- Symmetry and Anti-symmetry Tensor – Contraction and direct product – Quotient rule- Pseudo tensors, Levi-Civita Symbol - Dual tensors, irreducible tensors-Metric tensors-Christoffel symbols – Geodesics.

BLOCK IV: COMPLEX VARIABLE

Functions of complex variable-Analytic functions-Cauchy- Riemann equations-integration in the Complex plane-Cauchy's theorem- Cauchy's integral formula-Taylor and Laurent expansions- Singular Points- Cauchy's residue theorem - poles - evaluation of residues - evaluation of definite integrals.

BLOCK V: GROUP THEORY

Definition - Subgroups - Cyclic groups and abelian groups - Homomorphism and isomorphism of groups - Classes - Symmetry operations and symmetry elements - Representations of groups - Reducible and irreducible representations - Character tables for simple molecular types (C_{2v} and C_{3v} point group molecules).

BOOKS FOR REFERENCE:

1. Mathematical Physics, B.D. Gupta, Vikas Publishing House Pvt. Ltd, 1995.
2. Mathematical Physics, B.S.Rajput, 20th Edition, Pragati Prakashan, 2008.
3. Mathematical Physics, H.K. Dass and Rama Verma, S.Chand and Company Ltd, 2010.
4. Mathematical physics, P.K. Chattopadhyay, Wiley Eastern Limited, 1990.
5. Introduction to Mathematical physics, Charlie Harper, Prentice Hall of India Pvt.Ltd, 1993.
6. Applied Mathematics for Engineers and Physicists, L.A. Pipes and L.R. Havevill, McGraw Hill Publications Co., 3rd Edition, 1971.
7. Theory and Problems of Laplace Transforms, Murray R. Spigel, Schaum's outline series, McGraw Hill, 1986.

8. Matrices and Tensors in Physics, A.W. Joshi, Wiley Eastern limited, 3rd Edition, 1995.

Web Resources

1. Lecture 2 : Vector Space - YouTube
2. Lecture 3 : Span, Linear combination of vectors - YouTube
3. Prof. Samudra Roy - YouTube
4. Gauss's Divergence Theorem - YouTube
5. Stokes' Theorem and Green's Theorem - YouTube
6. Types of Matrices Mathematical Physics (Part-2) CSIR-NET Physical Sciences Physics B.Sc M.Sc Physics - YouTube
7. Rank of the matrix | Cayley Hamilton Theorem | Matrix | Mathematical Physics | CSIR NET PHYSICS EXAM - YouTube
8. Eigenvalues & Eigenvectors | Overview, Equation & Examples - Video & Lesson Transcript | Study.com
9. Finding Eigenvalues and Eigenvectors - YouTube
10. Lecture 18 : Cayley - Hamilton Theorem, Function space - YouTube
11. Mathematical Physics - Tensor Analysis: Algebraic Operations With Tensors - Addition and Subtraction - YouTube
12. Tensor Analysis- Lec.1,(Basic Concepts) by Dr. D. N. Garain, For Maths & Phy(B.Sc. , M.Sc) & Engg. - YouTube
13. Mathematical Physics - Tensor Analysis : Higher Rank Tensors / Zero Tensors - YouTube
14. Mathematical Physics - Tensor Analysis : An Introduction - Conductivity Tensor / Dyadic / Triadic - YouTube
15. Mathematical Physics - Tensor Analysis : Problems in Contravariant and Covariant Vectors - YouTube

16. Mathematical Physics- Functions of a complex variable- Analytic function - YouTube
17. Mathematical Physics- Functions of a complex variable- Intro & important terms of definition - YouTube
18. Mod-01 Lec-01 Analytic functions of a complex variable (Part I) - YouTube
19. Mod-01 Lec-02 Analytic functions of a complex variable (Part II) - YouTube
20. Mathematical Physics- Functions of a complex variable- The Cauchy-Riemann Condition (Equation) - YouTube
21. Group theory in Mathematical Physics- an introduction #Tamil - YouTube
22. Group Theory for Physicists | Lecture 1: Introduction - YouTube
23. Group Theory Methods in Physicists | Lecture 1: Introduction I - YouTube

COURSE LEARNING OUTCOMES

After completion of the **MATHEMATICAL PHYSICS-1**, the Learner will be able to:

CLO 1: Master the basic elements of mathematical physics and demonstrate an ability to use vector analysis in the solution of physical problems

CLO 2: Apply and analyze the various types of matrix operations for solving physical problems

CLO 3: Learn about the concept and uses of Tensors and Tensor algebra (Dual tensors, irreducible tensors, Metric tensors).

CLO 4: Solve different physical problems which contain complex variables and implementation of complex variable for calculation of integrals, and also able to expand functions in Taylor's and Laurent's series. Knowledge of theorems of residues and contour integration.

CLO 5: Obtain the basic knowledge of Group theory and its applications. This theory is also used to describe the simple molecular types.

M.Sc., Physics - Syllabus – I year – I Semester (Distance Mode)

COURSE TITLE : LINEAR AND INTEGRATED ELECTRONICS

COURSE CODE : MPHS 13

COURSE CREDIT : 4

COURSE OBJECTIVES

While studying the **LINEAR AND INTEGRATED ELECTRONICS**, the Learner shall be able to:

CO 1: Give an insight about fundamental concepts of Semiconductor Diodes.

CO 2: Introduce the formal structure of the subject and to equip them with the knowledge of various semiconductor field effect Transistors and Optoelectronic devices.

CO 3: Discuss the op-amp's basic construction, characteristics, parameter limitations, various configurations and countless applications of op-amp.

CO 4: To impart knowledge about various memory devices, systems, elements and materials used in developing them.

CO 5: The theoretical knowledge gained in the classroom can be experimented in the practical classes.

COURSE SYLLABUS

BLOCK I: SEMICONDUCTOR DIODES

Introduction to Semiconductor- PN Junction diode – Zener diode- Gunn diode- Tunnel diode- Photo diode - schottky diode – Impatt diode-Characteristics and Applications.

BLOCK II: TRANSISTOR BIASING AND OPTO ELECTRONIC DEVICES

Thevenin's and Norton's theorems - Transistor action- PNP-NPN transistors – Transistor biasing and stabilization- Need for biasing- DC load line- operating point-

Bias stability-Two port Network - Hybrid model – h parameters –– JFET – UJT- SCR.

BLOCK III: OPERATIONAL AMPLIFIER APPLICATIONS

Operational Amplifier- CMRR-Slew rate -Instrumentation amplifier – V to I and I to V converter – Op-amp stages- Equivalent circuits - Sample and Hold circuits.

Applications of Op-Amp: Inverting, Non- inverting Amplifiers- circuits – Adder- Subtractor- Differentiator- Integrator- Electronic analog Computation solving simultaneous and differential equation –. Schmitt Trigger – Triangular wave generator – Sine wave generator – Active filters: Low, High and Band pass first and second order Butterworth filters – wide and narrow band reject filters.

BLOCK IV: SEMICONDUCTOR MEMORIES

Classification of memories and sequential memory – Static Shift Register and Dynamic Shift Register, ROM, PROM and EPROM principle and operation Read & Write memory - Static RAM, dynamic RAM, Content Addressable Memory - principle, block diagram and operation. Programmable Logic Array (PLA) - Operation, Internal Architecture. Charge Couple Device (CCD) - Principle, Construction, Working and Data transfer mechanism.

BLOCK V: A/D AND D/A CONVERTER

Sampling theorem-Time division multiplexing – Quantization – DAC- Weighted resistor method – Binary Ladder network – ADC – successive approximation, Dual slope and Counter method – Voltage to Frequency conversion and Voltage to Time conversion .

BOOKS FOR REFERENCE:

1. Modern Digital Electronics – R.P. Jain – Tata McGraw Hill, 2007.
2. Op-Amp and linear integrated circuits - R.F. Coughlin and F.F, Driscol, Prentice
   Hall of India, New Delhi, 1996.
3. Op-Amps and Linear Integrated Circits -Ramakant A. Gayakwad, Pearson Education: Fourth Edition, 2015.

4. Electronic Principles- Albert Malvino, David J Bates, 7 th Edition, McGraw Hill, 2007.
5. Principles of Electronics- V.K.Mehta, 6 th Revised Edition, S.Chand and Company, 2001.
6. Electronic Devices and Circuits- David A. Bell, 4th Edition, Prentice Hall. 2007.

Web Resources

1. Semiconductor Diode - YouTube
2. Semiconductor Diodes - Part 1 | MODULE 1 | Basic Electronics | 15ELN15 / 15ELN25 | VTU - YouTube
3. L1 | Introduction to Semiconductors | Energy Band Diagram | | Electronic Devices (AKTU) - YouTube
4. L2 | Types of Semiconductors | Intrinsic & Extrinsic Semiconductors | | Electronic Devices (AKTU) - YouTube
5. Electronic Devices - Inderjit Singh (weebly.com)
6. Introduction to Operational Amplifier: Characteristics of Ideal Op-Amp - YouTube
7. Lecture - 31 Applications of Op Amps - YouTube
8. Operational Amplifiers Basics, Characteristics, Types and Applications (elprocus.com)
9. Semiconductor Memories - SRAM, DRAM | Digital Electronics | Lec 38 | Free GATE 2021 Crash Course - YouTube
10. Classification of Semiconductor memories [ROM, RAM & CAM] | | Digital Electronics - YouTube
11. PART 2 : Classification of Semiconductor Memories - YouTube
12. Introduction to ADC and DAC - YouTube

COURSE LEARNING OUTCOMES

After completion of the **LINEAR AND INTEGRATED ELECTRONICS**, the Learner will be able to:

CLO 1: Aware of the general characteristics of important semiconductor materials and develop a deep understanding of the basic design, operation and characteristics of a PN-junction.

CLO 2: Learn to devise and analyze various transistor amplifier models.

CLO 3: Analyze and design basic op-amp circuits, particularly various linear and non-linear circuits, active filters and signal generators, and data converters

CLO 4: Evaluate the characteristics of Classification of memories and sequential memory

CLO 5: Analyze the working of various A/D and D/A Converters

M.Sc., Physics - Syllabus – I year – I Semester (Distance Mode)

COURSE TITLE : NUMERICAL METHODS

COURSE CODE : MPHS EL-1

COURSE CREDIT : 3

COURSE OBJECTIVES

While studying the **NUMERICAL METHODS**, the Learner shall be able to:

CO 1: Explain the concept of various Interpolation.

CO 2: Introduce the concept of Roots of Non-Linear Equation and apply to solve the Physical Problem.

CO 3: Describe the Need and Scope of Solution of Linear Equation

CO 4: Discuss the concepts of numerical differentiation and integration

CO 5: Solve the Numerical solution of ordinary differential equation

COURSE SYLLABUS

BLOCK I : INTERPOLATION

Introduction, Polynomial Forms, Linear interpolation, Lagrange Interpolation Polynomial, Newton Interpolation Polynomial, Divided difference table, Interpolation with equidistance points, Spline interpolation

BLOCK II: ROOTS OF NONLINEAR EQUATIONS

Introduction, Methods of Solution, Iterative Methods, Starting and Stopping and Iterative Process, evaluation of Polynomials, Bisection method, False Position Method, Newton-Raphson Method, Secant Method, Fixed Point Method, Determining All Possible Roots.

BLOCK III: SOLUTIONS OF LINEAR EQUATIONS

Need and Scope, Existence of Solutions, Solution by Elimination, Basic Gauss Elimination Method, Gauss Elimination with Pivoting, Gauss- Jordan Method,

Triangular Factorization Methods, Round-off Errors and Refinement, Ill-Conditioned Systems, Matrix Inversion Method, Jacobi Iteration Method, Gauss Seidel Method.

BLOCK IV: NUMERICAL DIFFERENTIATION AND INTEGRATION

Numerical Differentiation: Need and Scope, differentiating continuous functions, Differentiating tabulated functions, Difference tables, Numerical Integration: Trapezoidal Rule, Simpson's 1/3 Rule, Simpson's 3/8 Rule, Higher Order Rules.

BLOCK V: NUMERICAL SOLUTIONS OF ORDINARY DIFFERENTIAL EQUATIONS

Need and Scope, Tailor Series Method – Improving accuracy, Picard's method, Euler's Method – accuracy of Euler's method, Heun's Method – Error analysis, Polygon Method, Runge-Kutta Methods- Determination of weights, Fourth order Runge-Kutta methods.

BOOKS FOR STUDY:

1. Numerical methods in Science and Engineering- M.K. Venkataraman National Publishing Co. Madras, 1996.
2. Numerical methods for scientific and engineering computations -Jain and Iyengar. New Age International, 2003
3. Numerical Methods, E. Balagurusamy, Tata McGraw-Hill, India,1999.

BOOKS FOR REFERENCE:

1. Introductory Methods of Numerical Analysis- S.S. Sastry-Prentice Hall, 2005.
2. Numerical Methods for Engineers, Steven C. Chapra and Raymond P. Canale, McGraw Hill International editions, 2nd edtion, 1990.

Web Resources

1. Interpolation Part I (Introduction to Interpolation) - YouTube
2. Interpolation part-II (Some basic operators and their properties) - YouTube

3. Interpolation part-III (Newton's Forward/Backward difference and derivation of error) - YouTube
4. Interpolation part-IV (Error estimation in Newton's Forward/Backward difference formula) - YouTube
5. NUMERICAL METHODS: Roots of nonlinear equations (Bisection method & Newton Raphson method) - YouTube
6. Lec 2: Roots of Non-linear equations, Bisection method - YouTube
7. Lec 2: Roots of Non-linear equations, Bisection method - YouTube
8. Solutions of Nonlinear Equations; Newton-Raphson Method - YouTube
9. Linear Approximation/Newton's Method - YouTube
10. Gauss Elimination Method | Numerical Methods | solution of Linear Equations - YouTube
11. Numerical Solutions of Linear Systems - Introduction - YouTube
12. Lecture 38 Solution Of Linear Systems Of Equations - 1 - YouTube
13. Lecture 39 Solution Of Linear Systems Of Equations - 2 - YouTube
14. Lecture 40 Solution Of Linear Systems Of Equations - 3 - YouTube
15. Lecture 41 Solution Of Linear Systems Of Equations - 4 - YouTube
16. Lecture 42 Solution Of Linear Systems Of Equations - 5 - YouTube
17. lecture 43 Solution Of Linear Systems Of Equations - 6 - YouTube
18. Lecture 44 Solution Of Linear Systems Of Equations - 7 - YouTube
19. Lecture 45 Solutions Of Linear Systems Of Equations - 8 Iterative Method - 1 - YouTube
20. Lecture 46 Solutions Of Linear Systems Of Equations - 8 Iterative Method - 2 - YouTube
21. Lec-34 Numerical Differentiation and Integration-Part-1 - YouTube
22. Lec-35 Numerical Differentiation and Integration-Part-2 - YouTube
23. Lec-36 Numerical Differentiation and Integration-Part-3 - YouTube
24. Lec-37 Numerical Differentiation and Integration-Part-4 - YouTube
25. Lec-38 Numerical Differentiation and Integration-Part-5 - YouTube
26. Lec-39 Numerical Differentiation and Integration-Part-6 - YouTube
27. Lec-40 Numerical Differentiation and Integration-Part-7 - YouTube

28. Lec-41 Numerical Differentiation and Integration-Part-8 - YouTube
29. Lecture 18 Numerical Solution of Ordinary Differential Equation (ODE) - 1 - YouTube
30. NUMERICAL METHODS: Numerical solution of ordinary differential equations - YouTube
31. Lecture - 20 Numerical Solution of Differential Equations - YouTube
32. Lecture 21 Numerical Solution Of ODE - 4 - YouTube
33. Lecture 22 Numerical Solution Of ODE - 5 - YouTube
34. Lecture 23 Numerical Solution Of Ordinary Differential Equations - 6 - YouTube
35. Lecture 24 Numerical Solution Of ODE - 7 - YouTube
36. Lecture 25 Numerical Solution Of Differential Equations - 8 - YouTube
37. Lecture 26 Numerical Solution of Ordinary Differential Equations - 9 - YouTube
38. Lecture 27 Numerical Solution of Ordinary Differential Equations - 10 - YouTube
39. Lecture 28 Numerical Solution of Ordinary Differential Equations - 11 - YouTube
40. Lecture 29 Root Finding Methods - 1 The Bisection Method - 1 - YouTube
41. Lecture 30 Root Finding Methods - 2 The Bisection Method - 2 - YouTube
42. Lecture 31 Root Finding Methods - 3 Newton-Raphson Method - 1 - YouTube

COURSE OUTCOMES

After completion of the **NUMERICAL METHODS,** the Learner will be able to:

CLO 1: Recognize the various interpolation formulae, best fit curve, nature of a specific numerical problem and would develop the acumen for choosing an appropriate numerical technique to find its solution.

CLO 2: Ability to solve the roots of liner equation using an appropriate numerical method

CLO 3: Estimate errors while solving equations and effectively use methods like matrix inversion, Gauss elimination and Gauss Seidel Method to solve linear equations.

CLO 4: Interpret and apply the basic methodology of numerical differentiation and numerical integration to a broad range of physics problems.

CLO 5: Enriched with various computational methods like Euler, Newton-Raphson and Runge-Kutta etc. to solve the problem

M.Sc., Physics - Syllabus – I year – IISemester (Distance Mode)

COURSE TITLE : MATHEMATICAL PHYSICS- II

COURSE CODE : MPHS 21

COURSE CREDIT : 4

COURSE OBJECTIVES

While studying the **MATHEMATICAL PHYSICS -II**, the Learner shall be able to:

CO 1: Develop an understanding of differential equation

CO 2: Discuss various types of special functions (Bessel, Hermite, Laguerre, Legendre) in solving physical problems.

CO 3: Describe about Solution of partial differential equation and its applications

CO 4: Develop concept of Fourier transform and Laplace transform in theoretical mechanics.

CO 5: Develop expertise in mathematical techniques required in physics and enhance their problem-solving skills.

COURSE SYLLABUS

BLOCK I: DIFFERENTIAL EQUATIONS

Homogeneous linear equations of second order with constant coefficients and their solutions – ordinary second order differential with variable coefficients and their solution by power series and Frobenius methods – extended power series method for indicial equations.

BLOCK II: SPECIAL FUNCTIONS – I

Gamma and Beta function- Legendre's differential equation: Legendre polynomials - Generating functions - Recurrence relation - Rodrigue's formula - Orthogonality; Bessel's differential equation: Bessel polynomials - Generating functions - Recurrence relation -Rodrigue's formula – Orthogonality.

BLOCK III: SPECIAL FUNCTIONS – II

Hermite differential equation – Generating functions – Hermite polynomials - Recurrence relations – Rodrigue's formula - Orthogonality: Laguerre differential equations – Generating functions - Laguerre polynomials - Recurrence relation - Rodrigue's formula – Orthogonality.

BLOCK IV: PARTIAL DIFFERENTIAL EQUATIONS

Solution of Laplace Differential Equation - Two dimensional flow of heat in cartesian and cylindrical co-ordinates. Solution of heat flow equation in one dimension - Solution of wave equation - Transvers e vibrations of a stretched string (Theory).

BLOCK V: INTEGRAL TRANSFORMS

Fourier transforms - cosine and sine transforms - Linearity theorem - Parseval's theorem - solution of differential equation. Laplace transforms - Definition - Linearity, shifting and change of scale properties. Inverse Laplace transforms – Definition - Problems - Solution of differential equation (problems using the above methods).

BOOKS FOR REFERENCE:

1. Mathematical Physics, B.D. Gupta, Vikas Publishing, 1995.
2. Mathematical Physics, B.S. Rajput, 20th Edition, Pragati Prakashan, 2008.
3. Mathematical Physics, H.K. Dass and Rama Verma, Chand and Company Ltd, 2010.
4. Mathematical physics, P.K. Chattopadhyay, Wiley Eastern Limited, 1990.
5. Introduction to Mathematical Physics, Charlie Harper, Prentice Hall of India Pvt. Ltd, 1993.
6. Applied Mathematics for Engineers and Physicists, L.A. Pipes and L.R. Havevill, 3rd Edition, McGraw Hill, 1971.
7. Theory and problems of Laplace Transforms, Murray R. Spigel, International edition, McGraw Hill, 1986.

Web Resources

1. Mathematical Physics MSc 1st Sem | Differential Equations | MSc Physics Full Course - YouTube
2. Ordinary Differential Equations: Mathematical Physics II #11.1 | ZC OCW - YouTube
3. Lecture 1 Mathematical Physics: Ordinary Differential Equations: Introduction - YouTube
4. Lecture 2 Ordinary Differential Equation: Variable Separable Equations - YouTube
5. Lecture 3 Ordinary Differential Equations: Variable Separable Technique - YouTube
6. Lecture 4 Ordinary Differential Equations Homogeneous Equations - YouTube
7. Mathematical Physics- Special Functions: An Introduction - YouTube
8. Explaining Special Function in Mathematical Physics - Part 1 | CSIR-NET - YouTube
9. Explaining Special Function in Mathematical Physics - Part 2 | CSIR-NET - YouTube
10. Special Functions And Diff. Equation Course Evaluation - YouTube
11. Mathematical Physics- Special Functions: Bessel's Functions- Some Problems - YouTube
12. Mathematical Physics- Special Functions: Legendre's Polynomials - YouTube
13. Mathematical Physics- Special Functions: Problems on Legendre's Polynomials- 2 - YouTube
14. Mathematical Physics- Special Functions: Bessel's Equation and its Solution - YouTube
15. Mathematical Physics- Special Functions: Hermite Polynomials- 1 - YouTube
16. Mathematical Physics- Special Functions: Hermite Polynomials- 2 - YouTube
17. Mathematical Physics Special Functions Part 3 - YouTube
18. Partial Differential Equations Overview - YouTube
19. Partial Differential Equations | CSIR NET Mathematical Science | Sankalpa Batch - YouTube
20. Partial Differential Equations (MTH-PDE) Lecture 1 - YouTube
21. Introduction to Partial Differential Equations - YouTube
22. Lecture 2 : Classification of partial differential equations - YouTube
23. Lecture 3 : Examples of partial differential equations - YouTube
24. Lecture 4 : Examples of partial differential equations (contd.) - YouTube

25. Lecture 5 : Nature of the charateristics of partial differential equation - YouTube
26. Lecture 6 : Euler-Lagrangian equation - YouTube
27. Lecture 1 || Introduction to Partial Differential Equations|| - YouTube
28. Lecture 2 || Partial Differential Equations || Formulation and Classifications - YouTube
29. Lecture 3 || Formation of p.d.e by eliminating arbitrary functions || Partial Differential Equations - YouTube
30. Lecture4 || Lagrange's Equation || Derivation || P.D.E - YouTube
31. Mathematical Physics - Integral Transforms : Laplace Transform / Fourier Transform - YouTube
32. Using Integral transforms for solving integral equations: Laplace - YouTube
33. Mathematical Physics - Integral Transforms : Laplace Transform / Fourier Transform - YouTube
34. Integral Transforms Lecture 1: Motivation & Introduction. Oxford Mathematics 2nd Yr Student Lecture - YouTube

COURSE OUTCOMES

After completion of the **MATHEMATICAL PHYSICS-II**, the Learner will be able to:

CLO 1: Create and solve mathematical models of physical phenomena using analytic and numerical methods

CLO 2: Familiarized with different special functions like Associated Legendre Polynomials, Laguerre's Polynomials, etc. and their solutions in solving different physical problems.

CLO 3: Apply and analyze the Gamma and Beta function and its application in solving nonhomogeneous differential equations

CLO 4: Learn about the concept and Generating functions and Hermite polynomials

CLO 5: Apply and analyze the Fourier and Laplace Transforms in solving different problems of Mechanics and Electronics etc

M.Sc., Physics - Syllabus – I year – IISemester (Distance Mode)

COURSE TITLE : QUANTUM MECHANICS – I

COURSE CODE : MPHS 22

COURSE CREDIT : 4

COURSE OBJECTIVES

While studying the **QUANTUM MECHANICS - I**, the Learner shall be able to:

CO 1: Discuss concepts of the fundamentals of wave mechanics.

CO 2: Describe the stationary state and eigen spectrum of systems using time dependent Schrodinger equation.

CO 3: Solve the exactly soluble eigen value problems.

CO 4: Discuss the matrix formulation of quantum theory and how it can be used to understand the equation of motion.

CO 5: Explain the theory of identical particles and Angular momentum.

COURSE SYLLABUS

BLOCK I: FOUNDATIONS OF WAVE MECHANICS

Postulates of wave mechanics -adjoint and self-adjoint operators-degeneracy-eigen value, eigen functions-Hermitian operator- parity - observables - Physical interpretation-expansion coefficients-momentum eigen functions-Uncertainty principle-states with minimum value-commuting observables.

Matter waves- Equation of motion- Schrodinger equation for the free particle – physical interpretation of wave function-normalised and orthogonal wave functions-expansion theorem- admissibility conditions- stationary state solution of Schrodinger wave equation - expectation values-probability current density-Ehrenferts theorem.

BLOCK II: STATIONARY STATE AND EIGEN SPECTRUM

Time independent Schrodinger equation - Particle in a square well potential – Bound states – eigen values, eigen functions –Potential barrier – quantum

mechanical tunnelling- alpha emission.

Identical Particles and Spin:

Identical Particles – symmetry and antisymmetric wave functions – exchange degeneracy – Spin and statistics: Pauli's exclusion principle-Slater determinant-spin and Pauli's matrices.

BLOCK III: EXACTLY SOLUBLE EIGENVALUE PROBLEMS

One dimensional linear harmonic oscillator – properties of stationary states-abstract operator method - Angular momentum operators- commutation relation-spherical symmetry systems -Particle in a central potential – radial wave function – Hydrogen atom: solution of the radial equation – stationary state wave functions – bound states-the rigid rotator: with free axis-in a fixed plane-3-Dimentional harmonic oscillator.

BLOCK IV: MATRIX FORMULATION OF QUANTUM THEORY, EQUATION OF MOTION & ANGULAR MOMENTUM

Quantum state vectors and functions- Hilbert space-Dirac's Bra-Ket notation-matrix theory of Harmonic oscillator –Equation of motions-Schrodinger, Heisenberg and Interaction representation.

Angular Momentum

Angular momentum -commutation relation of J_Z, J_+, J_- - eigen values and matrix representation of J^2, J_Z, J_+, J_- – Spin angular momentum – spin ½ , spin-1- addition of angular momenta- Clebsch-Gordan coefficients.

BLOCK V: SCATTERING THEORY

Kinematics of scattering process - wave mechanical picture- Green's functions – Born approximation and its validity –Born series – screend coulombic potential scattering from Born approximation.

Partial wave analysis

Asymptotic behavior – phase shift – scattering amplitude in terms of phase shifts – differential and total cross sections – optical theorem – low energy scattering –

resonant scattering – non-resonant scattering-scattering length and effective range– Ramsauer-Townsend effect – scattering by square well potential.

BOOKS FOR STUDY:

1. A Text book of Quantum Mechanics – G. Aruldhas, Prentice Hall of India Pvt., Ltd., 2002
2. Quantum Mechanics - Satya Prakash, Kedar Nath Ram Nath and Co. Publications, 2018.

BOOKS FOR REFERENCE:

1. Quantum Mechanics – Theory and applications - A. K. Ghatak and
2. Lokanathan, Macmillan India Ltd Publication, Fifth Edition, 2015.
3. Quantum Mechanics - Leonard I. Schiff, McGraw-Hill International
4. Publication, Third Edition, 1968.
5. Quantum Mechanics - V. K. Thankappan, New Age International (P) Ltd. Publication, Second Edition, 2003.
6. Quantum Mechanics - E. Merzbacher, John Wiley Interscience Publications,
7. Third Edition, 2011.
8. Quantum Mechanics (Vol .I) - Claude Cohen-Tannoudji, Bernard Diu, Franck
9. Laloë , JohnWiley Interscience Publications, First Edition, 1991.
10. Quantum Mechanics - Pauling & Wilson, Dover Publications, New Edition,1985.
11. Principle of Quantum Mechanics - R. Shankar, Plenum US Publication, Second Edition, 1994.

Web Resources

1. Foundations of Quantum Mechanics (1): Introduction. Recap of Schrödinger equation. - YouTube
2. Foundations of Quantum Mechanics - Joseph Emerson - USEQIP 2011 - YouTube

3. Fundamentals of Quantum Mechanics 1 - YouTube
4. Foundations of Quantum Mechanics (2): continuing recap of Schrödinger equation - YouTube
5. Stationary states: key equations - YouTube
6. Stationary States in Quantum Mechanics - YouTube
7. L22.4 Identical particles and exchange degeneracy - YouTube
8. Lec 1: Identical Particles and Spin (Tips, tricks, misconcepts, FAQs) - YouTube
9. Another Example of an Eigenfunction /Eigenvalue Problem in Quantum Mechanics - YouTube
10. Harmonic Oscillator Wavefunctions, Eigenenergies, Quantum Transition and Hermite Recurrences - YouTube
11. Quantum Harmonic Oscillator - L16 - Frederic Schuller - YouTube
12. The Quantum Harmonic Oscillator Part 1: The Classical Harmonic Oscillator - YouTube
13. The Quantum Harmonic Oscillator Part 2: Solving the Schrödinger Equation - YouTube
14. The Quantum Harmonic Oscillator Part 3: Interpretation and Application - YouTube
15. The Quantum Barrier Potential Part 1: Quantum Tunneling - YouTube
16. The Quantum Barrier Potential Part 2: Defining the Transmission and Reflection Coefficients - YouTube
17. Particle in a Box Part 1: Solving the Schrödinger Equation - YouTube
18. Particle in a Box Part 2: Interpreting the Results - YouTube
19. Mod-01 Lec-07 Angular Momentum in Quantum Mechanics - YouTube
20. Matrix formulation of quantum mechanics - YouTube
21. Quantum Mechanics - Spin Angular Momentum : Matrix Form of Spin Operators and Wave Functions - YouTube

22. Lecture 15: Eigenstates of the Angular Momentum Part 1 - YouTube
23. Lecture 16: Eigenstates of the Angular Momentum Part 2 - YouTube
24. Lecture 17: More on Central Potentials - YouTube
25. Lecture 18: "Hydrogen" and its Discontents - YouTube
26. Lecture 19: Identical Particles - YouTube
27. Mod-07 Lec-25 Dirac's Bra and Ket Algebra : The Linear Harmonic Oscillator - YouTube
28. Mod-04 Lec-25 Schrodinger, Heisenberg and Dirac "pictures" of QM - YouTube
29. L9.1 The interaction picture and time evolution - YouTube
30. Mod-08 Lec-34 Clebsch Gordon Coefficients - YouTube
31. Spin Angular Momentum, Addition of Angular Momentum, Clebsch gordan coefficients - YouTube
32. SCATTERING THEORY QUANTUM MECHANICS - YouTube
33. Scattering Theory - YouTube
34. SCATTERING THEORY IN QUANTUM MECHANICS - YouTube
35. Partial wave analysis -part 1 - YouTube
36. partial wave analysis part 2 (derivation) - YouTube

COURSE OUTCOMES

After completion of the **QUANTUM MECHANICS - I**, the Learner will be able to:

CLO 1: Describe the background for the main features in the historical development of wave mechanics

CLO 2: Discuss and interpret experiments displaying wavelike behaviour of matter, and how this motivates the need to replace classical mechanics by a wave equation of motion for matter (the Schrödinger equation)

CLO 3: Solve the linear harmonic oscillator and hydrogen-like atom problems using

Dirac formulation

CLO 4: Formulate the Heisenberg & Dirac formulation of quantum mechanics.

CLO 5: demonstrate angular momentum operators associated with spherical and symmetrical systems and various tools to calculate Eigen values and total angular momentum of particles.

M.Sc., Physics - Syllabus – I year- II Semester (Distance Mode)

COURSE TITLE : ELECTROMAGNETIC THEORY

COURSE CODE : MPHS 23

COURSE CREDIT : 4

COURSE OBJECTIVES

While studying the **ELECTROMAGNETIC THEORY**, the Learner shall be able to:

CO 1: Develop theoretical knowledge in electromagnetism.

CO 2: Discuss the concept of Electromagnetic induction and its Applications

CO 3: Derive maxwell equation in free space and Poynting theorem.

CO 4: Explain the basic principles of waveguides and transmission lines & Rendering insights into fields generated by oscillating sources, and their applications.

CO 5: Develop skills on solving analytical problems in electromagnetism and give basics of defining the complete electromagnetic response of complex systems.

COURSE SYLLABUS

Block I : ELECTROSTATICS

Coulomb's law; the electric field – line, flux and Gauss's Law in differential form - the electrostatic potential; conductors and insulators; Gauss's law - application of Gauss's law – curl of E - Poisson's equation; Laplace's equation – work and energy in electrostatics – energy of a point charge distribution – energy of continuous charge distribution – induced charges – capacitors. Potentials: Laplace equation in one dimension and two dimensions – Dielectrics – induced dipoles – Gauss's Law in the presence of dielectrics.

BLOCK II: MAGNETOSTATICS

Lorentz force – magnetic fields – magnetic forces – currents – Biot-Savart Law – divergence and curl of B – Ampere's Law – Electromagnetic induction - comparison of magnetostatics and electrostatics – Magnetic vector potential. Magnetization: effect of magnetic field on atomic orbit – Ampere's Law in magnetized materials – ferromagnetism.

BLOCK III: ELECTROMOTIVE FORCE

Ohm's Law – electromotive force – motional emf – Faraday's Law – induced electric field – inductance – energy in magnetic field – Maxwell's equation in free space and linear isotrophic media – continuity equation – Poynting theorem.

Electromagnetic waves in vacuum: Waves in one dimension – wave equation – sinusoidal waves – reflection and transmission – Polarization.

BLOCK IV: ELECTROMAGNETIC WAVES

The wave equation for E and B – Monochromatic Plan waves – energy and momentum in electromagnetic waves – electromagnetic waves in matters –TE waves in rectangular wave guides – the co-axial transmission line. Potentials: potentials and fields – scalar and vector potentials – Gauge transformation – Coulomb Gauge and Lorentz Gauge – Lorentz force law in potential form.

BLOCK V: APPLICATION OF ELECTROMAGNETIC WAVES

Boundary conditions at the surface of discontinuity – Reflection and refraction of E.M waves at the interface of non – Conducting media – Kinematic and dynamic properties – Fresnel's equation – Electric field vector 'E' parallel to the plane of incidence and perpendicular to the plane of incidence – Reflection and transmission co-efficients at the interface between two non–Conducting media – Brewster's law and degree of polarization – Total internal reflection.

BOOK FOR STUDY:

1. Introduction to Electrodynamics – David J. Griffiths, 4th Edition, Pearson.
2. Electromagnetic Theory and Electrodynamics, SathyaPrakash, KedarNath

RamNath and Co, 2017.

3. Electromagnetics, B.B Laud, Wiley Eastern Company, 2000.
4. Fundamentals of Electromagnetic, Wazed Miah, Tata Mc Graw Hill, 1980.
5. Basic Electromagnetics with Application, Narayana rao, (EEE) Prentice Hall, 1997.

BOOKS FOR REFERENCE:

1. Fundamentals of Electromagnetic Theory, Third edition, Narosa Publishing House, New Delhi – John R.Reitz, Frederick J Milford and Robert W.Christy, 1998.
2. Classical Electrodynamics – J.D. Jackson, II Edition, Wiley Eastern Limited, 1993.
3. Electromagnetic Fields and Waves – P.Lorrain and D.Corson.
4. Electromagnetics , B.B Laud, Wiley Eastern Company, 2000.

Web Resources

1. Electrostatics - YouTube
2. Classical Electrodynamics for MSc Physics | Prof. Sivakumar Rajagopalan (profsiva.in)
3. MSc Physics Online Classes -Electrostatics - YouTube
4. IIT JAM PHYSICS LECTURE (MAGNETOSTATICS) For All MSc Entrances - YouTube
5. II year Msc physics magnetostatics (introduction) magnetic force and magnetic field - YouTube
6. MAGNETOSTATICS: INTRODUCTION AND BIOT SAVART LAW (CH_22) - YouTube
7. 8.02x - Lect 16 - Electromagnetic Induction, Faraday's Law, Lenz Law, SUPER DEMO - YouTube
8. Magnetic Vector Potential || Electromagnetic Theory || The Physics Family - YouTube
9. Important Concept On Magnetism & EMF: IIT JAM Physics | L-2 | IFAS - YouTube
10. Electro Magnetics - Poynting Theorem Part 1 - YouTube
11. Electro Magnetics - Poynting Theorem Part 2 - YouTube
12. Electromagnetic Waves in a Vacuum - YouTube

13. Maxwell's Equations and Electromagnetic Waves I - YouTube
14. Maxwell's Equations - Basic derivation - YouTube
15. Rectangular waveguide - YouTube
16. Transverse Electric (TE) Mode For Rectangular Waveguide|| M.Sc.(Physics), B.Tech.|| EMT|| MIcrowave - YouTube
17. Coulomb Gauge and Lorentz Gauge - YouTube
18. Classical Electrodynamics Lectures 20 | Gauge Transformation and Coulomb Gauge | MSc Physics - YouTube
19. Electromagnetic Theory II - Lecture 3.2 - YouTube
20. Reflection and refraction at media interface - YouTube
21. electromagnetic wave in non conducting medium - YouTube
22. Reflection from a conducting boundary - YouTube
23. Reflection and Transmission of Electromagnetic Wave at Normal Incidence - YouTube
24. Lecture 32-Boundary conditions for Electromagnetic fields - YouTube
25. Propagation of Electromagnetic Waves in a Conducting Medium-I - YouTube

COURSE OUTCOMES

After completion of the **ELECTROMAGNETIC THEORY**, the Learner will be able to:

CLO 1: Provide basic understanding of the concepts of electricity, magnetism and electromagnetic waves.

CLO 2: Describe Biot-Savart Law and its applications

CLO 3: Analyze and apply the laws of electromagnetism and Maxwell's equations. Basics of electrostatics and magneto statics Solve the electric and magnetic fields problems for different configurations.

CLO 4: Learn the concept of conservation laws and gauges used in electrodynamics.

CLO 5: Discuss the propagation of electromagnetic waves in various bound and unbound media will help the students to solve the difficult problems of electrodynamics.

M.Sc., Physics - Syllabus – I year – II Semester (Distance Mode)

COURSE TITLE : MICROPROCESSORS AND MICROCONTROLLER

COURSE CODE : MPHS EL-2

COURSE CREDIT : 3

COURSE OBJECTIVES

While studying the **MICROPROCESSORS AND MICROCONTROLLER**, the Learner shall be able to:

CO 1: Learn the Basic Concept of Microprocessor 8085

CO 2: Study the assembly language programming of Microprocessors 8085

CO 3: Learn the Architecture and Operating modes Microprocessor 8086

CO 4: Study the various types of instructions of Microcontroller 8051

CO 5: Explain the interfacing of 8085 microprocessor

COURSE SYLLABUS

BLOCK I: MICROPROCESSORS 8085 ARCHITECTURE

Intel 8085 microprocessor: Introduction – Pin configuration- Architecture and its operations - Machine cycles of 8085. Interfacing of memory and I/O devices. Instruction classification: number of bytes, nature of operations- Instruction format. Vectored and non-vectored interrupts.

BLOCK II: 8085 ASSEMBLY LANGUAGE PROGRAMMING

Instruction set: Data transfer operations - Arithmetic operations Logical operations – Branching and machine control operations. Addressing modes. Writing assembly language programs: Looping, counting, and indexing. Counters and time delays - Stack - subroutine. Translation from assembly language to machine language

BLOCK III: MICROPROCESSOR 8086

Intel 8086 microprocessor: Introduction – Architecture - Pin configuration- Operating modes: Minimum mode, Maximum mode. Memory addressing: 8-bit data from even and odd address bank, 16-bit data from even and odd address bank.

Addressing modes. Interrupts: Hardware interrupts – Software interrupts –Interrupt priorities. Simple programs.

BLOCK IV: MICROCONTROLLER 8051 ARCHITECTURE AND PROGRAMMING

Introduction to microcontroller and embedded system. Difference between microprocessor and microcontroller. 8051 microcontroller : Pin configuration, Architecture and Key features. 8051. Data types and directives Instruction set: Data transfer instructions - Arithmetic instructions – Logical instructions- Branching instructions- Single bit instructions. Addressing modes. Simple programs using 8051 instruction set.

BLOCK V: INTERFACING OF MICROPROCESSOR 8085

Basic concepts of programmable device - 8255 Programmable Peripheral Interface (PPI) – interface of ADC and DAC. 8257 Direct Memory Access (DMA) controller. Basic concepts of serial I/O and data communication – interface of 8251 Universal Synchronous Asynchronous Receiver Transmitter (USART)

BOOKS FOR REFERENCE:

1. Microprocessor Architecture, Programming and Applications with 8085/8080, Ramesh S. Gaonkar, New Age International 6th edition, 2013.
2. Microprocessors and Interfacing-Programming and Hardware, Douglas V. Hall, Tata McGraw Hill, 1993.
3. Microprocessors and Microcontrollers by A.P.Godse and D.A.Godse, Technical Publications, Pune.
4. Advanced Microprocessors and Interfacing, Badri Ram, Tata McGraw Hill, 2001.
5. The 8051 Microcontroller and Embedded systems, Muhammad Ali Mazidi and Janice Mazidi. Pearson Education, 2000.
6. The 8051 Microcontroller Architecture, Programming and Applications.

Kenneth J. Ayala. Penram International publishing Pvt. Ltd., second edit, 1996.

Web Resources

1. 8085 Microprocessor Architecture Bharat Acharya Engineering, GATE Studies - YouTube
2. Architecture of 8085 Microprocessor with Block Diagram - 8085 Microprocessor - Microprocessors - YouTube
3. Pin Diagram of 8085 Microprocessor - 8085 Microprocessor - Microprocessor & Peripherals Interfacing - YouTube
4. 8085 Microprocessor Architecture Block Diagram - 8085 Microprocessor - Microprocessor - YouTube
5. 8085 Assembly Language Programming (Part 1) | Introduction and How the Program Counter Works | TDG - YouTube
6. 8086 microprocessor architecture | Bus interface unit | part-1/2 - YouTube
7. 8086 Microprocessor Architecture - Bharat Acharya - YouTube
8. addressing modes of 8086 | part-1/3 - YouTube
9. 8086 microprocessor | Minimum mode | Lec-22 | Bhanu Priya - YouTube
10. Architecture of 8086 microprocessor in Tamil/ animated video - YouTube
11. 8086 microprocessor | Maximum mode | Lec-23 | Bhanu Priya - YouTube
12. difference between max and min mode 8086 - YouTube
13. 8051 microcontroller architecture | part-1/2 - YouTube
14. 8051 microcontroller architecture | part-2/2 - YouTube
15. chapter2 The 8051 Microcontroller ARCHITECTURE, PROGRAMMING, and APPLICATIONS - YouTube
16. chapter 4 The 8051 Microcontroller ARCHITECTURE, PROGRAMMING, and APPLICATIONS - YouTube

17. lec 22 - Architecture and Organization of Intel 8051 - YouTube
18. 8051 | Programming Part 1 | Bharat Acharya Education - YouTube
19. 8051 | Programming Part 3 | Bharat Acharya Education - YouTube
20. Interfacing I/O Devices with 8085 Microprocessor Memory Mapped and Peripheral Mapped I/O Interfacing - YouTube
21. I/O Device Interfacing with 8085 Microprocessor - YouTube
22. 8251A - USART - Architecture of 8251 - Serial communication Interface - MPMC - YouTube
23. 8255 Programmable Peripheral Interface - Microprocessor - YouTube
24. 8257 Direct Memory Access Controller (DMA) Block Diagram & Pin Description - YouTube

COURSE OUTCOMES

After completion of the **MICROPROCESSORS AND MICROCONTROLLER**, the Learner will be able to:

CLO 1: Discuss the Pin configuration, Architecture, and its operations of Microprocessor 8085.

CLO 2: Develop the skills to write Assembly Language programming of Microprocessor and Translation from assembly language to machine language.

CLO 3: Describe the various modes of addressing and Interrupts of Microprocessor 8086.

CLO 4: Distinguish between microprocessor and microcontroller and design Simple programs using 8051 instructions set.

CLO 5: Describe the interface of 8251 Universal Synchronous Asynchronous Receiver Transmitter (USART)

M.Sc., Physics - Syllabus – II year – III Semester (Distance Mode)

COURSE TITLE : QUANTUM MECHANICS – II

COURSE CODE : MPHS 31

COURSE CREDIT : 4

COURSE OBJECTIVES

While studying the **QUANTUM MECHANICS – II**, the Learner shall be able to:

CO 1: learn about the approximation method for time independent perturbation theory.

CO 2: Study the approximation method for time dependent perturbation theory and Semi-classical theory of radiation.

CO 3: Describe basic concept of Variation method and Variation Principle

CO 4: Study the quantum theory of atomic and molecular structures

CO 5: Learn the basics of relativistic quantum mechanics and field quantization

COURSE SYLLABUS

BLOCK I: APPROXIMATION METHODS FOR TIME INDEPENDENT PROBLEMS

Time independent perturbation theory – stationary theory- Non-degenerate case: first and second order-Normal Helium atom– Zeeman effect without electron spin – Stark effect in hydrogen molecule - Degenerate case: Energy correction- Stark effect in hydrogen atom.

BLOCK II: APPROXIMATION METHODS FOR TIME DEPENDENT PERTURBATION THEORY

Time dependent Perturbation theory - first order transitions – constant perturbation- transition probability: Fermi Golden Rule –Periodic perturbation – harmonic perturbation – adiabatic and sudden approximation.

Semi-classical theory of radiation: Application of the time dependent perturbation theory to semi-classical theory of radiation – Einstein's coefficients – absorption - induced emission- spontaneous emission – Einstein's transition

probabilities- dipole transition - selection rules – forbidden transitions.

BLOCK III: VARIATION METHOD

Variation method: Variation Principle – upper bound states- ground state of Helium atom – Hydrogen molecule-WKB approximation - Schrodinger equation-Asymptotic solution-validity of WKB approximation-solution near a turning point – connection formula for penetration barrier – Bohr-Summer field quantization condition- tunneling through a potential barrier.

BLOCK IV: QUANTUM THEORY OF ATOMIC AND MOLECULAR STRUCTURE

Central field approximation: Residual electrostatic interaction-spin-orbit interaction- Determination of central field: Thomas Fermi statistical method-Hartree and Hartree-Fock approximations (self-consistent fields) – Atomic structure and Hund's rule.

Molecules

Born-Oppenheimer approximation – An application: the hydrogen molecule Ion (H_2^+) – Molecular orbital theory: LCAO- Hydrogen molecule.

BLOCK V: RELATIVISTIC QUANTUM MECHANICS & QUANTIZATION OF THE FIELD

Schrodinger relativistic equation- Klein-Gordan equation-charge and current densities – interaction with electromagnetic field- Hydrogen like atom – nonrelativistic limit- Dirac relativistic equation: Dirac relativistic Hamiltonian – probability density- Dirac matrices-plane wave solution – eigen spectrum – spin of Dirac particle – significance of negative eigen states – electron in a magnetic field – spin magnetic moment.

Quantization of the Field

Quantization of wave fields- Classical Lagrangian equation- Classical Hamiltonian equation- Field quantization of the non-relativistics Schrodinger equation- Creation, destruction and number operators- Anticommutation relations- Quantization of

Electromagnetic field energy and momentum.

BOOKS FOR STUDY:

1. A Text book of Quantum Mechanics - P. M. Mathews and K. Venkatesan, Tata McGraw – Hill Publications, Second Edition, 2010.
2. Quantum Mechanics - Satya Prakash, Kedar Nath Ram Nath and Co. Publications, 2018.
3. Claude Cohen-Tannoudji, Bernard Diu, Franck Laloë , Quantum Mechanics (Vol. II), Quantum Mechanics (Vol. II), John Wiley Publications, 2008.

BOOKS FOR REFERENCE:

1. Quantum Mechanics V. K. Thankappan, New Age International (P) Ltd.
2. Publication, Second Edition, 2003.
3. Quantum mechanics - Franz Schwabl, Narosa Publications, Fourth Edition, 2007.
4. Molecular Quantum mechanics - P.W.Atkins and R.S. Friedman,), Oxford University Press publication, Fifth Edition, 2010.
5. Quantum Mechanics – Theory and Applications, A. K. Ghatak and Lokanathan, Macmillan India Ltd Publication, Fifth Edition, 2015.
6. Quantum Mechanics - Leonard I. Schiff, McGraw-Hill International Publication, Third Edition, 1968.
7. Quantum Mechanics - E. Merzbacher, John Wiley Interscience Publications, Third Edition, 2011.
8. Fundamental principles of Quantum mechanics with elementary applications - Edwin C. Kemble, Dover Publications, ReIssue Edition, 2005.
9. Principle of Quantum Mechanics - R. Shankar, Plenum US Publication, Second Edition, 1994.

Web Resources

1. Non-degenerate Perturbation Theory - Time-independent Perturbation Theory | Coursera

2. k-dot-p Method - Time-independent Perturbation Theory | Coursera
3. Variational Method - Other Approximation Methods | Coursera
4. L55.4 Time independent non-degenerate perturbation theory- Problems - YouTube
5. PERTURBATION THEORY | QUANTUM MECHANICS - YouTube
6. Mod-10 Lec-40 Time Independent Perturbation Theory - YouTube
7. Mod-10 Lec-41 Time Independent Perturbation Theory (Contd.1) - YouTube
8. Lecture 48 - First and Second Order Time Independent Perturbation Theory for Non-Degenerate States - YouTube
9. Lecture 48 - First and Second Order Time Independent Perturbation Theory for Non-Degenerate States - YouTube
10. Lecture 47 - First Order Time Independent perturbation Theory for Non-Degenerate states - YouTube
11. Transition Probability 1 - Time-dependent Perturbation Theory | Coursera
12. Time dependent Perturbation Theory, Fermi's Golden rule, Einstein's A and B coefficients - YouTube
13. 30. Time-Dependent Perturbation Theory I: H is Time-Independent, Zewail Wavepacket. - YouTube
14. VARIATIONAL METHOD QUANTUM MECHANICS | VARIATIONAL PRINCIPLE - YouTube
15. The variational principle in quantum mechanics - YouTube
16. UNM Phys 531 2011 Lec09 Central field approximation - YouTube
17. Central Field Approximation-III - YouTube
18. Central Field Approximation - YouTube
19. Klein Gordon Equation or Relativistic Schrodinger equation | Relativistic Quantum Mechanics | NNN - YouTube
20. NPTEL :: Physics - Relativistic Quantum Mechanics
21. L4.4 Dirac equation for the electron and hydrogen Hamiltonian - YouTube
22. Quantum Field Theory 2a - Field Quantization I - YouTube
23. Quantum Field Theory 2b - Field Quantization II - YouTube
24. Quantum Field Theory 3a - Photons I - YouTube
25. Quantum Field Theory 3b - Photons II - YouTube
26. Field Equation continuation, Quantization of Non-relativistic Schrodinger equation | 9.7.2021 | NNN - YouTube
27. (Not Relativistic) Quantum Mechanics - QUANTUM FIELD THEORY 1 - YouTube
28. Solutions to Schrödinger Equation, Energy Quantization - YouTube

COURSE OUTCOMES

After completion of QUANTUM **MECHANICS - II**, the Learner will be able to:

CLO 1: Discuss the Time Independent Perturbation Theory and its application (Zeeman and Stark effect).

CLO 2: Explain the time dependent perturbation theory and semi- classical theory of radiations and its applications.

CLO 3: Describe the ground state of Helium atom and Hydrogen molecule an Account of WKB approximation.

CLO 4: Analyze and apply the Central field approximation in atom and Molecules.

CLO 5: Understand Klein- Gordon equation, Dirac's relativistic equation, Field quantization of the non-relativistic Schrodinger equation

M.Sc., Physics - Syllabus – II year – III Semester (Distance Mode)

COURSE TITLE	**:**	**THERMODYNAMICS AND STATISTICAL MECHANICS**
COURSE CODE	**:**	**MPHS 32**
COURSE CREDIT	**:**	**4**

COURSE OBJECTIVES

While studying the **THERMODYNAMICS AND STATISTICAL MECHANICS,** the Learner shall be able to:

CO 1: Provide a phenomenological introduction to thermodynamics through thermodynamics postulates, quantities and relations.

CO 2: Learn the basic concept of various canonical ensembles.

CO 3: Understanding the classical and quantum distribution laws and their relations.

CO 4: Study the transport properties, different phases of maters, equilibrium and non- equilibrium process

CO 5: Discuss the Heat capacities of diatomic gas.

COURSE SYLLABUS

BLOCK I: THERMODYNAMICS, MICROSTATES AND MACROSTATES

Basic postulates of thermodynamics – Phase space and ensembles – Fundamental relations and definition of intensive variables – Intensive variables in the entropic formulation – Equations of state – Euler relation, densities - Gibbs-Duhem relation for entropy - Thermodynamic potentials– Maxwell relations – Thermodynamic relations – Microstates and macrostates – Ideal gas – Microstate and macrostate in classical systems – Microstate and macrostate in quantum systems – Density of states and volume occupied by a quantum state

BLOCK II: MICROCANONICAL, CANONICAL AND GRAND CANONICAL ENSEMBLES

Microcanonical distribution function – Two level system in microcanonical ensemble – Gibbs paradox and correct formula for entropy – The canonical distribution function – Contact with thermodynamics - Partition function and free energy of an

ideal gas –The grand partition function – Relation between grand canonical and canonical partition functions – One-orbital partition function

BLOCK III: BOSE-EINSTEIN, FERMI-DIRAC AND MAXWELL-BOLTZMANN DISTRIBUTIONS

Bose-Einstein and Fermi-Dirac distributions – Thermodynamic quantities – Non-interacting Bose gas and thermodynamic relations – Chemical potential of bosons – The principle of detailed balance – Number density of photons and Bose condensation - Thermodynamic relations for non-interacting Fermi gas – Fermi gas at zero and low temperature – Fermi energy and Fermi momentum - Maxwell-Boltzmann distribution law for microstates in a classical gas - Physical interpretation of the classical limit – Fluctuations in different ensembles

BLOCK IV: TRANSPORT AND NON-EQUILIBRIUM PROCESSES

Derivation of Boltzmann transport equation for change of states without and with collisions – Boltzmann equation for quantum statistics – Equilibrium distribution in Boltzmann equation – Transport processes; One speed and one dimension - All speeds and all directions - Conserved properties - Distribution of molecular velocities – Equipartition and Virial theorems – Random walk - Brownian motion - Non-equilibrium process; Joule-Thompson process - Free expansion and mixing - Thermal conduction - The heat equation.

BLOCK V: HEAT CAPACITIES, ISING MODEL AND PHASE TRANSITIONS

Heat capacities of heteronuclear diatomic gas – Heat capacities of homonuclear diatomic gas – Heat capacity of Bose gas –One-dimensional Ising model and its solution by variational method – Exact solution for one-dimensional Ising model - Phase transitions and criterion for phase transitions – Classification of phase transitions by order and by symmetry – Phase diagrams for pure systems – Clausius-Clapeyron equation – Gibbs phase rule

BOOKS FOR REFERENCE:

1. Fundamentals of Statistical and Thermal Physics Paperback, Reif, Sarat Book Distributors (2010).
2. Fundamentals of Statistical Mechanics Paperback, B.B. Laud , New Age International Private Limited, Jan 2012.
3. Elementary Statistical Physics, C.Kittel, John Wiley & Sons, 2004.
4. Statistical and Thermal Physics, F.Reif, McGraw Hill, Fifth Edition, 2010.
5. Statistical Mechanics, Gupta & Kumar, 20th Edition, Pragati Prakashan,
6. Meerut, 2003.
7. Statistical Mechanics, B.K.Agarwal and M.Eisner, Second Edition, New Age International Private Limited, Delhi, 2016.
8. Statistical Mechanics and Properties of Matter (Theory and Applications), E.S.R.Gopal, Ellis Horwood Ltd, 1974.

Web Resources

1. MACROSTATE AND MICROSTATES | STATISTICAL MECHANICS - YouTube
2. Micro Canonical, Canonical and Grand Canonical Ensemble - YouTube
3. Mod-01 Lec-20 Classical statistical mechanics: Introduction - YouTube
4. Mod-01 Lec-21 Some probability distributions; isolated system - YouTube
5. Mod-01 Lec-22 The microcanonical emsemble - YouTube
6. Mod-01 Lec-23 Thermodynamics - YouTube
7. Mod-01 Lec-24 The canonical ensemble - YouTube
8. Mod-01 Lec-25 Connection between statistical mechanics and ther-modynamics - YouTube
9. Mod-01 Lec-26 Probability distributions - YouTube
10. Mod-01 Lec-27 Probability distributions (concld.). Phase transitions (Part 1) - YouTube
11. Mod-01 Lec-28 Phase transitions (Part 2) - YouTube
12. Mod-01 Lec-29 Phase transitions (Part 3) - YouTube
13. Mod-01 Lec-30 Phase transitions (Part 4); misc. topics - YouTube
14. Mod-01 Lec-31 Problems and solutions (Part 3) - YouTube

15. Bose-Einstein, Fermi-Dirac and Maxwell-Boltzmann distribution - YouTube
16. Fermi-Dirac and Bose-Einstein statistics - basic introduction - YouTube
17. Statistical distribution functions Maxwell Boltzman, Fermi Dirac & Bose Einstein - YouTube
18. Nonequilibrium Statistical Mechanics I - Chris Jarzynski - YouTube
19. Non-equilibrium statistical physics: Introductory examples (Lecture - 01) by Sidney Redner - YouTube
20. Ising Model of Phase Transition Statistical Mechanics (Physics) in English(Live Class Now) - YouTube
21. Lec : 1.1: Introduction to Ising Model : Phase, Phase Transition, Symmetry Breaking, Order Parameter - YouTube
22. Pressure of an ideal gas and fluctuations | The Theoretical Minimum
23. Statistical Mechanics Lecture 9 - YouTube
24. Statistical Mechanics Lecture 10 - YouTube
25. Heat Capacity of a Diatomic Gas -- Course in Thermal and Statistical Physics - YouTube

COURSE OUTCOMES

After completion of the **THERMODYNAMICS AND STATISTICAL MECHANICS**, the Learner will be able to:

CLO 1: Explain the Fundamental relations and definition of intensive variables, Equations of state, Euler relation, densities and Gibbs-Duhem relation for entropy.

CLO 2: Compare the uses of micro- canonical, canonical and grand canonical ensembles.

CLO 3: Describe Bose-Einstein and Fermi-Dirac distributions and calculate Fermi energy and Fermi momentum.

CLO 4: Explain the derivation of Boltzmann transport equation for change of states without and with collisions.

CLO 5: Differentiate the Heat capacities of heteronuclear and homonuclear diatomic gas

M.Sc., Physics - Syllabus – II year – III Semester (Distance Mode)

COURSE TITLE : CONDENSED MATTER PHYSICS – I

COURSE CODE : MPHS 33

COURSE CREDIT : 4

COURSE OBJECTIVES

While studying the **CONDENSED MATTER PHYSICS – I,** the Learner shall be able to:

CO 1: Learn the basic concepts of Crystal Physics

CO 2: Study about Diffraction of Waves and Particles by Crystal

CO 3: Discuss the various types of Crystal Imperfections

CO 4: Define Heat Capacity of Solids and Vibrational Models

CO 5: Study about the Theory of electrons and its applications.

COURSE SYLLABUS

BLOCK I: CRYSTAL PHYSICS: CRYSTAL STRUCTURE

Lattice representation - Simple symmetry operations - Bravais Lattices, Unit cell, Wigner -Seitz cell - Miller planes and spacing - Characteristics of cubic cells - Structural features of NaCl, CsCl, Diamond, ZnS – Close packing.

Crystal Binding: Interactions in inert gas crystals and cohesive energy – Lennard – Jones potential - Interactions in ionic crystals and Madelung energy - Covalent bonding – Heitler – London Theory – Hydrogen bonding – metallic bonding.

BLOCK II: DIFFRACTION OF WAVES AND PARTICLES BY CRYSTALS

X-rays and their generation - Moseley's law – Absorption of X-rays (Classical theory) – Absorption Edge – X-ray diffraction – The Laue equations – Equivalence of Bragg and Laue equations – Interpretation of Bragg equation – Ewald construction - Reciprocal lattice – Reciprocal lattice to SC, BCC and FCC crystals- Importance properties of the Reciprocal lattice – Diffraction Intensity - The Powder method – Powder Diffractometer - The Laue method -The Rotating Crystal method - Neutron

Diffraction - Electron diffraction.

BLOCK III: CRYSTAL IMPERFECTIONS AND ORDERED PHASES OF MATTER

Point imperfections – Concentrations of Vacancy, Frenkel and Schottky imperfections – Line Imperfections – Burgers Vector – Presence of dislocation – surface imperfections- Polorans – Excitons.

Ordered phases of matter: Translational and orientation order - Kinds of liquid crystalline order - Quasi crystals - Superfluidity.

BLOCK IV: LATTICE DYNAMICS

Theory of elastic vibrations in mono and diatomic lattices - Phonons – Dispersion relations - Phonon momentum.

Heat Capacity

Specific heat capacity of solids – Dulong and Petit's law - Vibrational modes - Einstein model - Density of modes in one and three dimensions - Debye Model of heat capacity.

Anharmonic Effects

Explanation for Thermal expansion, Conductivity and resistivity – Umklapp process.

BLOCK V: THEORY OF ELECTRONS

Energy levels and Fermi-Darac distribution for a free electron gas – Periodic boundary condition and free electron gas in three dimensions – Heat capacity of the electron gas – Ohm's law, Matthiessen's rule – Hall effect and magnetoresistance – Wiedemann – Franz law. Nearly free electron model and the origin and magnitude of energy gap – Bloch functions - Bloch theorem - Motion of an electron in a periodic potential – Kronig – Penney model - Approximate solution near a zone boundary – Metals, semiconductors and insulators – effective mass – Limitations of K-P model – Tight binding approach - Construction of Fermisurfaces: Reduced and periodic zone schemes of construction- de Haas – van Alphen effect.

BOOKS FOR STUDY:

1. Charles Kittel, Introduction to Solid State Physics, 7th Edition, Wiley India Pvt. Ltd. , New Delhi, 2004.
2. Rita John, Solid State Physics, Tata Mc Graw Hill Publications, 2014.
3. M. A. Wahab, Solid State Physics – Structure and Properties of Materials. Narosa, New Delhi, 1999.
4. J.D. Patterson, B.C. Bailey Solid-State Physics: Introduction to the Theory, Springer Publications, 2007.
5. M. Ali Omar, Elementary Solid State Physics – Principles and Applications, Pearson, 1999.

BOOKS FOR REFERENCE:

1. J. Blakemore, Solid State Physics, 2nd Edition, W. B. Saunders Co, Philadelphia, 1974.
2. C. M. Kachhava, Solid State Physics, Tata Mcgraw Hill, New Delhi, 1990.
3. N. W. Aschroft and N. D., Mermin, Solid State Physics, Rhinehart and Winton, New York. 1976.
4. M. Tinkham, Introduction to Superconductivity, Tata Mcgraw Hill, New Delhi, 1996.
5. K.K.Chattopadhyay, A.N.Banerjee, Introduction to Nanoscience and
6. Nanotechnolog, PHI Learning private Ltd., Delhi 2014.
7. J. Dekker, Electrical Engineering Materials, Prentice Hall of India, 1975.
8. S.O. Pillai, Problems and Solutions in Solid State Physics, New Age international Publishers, New Delhi, 1994.
9. A.K. Bain, P. Chand, Ferroelectrics, Wiley, 2017.
10. Kwan Chi Kao, Dielectric phenomena in solids with eMPHSasis on physical concepts of electronic processes, Elsevier Academic Press, 2004
11. Alexander O. E. Animalu, Intermediate Quantum Theory of Crystalline solids, Prentice Hall of India, New Delhi, 1978.

12. Eleftherios N. Economou, The Physics of Solids – Essentials and Beyond, Springer, 2010.

Web resource

1. Introduction to Solid State Physics, Lecture 1: Overview of the Course - YouTube
2. Introduction to Solid State Physics, Lecture 2: Basics of Quantum Mechanics - YouTube
3. Introduction to Solid State Physics, Lecture 3: Einstein and Debye Models of a Solid - YouTube
4. Introduction to Solid State Physics, Lecture 4: Drude and Sommerfeld Theories of Electrons in Solids - YouTube
5. Introduction to Solid State Physics, Lecture 5: One-dimensional models of vibrations in solids - YouTube
6. Introduction to Solid State Physics, Lecture 6: One-dimensional Tight Binding Model for Electrons - YouTube
7. Introduction to Solid State Physics, Lecture 7: Crystal Structure - YouTube
8. Introduction to Solid State Physics, Lecture 8: Reciprocal Lattice - YouTube
9. Introduction to Solid State Physics, Lecture 9: Scattering Experiments (X-ray Diffraction) - YouTube
10. Introduction to Solid State Physics, Lecture 10: Electron Waves in Crystals - YouTube
11. Introduction to Solid State Physics, Lecture 11: Band Structure of Electrons in Solids - YouTube
12. Introduction to Solid State Physics, Lecture 12: Physics of Semiconductors - YouTube
13. Introduction to Solid State Physics, Lecture 13: Graphene and Carbon Nanotubes - YouTube
14. Introduction to Solid State Physics, Lecture 14: Semiconductor Devices - YouTube
15. Introduction to Solid State Physics, Lecture 15: Paramagnetism and Diamagnetism - YouTube
16. Lecture 04: X-ray diffraction: Crystal structure determination - YouTube
17. Introduction to x-ray diffraction by Dr Rajesh Prasad, IIT Delhi - YouTube
18. Lecture 05: Crystal planes and directions: Indexing - YouTube
19. Defects In Solids - Causes, Types Of Imperfections, Examples (byjus.com)

20. Lattice Dynamics in Three Dimensions - YouTube
21. Introduction to Solid State Physics: Lecture-21 (Lattice Dynamics-II) - YouTube
22. Introduction to Solid State Physics: Lecture-22 (Lattice Dynamics-III) - YouTube
23. Introduction to Solid State Physics: Lecture-23 (Lattice Dynamics-IV) - YouTube
24. Debye's Theory of Specific Heat Capacities of Solids | Solid State Physics | B.Sc Physics - YouTube
25. Mod-01 Lec-13 Debye Theory of Specific Heat, Lattice Vibrations - YouTube
26. Mod-01 Lec-9 The Free Electron Theory of Metals - YouTube
27. 04 Sommerfeld Free Electron Theory of Electrons in Metals - YouTube
28. Mod-01 Lec-03 Free electron theory - YouTube
29. The Hall Effect and Hall emf - YouTube
30. Kronig Penney Model - YouTube
31. Quantum Hall Effect - YouTube
32. Kronig-Penny Model | band theory of solids | Physics | - YouTube
33. noc19-ph02 Lecture 63-Kronig- Penney model - YouTube
34. L14: Kronig Penny Model: Bloch Theorem - YouTube
35. Kronig-Penny Solution in Python - YouTube

COURSE OUTCOMES

After completion of the **CONDENSED MATTER PHYSICS – I**, the Learner will be able to:

CLO 1: Identify the importance of crystal physics to analyze the Structural features of NaCl, CsCl, Diamond, ZnS.

CLO 2: Recognize the analytical techniques for studying the Structural Properties of Crystal by X ray diffraction (Laue method and Rotating Crystal method).

CLO 3: Identify and Differentiate the Various Types of Crystal Imperfections (Frenkel and Schottky imperfections)

CLO 4: Describe Dulong and Petit's law and Debye Model of heat capacity.

CLO 5: Explain the Motion of an electron in a periodic potential by using Kronig – Penney model and classify the solids in to Metals, semiconductors and insulators

M.Sc., Physics - Syllabus – II year – III Semester (Distance Mode)

COURSE TITLE : PHYSICS OF NANOMATERIALS

COURSE CODE : MPHS- EL3

COURSE CREDIT : 3

COURSE OBJECTIVES

While studying the **PHYSICS OF NANOMATERIALS,** the Learner shall be able to:

CO 1: Provide the basic Knowledge about basics nanoscience and technology.

CO 2: Study about Various structure of Carbon nanomaterials and Micro and Mesoporous Materials.

CO 3: Describe the physical properties nanostructured materials.

CO 4: Enumerate the various methods of synthesis of nanoparticles & describe the Physical properties.

CO 5: Acquire the knowledge about characterization techniques and its applications.

COURSE SYLLABUS

BLOCK I: INTRODUCTION

Introduction – History of nanotechnology - Classification of nanomaterials: Definition of – Zero, one and two dimension nano structures – Examples - Classification of synthesis methods. Surface energy – Chemical potential as a function of surface curvature – Electrostatic stabilization - Steric stabilization – DLVO theory.

BLOCK II: SPECIAL NANOMATERIALS

Carbon Fullerenes and Nanotubes: Carbon fullerenes, Fullerene derived crystals, Carbon nanotubes. Micro and Mesoporous Materials: Ordered mesoporous structures, Random mesoporous structures, crystalline microporous materials. Core-shell structures: Metal-oxide structures, Metal-polymer structures, Oxide-polymer structures. Organic- Inorganic Hybrids. Intercalation Compounds – Nanocomposites.

BLOCK III: PROPERTIES

Physical properties of nanomaterials: Melting points, Specific heat capacity and lattice constants – Mechanical properties – Optical properties:-Surface Plasmon Resonance – Quantum size effects – Electrical property: Surface scattering, charge of electronic structure, Quantum transport, effect of microstructure: Ferroelectrics and dielectrics – Variation of magnetism with size-Super para magnetism-Diluted magnetic semi conductor.

BLOCK IV: SYNTHESIS

Synthesis of nano materials: Physical vapour deposition - Chemical vapour deposition plasma arching - Sol gel - Ball milling technique - Reverse miceller technique - Electro deposition. Synthesis of Semiconductors: Nanostructures fabrication by physical techniques – Nano lithography – Nanomanipulator.

BLOCK V: CHARACTERIZATION AND APPLICATIONS

Structural Characterization: X-Ray diffraction – Scanning tunneling Microscopy – Transmission Electron Microscopy – Chemical Characterization: Optical spectroscopy.

Applications: Molecular electronics and Nano electronics, Nano electromechanical systems- Colorants and pigments –DNA chips – DNA array devices – Drug delivery systems.

BOOKS FOR STUDY:

1. Nanostructured Materials and Nanotechnology -Hari Singh Nalwa, Academic Press, 2002.
2. Nano Materials, Viswanathan B, Narosa publishing House Pvt Ltd., 2014.
3. Nano: The Essentials, Pradeep T, Tata MC Graw-Hill Publishing Company limited, 2012.
4. Nanobiotechnology: Concepts, Applications and Perspectives, Christof M. Niemeyer, Chad A. Mirkin, Wiley-VCH Verlag GmbH & Co, 2004.

BOOKS FOR REFERENCE:

1. Organic and Inorganic Nanostructures, A. Nabok- Artech House, 2005
2. Nanoscience: "Nanotechnologies and Nanophysics", C. Dupas, P.Houdy, M. Lahmani, Springer-Verlag Berlin Heidelberg, 2007
3. Introduction to Nanotechnology, Charles P. Poole, Frank J Owens, Wiley-Interscience.
4. Nanosystem Characterization Tools in the Life Sciences edited by Challa Kumar
5. Nanostructures and Nanomaterials (Synthesis, Properties and Applications), Guozhong Cao. World Scientific Publishing Co Pvt. Ltd. 2004

Web Resources

1. History of nanotechnology - YouTube
2. Brief History of Nanoscience - YouTube
3. Classification of nanomaterials - YouTube
4. Classification of Nanomaterials based upon Dimension and Composition by Dr.K.Shirish Kumar. - YouTube
5. mod-05 Lec-29 Basics of Nano-Structured Material Synthesis: Part I - YouTube
6. Nanomanufacturing: 14 - Nanoparticle synthesis in solution - YouTube
7. Physics of Nano Scale Materials; Course Summary - YouTube
8. Synthesis of nanomaterials by Physical and Chemical Methods - YouTube
9. Mod-01 Lec-31 The New Carbon family I- Fullerenes and Nanotubes - YouTube
10. Carbon Nanotubes (CNT) - YouTube
11. Mod-03 Lec-15 Fullerences and Carbon Nanotubes - I - YouTube
12. Mod-03 Lec-16 Fullerences and Carbon Nanotubes - II - YouTube
13. Mod-03 Lec-17 Fullerences and Carbon Nanotubes - III - YouTube
14. Nanomaterials-Fullerene, CNT and Graphene- Module-3 - YouTube
15. Unified Approach to Understanding Porous Materials - YouTube
16. Hybrid Organic Inorganic Nanocomposites Materials - YouTube
17. Mod-03 Lec-27 Nanocomposites - I - YouTube

18. Mod-03 Lec-28 Nanocomposites - II - YouTube
19. SFCM 13/14 15: PROCESSING AND PROPERTIES OF POLYMER MATRIX NANOCOMPOSITES WITH CARBON NANOPARTICLES - YouTube
20. SFCM 14/15 16: ADVANCED POLYMER NANOCOMPOSITES - YouTube
21. Physical Properties of Nanomaterials: Part 1st, Effect of Size, Shape and Composition - YouTube
22. Mod-01 Lec-14 Surface Effects and Physical properties of nanomaterials - YouTube
23. Mod-01 Lec-11 Surface Effects and Physical properties of nanomaterials - YouTube
24. Mod-01 Lec-12 Surface Effects and Physical properties of nanomaterials - YouTube
25. Mod-01 Lec-15 Surface Effects and Physical properties of nanomaterials - YouTube
26. Mod-01 Lec-21 Electrical, Magnetic and Optical Properties of Nanomaterials - YouTube
27. Mod-01 Lec-25 Electrical, Magnetic and Optical Properties of Nanomaterials - YouTube
28. Size Effect in Physical and Other Properties of Nanostructured Coatings - YouTube
29. Mod-01 Lec-24 Electrical, Magnetic and Optical Properties of Nanomaterials - YouTube
30. Nanomaterials Synthesis - YouTube
31. Lecture 15 : Synthesis of Nanomaterials - YouTube
32. Synthesis of Nanomaterials-Sol Gel method- Prof.Shwethambika. P. - YouTube
33. Synthesis of Nanomaterials in Tamil - YouTube
34. Preparation of Nanomaterials by Sol-Gel method (Wet Chemical Synthesis) by Dr.K.Shirish Kumar - YouTube
35. M-13.Characterization and Applications of Liposomes - YouTube
36. Characterisation of Nanomaterials - YouTube
37. Mod-11 Lec-29 Nano-particle Characterization: Bottom-Up Synthesis

Methods - YouTube

38. Introduction to Laser Diffraction for Particle Size Analysis - YouTube
39. Electronics Nanoelectronics Devices and Materials mod11lec36 - YouTube
40. Future Nanoscale Multiferroic Devices - YouTube

COURSE OUTCOMES

After completion of the **PHYSICS OF NANOMATERIALS**, the Learner will be able to:

CLO 1: Explain the term Nanoscience and Nanotechnology and quantum confinement, zero-, one and two-dimension nano structures.

CLO 2: Describe Carbon Fullerenes and Carbon Nanotubes (SWCNT, MWCNT) and Mextal Oxide Nanopartcile Structures.

CLO 3: Identify the various techniques to investigate the different properties such as optical, structural and morphology of nanoparticles.

CLO 4: Acquire knowledge of basic approaches like Bottom up and Top down to synthesize inorganic colloidal nanoparticles and their self-assembly in solution and surfaces.

CLO 5: Apply their acquired knowledge in research level to synthesis and characterize the nanomaterials, analyze electrical properties, and stability of nano structures, Various applications, and perspectives of nanotechnology in the development of value-added new products and devices.

M.Sc., Physics - Syllabus – II year – IV Semester(Distance Mode)

COURSE TITLE : SPECTROSCOPY

COURSE CODE : MPHSY 41

COURSE CREDIT : 4

COURSE OBJECTIVES

While studying the **SPECTROSCOPY,** the Learner shall be able to:

CO 1: Learn about the intricacies of spectra of Hydrogen-like atoms and alkali metals.

CO 2: Study about IR spectroscopy and its application

CO 3: Learn the Theories about Raman Spectroscopy

CO 4: Acquire the knowledge about NMR & NQR Spectroscopy

CO 5: Learn the basics of ESR & Mossbauer Spectroscopy

COURSE SYLLABUS

BLOCK I: Atomic & Microwave Spectroscopy

Spectra of Alkali Metal Vapours-Normal Zeeman Effect-Anomalous Zeeman Effect-Magnetic Moment of Atom and the G Factor-Lande's 'g' Formula-Paschen Back Effect- Hyperfine Structure of Spectral Lines.

Microwave Spectroscopy-Experimental Method-Theory of Microwave Spectra of Linear, Symmetric Top Molecules-Hyperfine Structure-Quadrupole Moment-Inversion Spectrum of Ammonia.

BLOCK II: Infrared Spectroscopy

IR Spectroscopy -Practical Aspects-Theory of IR Rotation Vibration Spectra of Gaseous -Diatomic Molecules-Applications-Basic Principles of FTIR Spectroscopy.

BLOCK III: Raman Spectroscopy:

Classical and Quantum Theory of Raman Effect-Rotation Vibration Raman Spectra of Diatomic and Polyatomic Molecules-Applications-Laser Raman Spectroscopy.

BLOCK IV: NMR & NQR Spectroscopy:

NMR Spectroscopy: Quantum Mechanical and Classical Description-Bloch

Equation- Relaxation Processes-Experimental Technique-Principle and Working of High-Resolution NMR Spectrometer-Chemical Shift

NQR Spectroscopy: Fundamental Requirements-General Principle-Experimental Detection of NQR Frequencies-Interpretation and Chemical Explanation of NQR Spectroscopy

BLOCK V: ESR & Mossbauer Spectroscopy:

ESR Spectroscopy: Basic Principles-Experiments-ESR Spectrometer-Reflection Cavity and Microwave Bridge-ESR Spectrum-Hyperfine Structure

Mossbauer Spectroscopy: Mossbauer Effect-Recoilless Emission and Absorption-Mossbauer Spectrum-Experimental Methods-Hyperfine Interaction-Chemical Isomer Shift- Magnetic Hyperfine and Electric Quadrupole Interaction

BOOKS FOR REFERENCE

1. Atomic structure and chemical bonding – Manas Chandra, T.M.H, New Delhi, 1979.
2. Molecular Spectroscopy – P.S.Sindu, T.M.H Pub. Co.
3. Molecular structure and spectroscopy, G.Aruldhas, Prentice Hall of India, New Delhi
4. Molecular Spectroscopy – Banwell, Tata MacroHill Publication, New Delhi 1998.
5. Basic principles of Spectroscopy, Chang. Mc-Graw Hill, Tokyo.
6. Quantum Chemistry and Spectroscopy, Madan .S, Pathania, Vishal Publications, NewDelhi, 1984.
7. Quantum chemistry – Eyring, Walter & Kimabl, John Wiley & Sons.

Web Resources

1. Rotational (Microwave) Spectroscopy By Dr. Smriti Dwivedi | AKTU Digital Education - YouTube
2. Lecture 36 _ Microwave (Rotational) Spectroscopy I - Diatomic Molecules - YouTube

3. Lec 37 _ Microwave (Rotational) Spectroscopy II - Diatomic & symmetric top polyatomic molecules - YouTube
4. Lec 19 :Microwave Spectra of Polyatomic molecules (Symmetric tops) - YouTube
5. An Introduction to Rotational Spectroscopy (Microwave Spectrum) - YouTube
6. Microwave Spectroscopy - YouTube
7. Spectra of Alkali Metals - YouTube
8. LANDE'S g - FACTOR | LANDE'S SPLITTING FACTOR | TOTAL MAGNETIC MOMENT OF ELECTRON IN AN ATOM | NOTES - YouTube
9. Introduction to Infrared Spectroscopy - YouTube
10. IR spectroscopy - YouTube
11. FTIR Spectroscopy - Theory and Fundamentals | JASCO (jascoinc.com)
12. Principles and instrumentation FTIR spectroscopy - YouTube
13. Introduction to Raman Spectroscopy Applications Explained - YouTube
14. Introduction to Raman Spectroscopy - YouTube
15. Raman Spectroscopy - YouTube
16. Rotational-Vibrational spectra of diatomic and polyatomic molecules. - YouTube
17. 10 Rotational Vibrational Raman Spectra of Diatomic Molecule & Raman Spectrophotometer - YouTube
18. Rotational Raman Spectra of Symmetric Top Molecules II Raman Spectroscopy Part-6; #MSc#CSIRNETJRF - YouTube
19. NMR spectroscopy - YouTube
20. Basic Introduction to NMR Spectroscopy - YouTube
21. Introduction to NMR Spectroscopy Part 1 - YouTube
22. Introduction to NMR Spectroscopy Part 2 - YouTube
23. NQR Principle and examples - YouTube
24. NQR| L-1|Nuclear quadrupol resonance spectroscopy - YouTube
25. Nuclear Quadrupole Resonance (NQR) Spectroscopy: Part 1: Principle - YouTube
26. Principles and instrumentation: NMR spectroscopy - YouTube
27. mod11lec53-ESR Spectroscopy - 1 - YouTube
28. mod11lec54-ESR Spectroscopy - 2 - YouTube

29. mod11lec55-ESR Spectroscopy - 3 - YouTube
30. Electron Spin Resonance (ESR) Spectroscopy - YouTube
31. Lecture 1: Introduction to EPR spectroscopy by Prof. Daniella Goldfarb - YouTube
32. EPR Spectroscopy - YouTube
33. Mod-01 Lec-42 Mossbauer Spectroscopy - YouTube
34. All About Mossbauer Spectroscopy || everything expained in a single video - YouTube
35. Mossbauer Spectroscopy - Part 1 - YouTube
36. Mod-01 Lec-23 Vibrational and Rotational levels - YouTube

COURSE LEARNING OUTCOMES

After completion of the **SPECTROSCOPY**, the Learner will be able to:

CLO 1: Explain the Zeeman effect, Stark Effect and Hyperfine Structure of Spectral Lines of Hydrogen

CLO 2: Analyze the information obtained from IR rotational Vibration spectroscopy to determine the bond lengths of heteronuclear diatomic molecules and applications of FTIR spectroscopy.

CLO 3: Distinguish between Classical and Quantum Theory of Raman Effect and Explain the application of Raman spectroscopy.

CLO 4: Describe the Bloch Equation and Explain the working Principle of High-Resolution NMR Spectrometer.

CLO 5: Understand molecular vibrations with the interaction of matter and electromagnetic waves and explain the Mossbauer Effect, Recoilless Emission and Absorption of Mossbauer Spectrum

M.Sc., Physics - Syllabus – II year – IV Semester (Distance Mode)

COURSE TITLE : NUCLEAR PHYSICS

COURSE CODE : MPHS 42

COURSE CREDIT : 4

COURSE OBJECTIVES

While studying the **NUCLEAR PHYSICS,** the Learner shall be able to:

CO 1: Impart the knowledge regarding the fundamentals and basics of Nuclear Structure

CO 2: Acquire knowledge about the various nuclear models.

CO 3: Learn the basic concept of nuclear reaction and nuclear decay

CO 4: Study about Nuclear forces and Properties of nuclear forces

CO 5: Learn the basics of elementary particles and their classification.

COURSE SYLLABUS

BLOCK I: Nuclear Structure

Distribution of Nuclear Charge-Nuclear Mass-Mass Spectroscopy-Bainbridge and Jordan, Neir, Mass Spectrometer-Theories of Nuclear Composition (proton-electron, protonneutron)- Bound States of Two Nucleons-Spin States-Pauli's Exclusion Principle-Concept of Hidden Variables-Tensor Force-Static Force-Exchange Force.

BLOCK II: Nuclear Models

Liquid Drop Model: Bohr Wheeler Theory of Fission-Condition for Spontaneous Fission- Activation Energy-Seaborg's Expression.

Shell Model: Explanation of Magic Numbers-Prediction of Shell Model-Prediction of Nuclear Spin and Parity-Nuclear Statistics-Magnetic Moment of Nuclei-Schmidt Lines-Nuclear Isomerism.

Collective Model: Explanation of Quadrupole Moments-Prediction of Sign of Electric Quadrupole Moments.

BLOCK III: Nuclear reaction and nuclear decay

Types of nuclear reactions, elastic scattering, inelastic scattering, disintegration,

radiative capture, direct reaction – conservation laws – law of conservation of energy, momentum, angular momentum, charge, spin , parity. Nuclear reaction kinemetics – Expression for Q-value Nuclear decay: Gawmow‟s theory of alpha decay, Fermi‟s theory of beta decay – Fermi and Gawmow Teller selection rules – internal conversion – nuclear isomerism

BLOCK IV: Nuclear forces and Properties of nuclear forces

Deutrons – properties of deuteron- ground state of deuteron – excited state – magnetic quadrupole moment of deuteron- neutron- proton scattering at low energies – proton – proton scattering at low energies – meson theory of nuclear forces- reciprocity theorem – Breit- wigner one level formula

BLOCK V: Particle Physics

Leptons-Hadrons-Mesons-Hyperons-Pions-Meson Resonances-Strange Mesons and Baryons-Gell-Mann Okuba Mass formula for Baryons-CP Violation in Neutral Kaons (K0) Decay- Symmetry and Conversion Laws-Quark Model-Reaction and Decays-Quark Structure of Hadrons.

BOOKS FOR REFERENCE:

1. Introduction to Nuclear Physics – Herald Enge, Addision Wesley Pub. Co, U.S.A.
2. Nuclear Physics – Irving Kaplan, Oxford & I.B.H Pub & Co.
3. Nuclear Physics – D.C.Tayal, Himalaya House, Bombay.
4. Elements of Nuclear Physics - M C Pandia and R P S Yadav
5. Nuclear Physics an Introduction - S B Patel
6. Atomic Nucleus – R.D.Evans, Mc-Graw Hill, 1955.
7. Nuclear Physics – R.R.Roy and B.P.Nigam, John Wiley 1967

Web Resources

1. Nuclear Physics - Definition, Nuclear Physics Theory, Radioactivity, Applications,

Examples, and FAQs (byjus.com)

2. Introduction to Nuclear Physics I Nuclear Physics II PHY 652 l MSc Physics l Physics Guide - YouTube
3. Liquid Drop Model of Nucleus (Binding Energy Formula) - YouTube
4. Liquid Drop Model l Nuclear Physics II ll MSc Physics Physics Guide - YouTube
5. Nuclear Physics || Liquid Drop Model & Semi- Empirical Mass Formula | CSIR-NET/GATE Physics Problem - YouTube
6. Mod-01 Lec-17 Shell model - YouTube
7. Mod-01 Lec-18 Shell model Contd.. - YouTube
8. Mod-01 Lec-19 Shell model Contd.. - YouTube
9. Mod-01 Lec-20 Shell model Contd.. - YouTube
10. Mod-01 Lec-21 Shell model Contd.. - YouTube
11. Collective Model of a Nucleus l Nuclear Physics II MSc Physics l Physics Guide - YouTube
12. Collective Model | Physical sciences | Unacademy Live - CSIR UGC NET | Rahul Mehla - YouTube
13. Mod-01 Lec-22 Collective models - YouTube
14. Types Of Nuclear Reaction (Part 2) l Nuclear Physics II PHY 652 l MSc Physics l Physics Guide - YouTube
15. Nuclear Transmutation by Deuterons in details l Nuclear Physics l MSc Physics l Physics Guide - YouTube
16. Types of Nuclear Reactions l Nuclear Physics II PHY 652 lMSc Physics l Physics Guide - YouTube
17. Radioactive Decay - Definition | Radioactive Decay Law | Types of Radioactive Decay (byjus.com)
18. Radioactive Decay and existence of Neutrinos in Beta-decay. Nuclear Physics MSc 3rd - YouTube
19. Gamow's Theory of Alpha Decay AND Geiger Nuttal Law - YouTube
20. [DERIVATION] Gamow's Theory of Alpha Decay - YouTube
21. Fermi Theory of Beta Decay | part-I | By Dr Asmat Elahi/English |Physics in Focus #NuclearPhysics - YouTube
22. Nuclear Physics - Nuclear Decay : Fermi Theory of Beta Decay - 1 - YouTube

23. Properties of nuclear force||Saturation||Strong in nature & more||Lec:3||Bsc/Msc - YouTube
24. Lecture 7 (5th Semester) - Nuclear forces - YouTube
25. Deutron Wave Function || Why Deuteron do not have any Excited States ???? || MSc Physics - YouTube
26. Mod-01 Lec-11 Deuteron - YouTube
27. Mod-01 Lec-12 Deuteron Cont.. - YouTube
28. Mod-01 Lec-13 Deuteron Cont.. - YouTube
29. Mod-01 Lec-14 Scattering of nucleons - YouTube
30. Mod-01 Lec-15 Low energy n-p scattering - YouTube
31. Mod-01 Lec-16 Theories of nuclear forces - YouTube
32. Particle Physics master cadre Physics | Lecture -1 | Bansal Academy - YouTube
33. Elementary Particles and the Laws of Physics - Richard Feynman - YouTube
34. Particle Physics| Introduction | Amazing In-Depth Lecture Series - YouTube
35. MSc Physics Classes || Introductory video of Particle PHYSICS || Classification of Various Particles - YouTube
36. Particle Physics 1: Introduction - YouTube
37. Particle Physics 2: Creation and Annihilation Operators and Mass - YouTube
38. Particle Physics 3: Angular Momentum and Spin - YouTube
39. Particle Physics 4: Rotation Operators, SU(3)xSU(2)xU(1) - YouTube
40. Particle Physics 5: Basic Introduction to Gauge Theory, Symmetry & Higgs - YouTube
41. Particle Physics 6: Particles & Supersymmetry - YouTube

COURSE LEARING OUTCOMES

After completion of the **NUCLEAR PHYSICS**, the Learner will be able to:

CLO 1: Explain the Distribution of Nuclear Charge, Nuclear Mass ,Bound States of Two Nucleons, Spin States and Pauli's Exclusion principle

CLO 2: Discuss the Stability and properties of different nuclei by various nuclear models.

CLO 3: Describe Radioactive α, β, γ -decay of nuclei by their respective quantum

mechanical theories, Conservation laws and various nuclear reactions.

CLO 4: Discuss the method and analysis of Scattering process & understand meson theory of nuclear forces

CLO 5: Discuss the Elementary particles as the building blocks of matter and interacting fields. Conservation laws and quantum numbers for production and decay of particles.

M.Sc., Physics - Syllabus – II year – IV Semester (Distance Mode)

COURSE TITLE : CONDENSED MATTER PHYSICS – II

COURSE CODE : MPHS 43

COURSE CREDIT : 4

COURSE OBJECTIVES

While studying the **CONDENSED MATTER PHYSICS – II,** the Learner shall be able to:

CO 1: Learn the basics of theories of dielectrics

CO 2: Study about fundamental theory of ferroelectrics and piezo electrics

CO 3: Discuss the various types of magnetic materials

CO 4: Study about the different parameters associated with superconductivity and the theory of superconductivity, idea of high temperature superconductivity.

CO 5: Define the term physics of nanosolids, and outline the various properties of nano materials and their fabrication techniques.

COURSE SYLLABUS

BLOCK I: THEORY OF DIELECTRICS

Dipole moment – Polarization – The electric field of a dipole – Local electric field at an atom – Clausius –Mosotti equation - Dielectric constants and its measurements - Polarizability – The Classical theory of electronic polarizability – Ionic polarizabilities - Orientational polarizabilities - The polarizability catastrophe - Dipole orientation in solids - Dipole relaxation and dielectric losses – Debye Relaxation time - Relaxation in solids - Complex dielectric constants and the loss angle - Frequency and temperature effects on Polarization – Dielectric breakdown and dielectric loss

BLOCK II: THEORY OF FERROELECTRICS AND PIEZO ELECTRICS

Ferroelectric Crystals – Classifications of Ferroelectric crystals - Dipole theory of ferroelectricity – Landau Theory of the phase transition – Second order Transition –

First Order Transition - Ferroelectric Transition - One-Dimensional Model of the Soft Mode of Ferroelectric Transitions – Antiferroelectricity - Ferroelectric domains – Ferroelectric domain wall motion – Piezoelectricity - Phenomenological Approach to Piezoelectric Effects - Piezoelectric Parameters and Their Measurements - Piezoelectric Materials

BLOCK III: MAGNETIC PROPERTIES OF MATERIALS

Terms and definitions used in magnetism – Classification of magnetic materials – Atomic theory of magnetism – The quantum numbers- The origin of permanent magnetic moments – Langevin's classical theory of diamagnetism – Sources of paramagnetism – Langevin's classical theory of paramagnetism – Quantum theory of paramagnetism – Paramagnetism of free electrons - Ferromagnetism – The Weiss molecular field – Temperature dependence of Spontaneous magnetization – The physical origin of Weiss Molecular field - Ferromagnetic domains - Domain theory – Antiferromagnetism – Ferrimagnetism – Structure of Ferrite.

BLOCK IV: SUPERCONDUCTIVITY

Occurence of super conductivity - Destruction of super conductivity by magnetic fields - Meissner Effect – Type I and Type II Super conductors - Heat Capacity - Energy gap - Microwave and infrared properties - Isotope effect - Thermodynamics of the superconducting transition - London equation - Coherence Length - BCS theory of superconductivity, BCS ground state - Flux quantisation in a super conduction ring - Duration of persistence currents - Single particle tunnelling - DC Josephson effect - AC Josephson effect - Macroscopic quantum interference – High temperature super conductors – Applications.

BLOCK V: PHYSICS OF NANOSOLIDS

Definition of nanoscience and nanotechnology – Preparation of nanomaterials – Surface to volume ratio – Quantum confinement – Qualitative and Quantitative

description – Density of states of nanostructures – Excitons in Nano semiconductors – Carbon in nanotechnology – Buckminsterfullerene – Carbon nanotubes – Nano diamond – BN nano tubes – Nanoelectronics – Single electron transistor – Molecular machine – nano biometrics.

BOOKS FOR STUDY:

1. Charles Kittel, Introduction to Solid State Physics, 7th Edition, Wiley India Pvt. Ltd. , New Delhi, 2004.
2. Rita John, Solid State Physics, Tata Mc Graw Hill Publications, 2014.
3. M. A. Wahab, Solid State Physics – Structure and Properties of Materials. Narosa, New Delhi, 1999.
4. J.D. Patterson, B.C. Bailey Solid-State Physics: Introduction to the Theory, Springer Publications, 2007.
5. M. Ali Omar, Elementary Solid State Physics – Principles and Applications, Pearson, 1999.

BOOKS FOR REFERENCE:

1. J. Blakemore, Solid State Physics, 2nd Edition, W. B. Saunders Co, Philadelphia, 1974.
2. C. M. Kachhava, Solid State Physics, Tata Mcgraw Hill, New Delhi, 1990.
3. N. W. Aschroft and N. D., Mermin, Solid State Physics, Rhinehart and Winton, New York. 1976.
4. M. Tinkham, Introduction to Superconductivity, Tata Mcgraw Hill, New Delhi, 1996.
5. K.K.Chattopadhyay, A.N.Banerjee, Introduction to Nanoscience and Nanotechnolog, PHI Learning private Ltd., Delhi 2014.
6. A. J. Dekker, Electrical Engineering Materials, Prentice Hall of India, 1975.
7. S.O. Pillai, Problems and Solutions in Solid State Physics, New Age international Publishers, New Delhi, 1994.
8. A.K. Bain, P. Chand, Ferroelectrics, Wiley, 2017.

9. Kwan Chi Kao, Dielectric phenomena in solids with eMPHSasis on physical concepts
of electronic processes, Elsevier Academic Press, 2004
10. Alexander O. E. Animalu, Intermediate Quantum Theory of Crystalline solids, Prentice Hall of India, New Delhi, 1978.
11. Eleftherios N. Economou, The Physics of Solids – Essentials and Beyond, Springer, 2010.

Web Resources

1. Dielectrics - Definition, Classification, Dielectric Polarization, Examples (byjus.com)
2. Clausius Mossotti Equation | Dielectric Constant | MSc Physics | Condensed Physics |CSIR NET Physics - YouTube
3. 29 Dielectric Materials - Introduction - YouTube
4. Lec 33 Polarization of Dielectrics | HC VERMA | GDS K S - YouTube
5. Lec 34 Bound charge densities | HC VERMA | GDS K S - YouTube
6. Lec 35 Electric field due to a polarized material | HC VERMA | GDS K S - YouTube
7. LEC 36 Problem Solving with Dielectrics | HC VERMA | GDS K S - YouTube
8. LEC 37 Displacement field | HC VERMA | GDS K S - YouTube
9. LEC 38 Linear Dielectrics | HC VERMA | GDS K S - YouTube
10. MSc#Physics#Dipole theory of ferroelectricity - YouTube
11. Ferroelectric Materials - YouTube
12. https://www.youtube.com/watch?v=CO0E9QTDBbs
13. Ferroelectrics- Part IV : Curie Wiess law for Ferroelectricity - YouTube
14. Ferroelectric, Pyroelectric and Piezoelectric Materials #msc #gate #bsc #chemistry #csirnetjrf - YouTube
15. Mod-08 Lec-19 Ferroelectric , Piezoelectric and Pyroelectric Ceramics - YouTube

16. Mod-08 Lec-20 Ferroelectric , Piezoelectric and Pyroelectric Ceramics (Contd.) - YouTube
17. Magnetic Properties - YouTube
18. What Is Magnetic Susceptibility? - Formula, Definition, Unit (byjus.com)
19. 29- MAGNETIC PROPERTIES OF MATERIALS - YouTube
20. MAGNETIC PROPERTIES OF SOLIDS & EFFECT OF TEMPERATURE ON SUCH MATERIALS - YouTube
21. L 07 | Magnetic materials | Bound and free currents | Ampere's law in a magnetised material | BSc | - YouTube
22. Magnetism, Magnetic Field Force, Right Hand Rule, Ampere's Law, Torque, Solenoid, Physics Problems - YouTube
23. Superconductivity#Lecture 1#Solid State Physics#M.Sc. Final - YouTube
24. Superconductivity#Lecture 2#M.Sc. Final#Solid State Physics - YouTube
25. Superconductivity#Lecture 3rd#Solid state Physics#M.Sc. Final - YouTube
26. Superconductivity#Lecture4#Solid state physics#M.Sc. Final - YouTube
27. Superconductors and Supercapacitors Session 1 (Superconductors, Critical temperature and field) - YouTube
28. Mod-01 Lec-27 Superconductivity - Perfect Electrical Conductivity and Perfect Diamagnetism - YouTube
29. Mod-01 Lec-28 Type I and Type II Superconductors - YouTube
30. Mod-01 Lec-29 Ginsburg - Landau Theory, Flux Quantization - YouTube
31. Mod-01 Lec-30 Cooper Pairs - YouTube
32. Mod-01 Lec-31 Microscopic (BCS) Theory of Superconductivity - YouTube
33. Mod-01 Lec-32 BCS Theory (Continued): Josephson Tunneling: Quantum Interference - YouTube
34. Physics of Nano Scale Materials; Course Summary - YouTube

35. Introduction To Nanophysics | Nanoscience and Nanotechnology - YouTube
36. Introduction To Nanophysics | Nanoscience and Nanotechnology - YouTube
37. Size Dependent Properties Of Nanoparticles | Size Dependence Of Properties - YouTube
38. Surface Energy And Melting Point Depression Of Nanoparticles In Hindi | Physics Of Nanomaterials - YouTube
39. Properties And Applications Of Carbon Nanotubes | Properties Of CNT - YouTube
40. CARBON NANOTUBES - PROPERTIES & APPLICATIONS - YouTube

COURSE LEARNING OUTCOMES

After completion of the **CONDENSED MATTER PHYSICS – II**, the Learner will be able to:

CLO 1: Describe the Local electric field at an atom, Clausius –Mosotti equation and the Classical theory of electronic polarizability and its types

CLO 2: Discuss the Classifications of Ferroelectric crystalsand Various theories of ferroelectricites (Dipole theory of ferroelectricity, Landau Theory of the phase transition).

CLO 3: Differentiate the Various Types of Magentic materials (dia, para and Ferro) on the basis of Langevin's classical theory and domain theory

CLO 4: Distinguish between type-I and type-II superconductors and their theories and explain the behavior of superconductors, applications and high temperature superconductivity.

CLO 5: Explain the concept of quantum confinement, electron confinement in deep square well and two and three dimensions, idea of quantum well, dot and wires.

M.Sc., Physics - Syllabus – II year – IV Semester (Distance Mode)

COURSE TITLE : INSTRUMENTAL METHODS OF ANALYSIS

COURSE CODE : MPHS- EL4

COURSE CREDIT : 3

COURSE OBJECTIVES

While studying the **INSTRUMENTAL METHODS OF ANALYSIS,** the Learner shall be able to:

CO 1: Learn the basic concept of the errors and analysis of experimental data

CO 2: Study the basic concept of Thermal Analysis and its applications

CO 3: Study different analytical techniques to characterize the samples using X ray Analysis

CO 4: Learn the Concept of optical method and Electron Microscopy

CO 5: Study different analytical techniques to characterize the samples using Electrical methods

COURSE SYLLABUS

BLOCK I : ERRORS AND ANALYSIS OF EXPERIMENTAL DATA

Types of errors – Mean, variance and standard deviation, standard deviation of standard deviation – sampling techniques – Chi square test.

Experimental Stress Analysis: Stress analysis by strain gauging- high temperature strain gauge techniques – photoelasticity and holography.

BLOCK II: THERMAL ANALYSIS

Introduction – thermo gravimetric analysis – instrumentation of weight loss and decomposition products – differential scanning calorimetric – instrumentation – specific heat capacity measurements – determination of thermo chemical parameters – differential thermal analysis – basic principles – melting point determination and analysis.

BLOCK III : X-RAY ANALYSIS

Single Crystal and powder diffraction – Diffractometer – interpretation of diffraction patterns – indexing – unknown and phase identification – double and four crystal Diffractometer for epitaxial characterization – lattice mismatch – tetragonal distortion – thin film characterization – X-ray fluorescence spectroscopy – uses.

BLOCK IV : OPTICAL METHODS AND ELECTRON MICROSCOPY

Photoluminescence – light-matter interaction – fundamental transitions – excitons – instrumentation – electroluminescence – instrumentation – photo reflectance-electronic transitions – behavior of electronic transitions as a function of electric field. Principles of SEM, TEM, EDAX, AFM, EPMA – Instrumentation – sample preparation – analysis of materials – study of dislocations – ion implantation – uses – Nanolithogrphy.

BLOCK V: ELECTRICAL METHODS

Hall Effect – carrier density – resistivity – two probe and four probe methods – scattering mechanism – van der pauw method – CV characteristics – Schottky barrier capacitance – impurity concentration – electrochemical CV profiling – limitations.

BOOKS FOR REFERENCE:

1. Instrumental Methods of Analysis - Willard.M, Steve.D, CBS Publishers, New Delhi, 1986.
2. Electron Microscopy and Microanalysis of Crystalline materials - Stradling, R.A, Applied Science Publishers, London, 1979.
3. Electron microscopy and Microanalysis of Crystalline Materials - Belk.J.A, Applied Science Publishers, London, 1979.
4. Modern Metallographic Techniques and their Applications - Philips V.A, Wiley

Interscience, 1971.

Web resources

1. Error Analysis in Physics Experiments - YouTube
2. What's Significant in Laboratory Measurement? Error Analysis Lecture - YouTube
3. Thermal Analysis | Basic Concept & Types Of Thermal Analysis Methods | MSc. Notes | - YouTube
4. Thermo Gravimetric Analysis [TGA] Principle || TGA Curve || Instrumentation || Application Of TGA || - YouTube
5. Analytical Chemistry | Thermal Analysis | TGA | DTA | DSC | CSIR NET | GATE | DU |BHU | CHEM ACADEMY - YouTube
6. X-Rays - Properties, Definition, Wavelength, Types, Uses, Invention (byjus.com)
7. Investigating Nanomaterials Using X-ray Diffraction - YouTube
8. Rotating Crystal Method of X-ray Diffraction || Solid State Physics - YouTube
9. Single Crystal and Powder X-ray Diffraction (jove.com)
10. X-Ray Fluorescence Spectroscopy | Basic Theory | wavelength dispersive analysis | - YouTube
11. Basics of Energy-dispersive X-ray spectroscopy(EDS) & Wavelength-dispersive X-ray spectroscopy (WDS) - YouTube
12. Introduction to x-ray diffraction by Dr Rajesh Prasad, IIT Delhi - YouTube
13. Scanning Electron Microscopy (SEM) Lecture: Principles, Techniques & Applications - YouTube
14. An Introduction to Scanning Electron Microscopy and Focused Ion Beam (Matthew Bresin) - YouTube
15. Photoluminescence (PL) Spectra - YouTube
16. Photo-luminescence (PL) Spectroscopy - YouTube
17. TRANSMISSION ELECTRON MICROSCOPE || TEM || AIM, PRINCIPLE, CONSTRUCTION, WORKING OF TEM | NOTES | - YouTube
18. Atomic Force Microscopy | AFM modes of operation | AFM working principle - YouTube
19. Mod-01 Lec-22 Atomic Force Microscope - I - YouTube
20. Mod-01 Lec-23 Atomic Force Microscope - II - YouTube
21. Lecture 36 : Atomic Force Microscopy (AFM) I - YouTube
22. Lecture 37 : Atomic Force Microscopy (AFM) II - YouTube

23. Resistance measurements processes || Two probe method || Four Probe Method || Van der Pauw Method - YouTube
24. Four Probe Method | Derivation of Resistivity Equation | Semiconductor Charcterization - YouTube
25. Electrochemical Capacitance-Voltage (ECV) technique - YouTube
26. Capacitance Voltage Measurement | CV measurement |C-V Profiling in semiconductor - YouTube
27. Schottky Diode Part 2 - Depletion Region and Capacitance - YouTube
28. Carrier Concentration | Capacitance-Voltage Measurement | Semiconductor Characterization | - YouTube

COURSE LEARNING OUTCOMES

After completion of the **INSTRUMENTAL METHODS OF ANALYSIS**, the Learner will be able to:

CLO 1: Apply and Analyze types of error in Mean, variance and standard Deviation

CLO 2: Explain the concept of thermo gravimetric analysis and differential scanning calorimetric analysis

CLO 3: Acquire knowledge to interpretation of diffraction patterns, indexing and identify unknown and phase identification and lattice mismatch

CLO 4: Describe the working Principles of SEM, TEM, EDAX, AFM, EPMA and its Instrumentation, sample preparation and analysis of materials.

CLO 5: Apply and analyze different analytical techniques to characterize the electical studies of samples (two probe and four probe methods and van der pauw method)

M.Sc., Physics - Syllabus – I year – I Semester (Distance Mode)

PRACTICAL – I

(Practical Examination at the end of the Second semester)

(Any 10 experiment)

CODE: MPHS-P1 **CREDITS:4**

COURSE OBJECTIVES:

While studying the **PRACTICAL - I,** the Learner shall be able to:

CO 1: Gain the practical knowledge on general physics

CO 2: demonstrate practical knowledge on practical Physics

CO 3: Expand experiments in modern physics to for day-to-day requirements

CO 4: Acquire practical knowledge about the characteristics of Various types of Flip-Flop using gates, and the applications of Op-Amp.

CO 5: Expose the various operations and interfacing using Microprocessor 8085

LIST OF EXPERIMENTS

1. De Sauty's bridge
2. Fresnel's Biprism – Spectrometer
3. Polarimeter
4. Cornu's method – Young's modulus and Poisson's ratio – Elliptic Fringes
5. Cauchy"s constant.
6. Hyperbolic fringes – Elastic constants.
7. Michelson"s interferometer.
8. Ultrasonic interferometer – velocity of ultrasonic waves in liquid.
9. Ultrasonic diffraction- compressibility of a liquid.
10. UV visible Spectrometer
11. Study of RS, Clocked RS, D flip flops using NAND and NOR
12. Arithmetic Operations 4 bit binary addition 7483 and subtraction
13. OP-AMP 4 bit Digital – Analog R – 2R Ladder
14. OP-AMP Waveform generators
15. Multi vibrators – Monostable and astable using 555 timer

16. Microprocessor 8085 Sum of Set of n data (8 bit numbers)
17. Microprocessor 8085 Traffic Signal Controller
18. Microprocessor 8085 Code Conversion
19. Microprocessor 8085 Stepper motor interface
20. Microprocessor 8085 interfacing of R-2R ladder
21. Microprocessor 8085 interfacing of 7 segmented display

Web Resources

1. Measurement of Capacitance by De Sauty's Bridge - Electronic Instrumentation and Measurement - YouTube
2. How To Find Wavelength Using Fresnel's Biprism | Engineering Physics - YouTube
3. Determining the elastic constants of a transparent bar by obtaining elliptical fringes. - YouTube
4. Elliptical Fringes:Cornu's Method - YouTube
5. Cauchy's constant and Dispersive power of a prism (Amrita Virtual Lab) - YouTube
6. Michelson's Interferometer video lecture - YouTube
7. Ultrasonic Interferometer-Determination of velocity of ultrasonic waves (Amrita Virtual Lab) - YouTube
8. UV Vis spectroscopy explained lecture - YouTube
9. SR Flip Flop | RS Flip Flop using NOR gate & NAND Gate with Truth Table & Circuit Diagrams - YouTube
10. R-2R Ladder DAC Explained (with Solved Example) - YouTube
11. 555 Timer as Astable Multivibrator (Working, Design and Derivations) - YouTube
12. DAC INTERFACING || Microprocessor - YouTube
13. addition of two 8 bit numbers using memory in 8085 microprocessor. 8085 programming - YouTube
14. OP-AMP as Square wave generator - YouTube
15. Seven Segment Display Interfacing with Microprocessor 8085 - YouTube

COURSE LEARNING OUTCOMES

After completion of the **PRACTICAL - I**, the Learner will be able to:

CLO 1: Explain the basics of Experimental physics

CLO 2: Interpret the concept of Young's modulus and Hyperbolic fringes.

CLO 3: Explain the construction and working of Michelson interferometer and Ultrasonic interferometer

CLO 4: Discuss the construction and working Astable multivibrator using transistor and IC 555.

CLO 5: Perform the mathematical operations using OP AMP and Microprocessor 8085 interfacing of R-2R ladder & 7segment display.

M.Sc., Physics - Syllabus – I year – II Semester (Distance Mode)

PRACTICAL – II

(Any 10 experiment)

CODE: MPHS-P2 **CREDITS:4**

COURSE OBJECTIVES:

While studying the **PRACTICAL - II,** the Learner shall be able to:

CO 1: Gain the practical knowledge on general physics

CO 2: demonstrate practical knowledge on practical Physics

CO 3: Expand experiments in interference of light

CO 4: Acquire practical knowledge about the characteristics and applications of Op-Amp.

CO 5: Expose the various operations using Microprocessor 8086

LIST OF EXPERIMENTS

1. e/m Magnetron method
2. Hall Effect
3. Thickness of insulation of a wire by interference method (air wedge)
4. Viscosity of a liquid by Mayer's method
5. Hydrogen spectra – Rydberg's constant
6. Cornu's method – Young's modulus and Poisson's ratio – Hyperbolic Fringes
7. Solar spectrum.
8. Determination of radius of a thin wire by forming air wedge and using laser light.
9. Characteristics of optical fibre.
10. Biprism – Determination of wavelength.
11. OP-AMP - Solving differential equation
12. OP-AMP - Low pass, band pass and high pass filter
13. Shift register, Ring counter and Johnson twisted ring counter
14. OP-AMP phase shift oscillator
15. OP-AMP – Pulse generator and application as Frequency divider

16. OP-AMP – Triangular Wave Oscillator.
17. UJT relaxation oscillator
18. Microprocessor 8085 sorting ascending and descending
19. Microprocessor 8085 programmable counter 8255 interface
20. Microprocessor 8086 Arithmetic operations

Web Resources

1. e by m magnetron method - YouTube
2. Hall Effect Experiment - YouTube
3. Thickness of a foil or thin wire by forming air wedge - Dr R Sanjeev Kumar - YouTube
4. Coefficient Of Viscosity of Liquid By Oscillating Disc Method - Lab Experiment - YouTube
5. Rydberg Constant Experiment | Hydrogen Spectrum | Balmer Series - YouTube
6. Cornu's Method - YouTube
7. Optical Fiber - Transmission Characteristics-I - YouTube
8. Twisted Ring Counter or Johnson's Counter - YouTube
9. Ring Counter or Shift Register Counter - YouTube
10. UJT Relaxation Oscillator in tamil - YouTube
11. 8255 Programmable Peripheral Interface - Microprocessor - YouTube
12. RC Phase Shift Oscillator (using Op-Amp) Explained - YouTube

COURSE LEARNING OUTCOMES

After completion of the **PRACTICAL - II**, the Learner will be able to:

CLO 1: Explain the basics of Experimental physics

CLO 2: Discuss the determination of Thickness of insulation of a wire by interference method (air wedge)

CLO 3: Explain the construction and working of e/m Magnetron method and Hall Effect

CLO 4: Describe the construction and working of OP AMP -Solving differential equation, Low pass, band pass and high pass filter and Phase shift oscillator

CLO 5: Perform the Arithmetic operations using Microprocessor

M.Sc., Physics - Syllabus – II year – III Semester (Distance Mode)

PRACTICAL – III

(Practical Examination at the end of Fourth semester)

(Any 10 experiment)

CODE: MPHS-P3 **CREDITS:4**

COURSE OBJECTIVES:

While studying the **PRACTICAL - III,** the Learner shall be able to:

CO 1: Gain the practical knowledge on general physics

CO 2: demonstrate practical knowledge on practical Physics

CO 3: Expand experiments in Properties of Materials

CO 4: Acquire practical knowledge about the characteristics flip-flops and applications of Digital ICs.

CO 5: Expose the various operations using Microprocessor

LIST OF EXPERIMENTS

1. Fabry Parot Etalon
2. Thickness of Edser and Butler fringes
3. B-H loop by CRO
4. Band gap of a thermistor
5. OP-AMP triangle wave oscillator
6. Susceptibility – Guoy's method
7. Resistivity – Four probe method.
8. Equipotential surface – For various pairs of electrodes.
9. Dielecteric constant –LCR circuit.
10. Characteristics of photo transistor and photo diode.
11. Regulated power supply ZC 723
12. Study of JK, DT flip-flops using 7476 and 7473
13. Study of binary up and down counters using 7473 and 7486
14. Shift register, Ring counter and Johnson counter
15. Microcontroller 8051 interfacing seven segmented display

16. OP-AMP Wein bridge oscillator
17. OP-AMP pulse generator and applications and frequency divider
18. Microprocessor 8086 multi byte addition and subtraction
19. Microprocessor 8086 sum of set of n data average of n numbers
20. Microcontroller 8051 Arithmetic Operations

Web Resources

1. Fabry-Perot etalon experiment with a low-pressure sodium lamp - YouTube
2. BH Curve Experiment - YouTube
3. Band gap of a thermistor - YouTube
4. Triangle Wave Generator Circuit using Op-amp - YouTube
5. Gouy's Method for Determination of Magnetic Susceptibility - YouTube
6. Four Probe Method [EXPERIMENT] - YouTube
7. Experiment-Measurement of Dielectric Constant using Capacitor - YouTube
8. Characteristics of Photodiode experiment on Breadboard || CH Bhavani Shankar - YouTube
9. JK and T flip flop | EXPERIMENT | IC 7473 |STLD | BY CBR - YouTube
10. Ring and Johnson counter - YouTube
11. Seven Segment Display Interfacing with 8051 Microcontroller - YouTube
12. Multibyte Addition and Subtraction using 8086 Microprocessor MPMC Lab by Mrs B Lakshmi Prasanna - YouTube
13. Proteus Video 4: Operational Amplifier Inverting Amplifier frequency response - YouTube
14. Addition Operation in 8051 - YouTube

COURSE LEARNING OUTCOMES

After completion of the **PRACTICAL - III**, the Learner will be able to:

CLO 1: Explain the basics of Experimental physics

CLO 2: Discuss the determination of Thickness of Edser and Butler fringes, B-H loop by CRO and Band gap of a thermistor

CLO 3: Explain the determination of Susceptibility using Guoy's method, Resistivity using Four probe method and Dielecteric constant using LCR circuit

CLO 4: Describe the construction and working JK, DT flip-flops using 7476 and 7473 and binary up and down counters using 7473 and 7486

CLO 5: Perform the Arithmetic operations using Microprocessor 8086 and 8051

M.Sc., Physics - Syllabus – II year – IV Semester (Distance Mode)

PRACTICAL – IV

(Any 10 experiment)

CODE: MPHS-P4 **CREDITS:4**

COURSE OBJECTIVES:

While studying the **PRACTICAL - IV,** the Learner shall be able to:

CO 1: Gain the practical knowledge on electronic circuits

CO 2: demonstrate practical knowledge on electronic circuits

CO 3: Acquire practical knowledge about the characteristics of diodes and Transistors

CO 4: Expose the various operations using OP AMP

CO 5: Learn the theory of ADC and DAC

LIST OF EXPERIMENTS

1. SCR Characteristics
2. UJT characteristics & Relaxation Oscillator
3. Construction of Dual regulated power supply using IC 78XX
4. Two stage RC coupled Transistor Amplifier- with and without feedback
5. Half adder and Full adder
6. Half Subtractor and Full Subtractor
7. Voltage to current and current to voltage converter - OP AMP
8. Square wave generator using IC741 and IC555
9. Wien‟s bridge Oscillator -using OPAMP
10. Differentiator and Integrator -using OPAMP
11. Solution of simultaneous equations using IC 741C
12. Schmitt Trigger
13. Phase Shift Oscillator
14. Mod „n‟ Counters
15. Sine Wave, Square wave & Triangular wave generator using IC 741C

16. D/A Converter- R-2R method
17. D/A Converter- Weighted Resistor method
18. Active filters[Low, high, Band- Pass] using OPAMP
19. Triangular and Saw tooth waveform generators using OPAMP
20. Monostable and Astable Multivibrator using IC741C

Web Resources

1. SCR Characteristics Experiment - YouTube
2. UJT || UJT Characteristics and Relaxation Oscillator || UJT Relaxation Oscillator || UJT - YouTube
3. Regulated Power Supply using IC 7912, 7812, 7905, 7805 - YouTube
4. Two Stage R-C Coupled Transistor Amplifier | Applied Electronics || Tesca 36146 - YouTube
5. 19ECL37-DEC Lab- Experiment 2- Half Adder, Full adder, Half subtractor, full subtractor - YouTube
6. Half Subtractor | Full Subtractor | Tamil | Digital Electronics - YouTube
7. Current-to-voltage converter - experiment - YouTube
8. Square Wave Generator Circuit using 741 IC - YouTube
9. OP-AMP as Square wave generator - YouTube
10. Schmitt Trigger Experiment - YouTube
11. R-2R ladder Digital to Analog Converter DAC (Voltage Switched Network), Digital Electronics, #R2RDAC - YouTube
12. Active Low Pass Filter - EXPERIMENT - YouTube
13. Active High Pass Filter [EXPERIMENT] - YouTube
14. Video.8- Types of Active Filters (Low pass, High pass, Band pass) - YouTube
15. RC phase shift oscillator lab experiment - YouTube

16. Solve linear equations with OP AMP - YouTube
17. Simultaneous Equation Solution Using OP-AMP | Circuit Design Idea. - YouTube
18. Applications of Operational Amplifiers (Op-Amp) Integrator Summer Differentiator Adder Divider subtr - YouTube

COURSE LEARNING OUTCOMES

After completion of the **PRACTICAL - IV**, the Learner will be able to:

CLO 1: Explain the basics of electronic circuits

CLO 2: Discuss the SCR Characteristics, UJT characteristics & Relaxation Oscillator.

CLO 3: Explain the construction and working of Half adder, Full adder, Half Subtractor and Full Subtractor.

CLO 4: Describe the construction and working of Square wave generator using IC741 and IC555

CLO 5: Perform the operations using D/A Converter- R-2R method and Weighted Resistor method

Mapping

Course Code / Programme Learning Outcomes	MPHS-11	MPHS-12	MPHS-13	MPHS-P1	MPHS-EL1	MPHS-21	MPHS-22	MPHS-23	MPHS-P2	MPHS-EL2	MPHS-31	MPHS-32	MPHS-33	MPHS-P3	MPHS-EL3	MPHS-41	MPHS-42	MPHS-43	MPHS-P4	MPHS-EL4
Knowledge	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Research	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Communication	✓		✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Problem Solving	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Science and Society	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Life-Long Learning	✓	✓	✓		✓	✓	✓			✓	✓	✓	✓		✓	✓	✓	✓		✓
Modern Tool Usage	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Project Management		✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Environment and Sustainability	✓		✓	✓		✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Local	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
National	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Regional	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
International	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓