MASTER OF SCIENCE IN PHYSICS (M.S.C., PHYSICS) (SEMESTER PATERN)

Academic Year 2021-2022 onwards

தமிழ்நாடு திறந்தநிலைப் பல்கலைக்கழகம்

Tamil Nadu Open University

[A State Open University established by Government of TamilNadu, Recognized by UGC-DEB, Member in Asian Association of Open Universities and Association of Commonwealth Universities]

School of Sciences
Department of Physics

தமிழ்நாடு திறந்தநிலைப் பல்கலைக்கழகம்

Tamil Nadu Open University, Chennai

சென்னை – 15

School of Sciences

Department of Physics

Master of Science in Physics
Distance Mode:Semester Pattern

(From Academic Year 2020-21 onwards)

Programme Project Report (PPR) & Detailed Syllabus

NOVEMBER 2020

Tamil Nadu Open University

[A State Open University established by Government of Tamil Nadu, Recognized by UGC-DEB,
Member in Asian Association of Open Universities and Association of Commonwealth Universities]

No- 577, Anna Salai, Saidapet, Chennai -600015, Tamil Nadu, India

Prof. K.Parthasarathy
Vice-Chancellor

FOREWORD

My dear Learners, Vanakkam,

I deem it a great privilege to extend a hearty welcome to you to the Post Graduate Programme being offered by the Tamil Nadu Open University (TNOU). I also appreciate your keen interest of know about the curriculum of the Programme, in which you shall gain an enthralling experience, and pleasurable and beneficial learning.

With passing a specific act in the Tamil Nadu Legislative Assembly (TNLA) in 2002, the TNOU came into existence as a State Open University (SOU). It has been offering the socially relevant academic Programmes in diverse disciplines with due approval of the University Grants Commission (UGC) and the Distance Education Bureau (DEB), New Delhi since its inception. This Post Graduate Programme is one among the approved Programmes.

The Board of Studies, a statutory academic body of the University, consisting of the versatile scholars, eminent teachers including both internal and external, well acclaimed industrialists, outstanding alumni, and prospective learners as members, has designed the robust curriculum of this Programme. The curriculum is overhauled to be more suitable to the socio-economic and scientific needs in the modern era based on the emerging trends in the discipline of State and National as well as International level and accordingly, modified to our local context. Moreover, the whole syllabi of this Programme have special focuses on promoting the learners to the modern learning environment.

With a Credit System / Choice Based Credit System (CBCS), this Programme is offered in semester / non-semester pattern. The Self-Learning Materials that are the mainstay of pedagogy in the Open and Distance Learning (ODL) have been developed incorporating both the traditional and the modern learning tools, like web-resources, multi-media contents, text books and reference books with a view to providing ample opportunities for sharpening your knowledge in the discipline.

At this juncture, I wish to place on record my deepest appreciations and congratulations to the Chairperson and the Members of the Board of Studies concerned for having framed the curriculum of high standard.

I would also like to acknowledge the Director, the Programme Coordinator and the members of staff of the respective School of Studies for their irrevocable contributions towards designing the curriculum of this Programme.

Last but not least, I register my profuse appreciation to Prof. S. Balasubramanian, the Director (i/c), Curriculum Development Centre (CDC), TNOU, who have compiled this comprehensive Programme Project Report (PPR) that includes the regulations and syllabi of the Programme, and also facilitated the designing in the form of e-book as well as printed book.

I am immensely hopeful that your learning at TNOU shall be stupendous, gratifying, and prosperous. Wish you all success in your future endeavours!

With regards,

Date: 05.11.2020

(K.PARTHASARATHY)

tnouvc@gmail.com | drkpsbard@gmail.com 044 24306633 | 24306634 9360991143

91- 44 - 24356767 www.tnou.ac.in

TAMIL NADU OPEN UNIVERSITY
School of Sciences
Department of Physics
Chennai-15

MEMBERS OF BOARD OF STUDIES

Chairperson

Dr. V. RAMASWAMY,
Professor and Nodal Officer,
Department of Physics,
Annamalai University.
Annamalai Nagar- 608002

Internal Faculty Members

Dr. E. KUMAR
Assistant Professor of Physics
Department of Physics
School of Sciences
Tamil Nadu Open University, Chennai – 15

Dr. P. SHANMUGAVELAN,
Assistant Professor of Chemistry
Department of Chemistry
School of Sciences
Tamil Nadu Open University, Chennai – 15

Member Subject Experts:

Dr. G. ANBALAGAN,
Professor,
Department of Nuclear Physics,
University of Madras, Chennai.

Dr. B.M. SORNAMURTHY
Associate Professor,
PG & Research Department of Physics
Presidency College (Autonomous),
Kamaraj Salai, Triplicane, Chennai – 600 005.

Dr.V.ULAGENDRAN
Assistant Professor,
Department of Physics,
Guru Nanak College, Velachery,
Chennai – 600 042.

Industrialist

Mr. CLAUDIOS FERNANDO
Director, WooryAutomotives India Pvt.Ltd.,
A1B, MMDA Industrial Complex, Maraimalai Nagar,
Kanchipuram Dist.,

Mr. VALANTINE,
Manager,Inkarp Instruments Pvt.Ltd.,
6A, 6B, Thaver Plaza,
1A Nungambakkam High Road,
Chennai – 600 034.

Student on Roll

R. RAMADEVI
Badal flats, No.5, Door No.17.
NSR Road, Nehru Nagar,
Chrompet, Chennai – 600 044.

TAMIL NADU OPEN UNIVERSITY
SCHOOL OF SCIENCES
DEPARTMENT OF PHYSICS
Master of Science in Physics
From Academic Year 2021-2022 onwards

M.S.c., Physics

Programme Project Report (PPR)

Programme's Mission and Objectives: Master of Science in Physics Programme has been designed to provide in depth knowledge in Physics to those students who are not having opportunity to study in regular mode and for drop-out students from rural and urban areas of Tamil Nadu. The main Objective of this Programme is to see that the recent developments in physics, has been included in the enriched M.Sc., (Physics) curriculum to meet out the present day needs of Academic and Research, Institutions andIndustries.

Relevance of the Programme with HEI's Mission and Goals: The Programme M.Sc., (Physics) is offered to meet current needs of aspiring youths and adult population and also create awareness about the basic scientific aspects to the society. This Programme aims at creating equity in education by providing opportunity to rural people for whom Higher Education isunreachable.

Nature of prospective target group of Learners: Master of Science (Physics) is meant for students who have completed an Undergraduate Degree Programme in Physics from recognized University or graduate teachers (BT assistant) are the target groups. It also targets the rural population to reach their dream of obtaining Higher Education for whom the opportunity weas denied due to lack of limited number of seats available in the conventional Universitysystem.

Appropriateness of Programme to be conducted in ODL mode to acquire specific skills and competence: Master's Degree Programme in Physics will meet out the present day needs of academic and Research, Institutions and Industries. As Programme outcome of the students may acquire depth knowledge in Nuclear Physics, Electronics, Mathematical Physics, Classical and Quantum mechanics, Molecular Physics, Electrodynamics and

Material Science which will motivate the students to go for higher studies/research in Physics. Study materials are given in the SLM format and Practical are being conducted at LSC's.

InstructionalDesign:

The Curriculum and the Syllabus for Master of Science in Physics Programme has been designed to provide the recent developments in physical sciences, has been included in the enriched M.Sc., (Physics) Syllabus to meet out the present day needs of academic and Research, Institutions and Industries. The course for the degree of Master of Science in Physics shall consist of two years (Four Semester) and the medium of instruction is English.

TheMaster of Science in Physics Programme is offered through the Learner Support Centres established by TNOU in the affiliated Arts and Science College, where the same Programme is offered through Conventional Mode.

The Faculty Members available at Department of Physics, School of Science of Tamil Nadu Open University and the faculties approved as Academic Counselors of TNOU at Learner Support Centres will be used for delivering the Master of Science Degree Programme in Physics.

The credits systems suggested as per UGC-ODL Regulations-2020 have been assigned to TheMaster of Science in Physics Programme. The total number of credit assigned for the Programme is 72. The Self Learning Materials in the form of print, e-content and audio/video materials wherever required has also been developed for the Programme.

Procedure for admissions, curriculum transaction andevaluation:

Eligibility: A candidate who has passed the B.Sc., Degree Examination in Branch III Physics Main or B.Sc. – Electronics / Any B.Sc., degree with specialization Applied Mathematics, Applied Physics, Electronics, Nuclear Physics or Nanobiotechnology, B.E (Mechanical, Civil, EEE, ECE and CSE) or an examination of some other university accepted by the syndicate as equivalent thereto shall be permitted to appear and qualify for the M.Sc. Physics Degree Examination of this University after a course of two academic years. Admissions performed in academic year only.

The Programme Fee is Rs.20000/- for two years, plus Registration and other Charges. The admission are carried out by Tamil Nadu Open University and through its Regional Centres located within the State of Tamil Nadu. The Theory Counselling and the Practical Counselling will be conducted through the Learners Support Centres of Tamil Nadu Open University. The evaluation will be carried by Tamil Nadu Open University consists of Continuous Internal Assessment through Assignment and External Assessment through Term End Examination.

Financial Assistance: SC/ST Scholarship available as per the norms of the State Government of Tamil Nadu. Complete Admission fee waiver for the Physically challenged/ differently abled persons.

Policy of Programme delivery: The Academic Calendar for the Programme will be available for the learners to track down the chronological events/ happenings. The Counselling schedule will be uploaded in the TNOU website and the same will be intimated to the students through SMS.

Evaluation System: Examination to Master Degree Programme in Physics is designed to maintain quality of standard. Theory will be conducted by the University in the identified Examination Centres. For the Assignment students may be permitted to write with the help of books/materials for each Course, which will be evaluated by the Evaluators appointed by theUniversity.

Continuous Internal Assessment (CIA): Assignment: 1 assignment for 2 credits are to be prepared by the learners. E.g. If a Course is of Credit 6, then 3 number of Assignments are to be written by the learner to complete the continuous assessment of the course. Assignment carries 30 Marks (Average of Total no of Assignment), consists of Long Answer Questions (1000 words) for each Course.

Sec-A	Answer any one of the question not exceeding 1000 words out of three questions.	1 x 30 = 30 Marks

Theory Examination: Students shall normally be allowed to appear for theory examination by completing Practical and Assignment. The Term -End Examination shall Carry 70 marks and has PART: A, B and C and will be of duration 3 hours.

Question Pattern for Theory Examinations:

Max. Marks: 70 Time: 3 hours

PART - A (5x2 = 10 marks)

Answer all FIVE questions in 50 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

PART - B (4x5 = 20 marks)

Answer any FOUR questions out of Seven questions in 150 words

All questions carry equal marks

6. From Block - I
7. From Block - II
8. From Block - III
9. From Block - IV
10. From Block- V
11. From any Block
12. From any Block

PART - C (4x 10 = 40 marks)

Answer any FOUR questions out of Seven questions in 400 words

[All questions carry equal marks]

13. From Block - I
14. From Block - II
15. From Block - III
16. From Block - IV
17. From Block - V
18. From any Block
19. From any Block

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

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 University examination in each theory paper and overall 50 percent in both Term End Examination and Continuous Internal Assment (Assignment) 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 50 marks in both external and internal taken together. However submission of record notebook is a must.

Classification of Successful Candidate: Candidates who pass all the Courses and who secure 60 per cent and above in the aggregate of marks will be placed in the First Class. Those securing 50 per cent and above but below 60 per cent in the aggregate will be placed in the Second Class.

Requirement of laboratory and Library Resources:

The Programme will be offered through the Learner Support Centre (LSC) maintained by Tamil Nadu Open University. The LSC's have the required infrastructural facilities to conduct the Counselling for the students who wish clear their doubts and also they are having well equipped laboratory facilities relevant to the Master Degree Programme in Physics.

A well-equipped Library is available in the University Headquarters with about 24,000 books and lot of research journals. The Learners Support Centre through which the Degree Programme is to be offered is also equipped will a full-fledged library having books and journals related Physics.

Cost estimate of the Programme and theprovisions:

S.No	Details	Amount in Rs.
1	Programme development and launching cost (Expenditure)	**-7626200**
2	Programme Fee charged for 2 years per student (Income)	**-20000**
3	Examination Fee charged for 2 years (Income) per student	**6000**
4	Examination expenses per student for 2 years per student (Expenditure)	**-12000**

Quality Assurance Mechanism and Programme Outcomes: The Quality of the Master's Degree Programme in Physics is maintained by adopting the curriculum suggested by the UGC. As per UGC guidelines the core courses, four subject specific elective courses, four practical courses are included in the Programme. The Curriculum of Master'sDegree Programme in Physics was approved by the Board of Studies on 19.06.2020. It will be placed for approval forthcoming Academic Council and Syndicate of our University subsequently. As a part of Quality assurance, the curriculum for the Programme will be updated once in three years. Necessary steps will be taken to obtain feedback from the students and the Academic Counsellors who are part of the Programme for effective delivery of theProgramme.

Programme Outcomes

1) Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at ideas and decisions (intellectual, organisational, and personal) from different perspectives.

2) Analytical Skill: To analyse from various branches of knowledge and arrive at independent conclusions.

3) Effective Communication: Communicate and comprehend clearly in person and through electronic media in English and to make meaning of the world by connecting people, ideas, books, media andtechnology.

4) Social Responsibility: To be conscious of the society and it's requirement, and contribute towardsit.

5) Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

6) Ethics & Morals: Recognize different value systems, understand the moral dimensions of decisions, and accept responsibility forthem.

7) Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.

8) Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context of socio- technological changes.

Structure of the M.Sc Physics Programme

Course	Course Code	Course Title	Evaluation			Credits
			CIA*	TEE**	Total	
I – Year - Semester I						
Core I	MPH-11	Classical Mechanics	30	70	100	4
Core II	MPH-12	Mathematical Physics – I	30	70	100	4
Core III	MPH-13	Linear and Integrated Electronics	30	70	100	4
Core Practical - 1	MPH-P1	Practical – I	30	70	100	4
Elective -1	MPH-EL1	Numerical Methods	30	70	100	3
I – Year - Semester II						
Core IV	MPH-21	Mathematical Physics – II	30	70	100	4
Core V	MPH-22	Quantum Mechanics – 1	30	70	100	4
Core VI	MPH-23	Electromagnetic Theory	30	70	100	4
Core Practical - 2	MPH-P	Practical – II	30	70	100	4
Elective-2	MPH-EL2	Microprocessor and Microcontroller	30	70	100	3
II Year- Semester III						
Core VII	MPH-31	Quantum Mechanics – II	30	70	100	4
Core VIII	MPH-32	Thermodynamics and Statistical Mechanics	30	70	100	4
Core IX	MPH-33	Condensed Matter Physics– I	30	70	100	4
Core Practical - 3	MPH-P3	Core Practical – III	30	70	100	4
Elective-3	MPH-EL3	Physics of Nanomaterials	30	70	100	3
II Year -Semester IV						
Core X	MPH-41	Spectroscopy	30	70	100	4
Core XI	MPH-42	Nuclear Physics	30	70	100	4
Core XII	MPH-43	Condensed Matter Physics – II	30	70	100	4
Core Practical -2	MPH-P4	Practical -IV	30	70	100	4
Elective-4	MPH-EL4	Instrumental Methods of Analysis	30	70	100	3
Total			600	1400	2000	72

**Continuous Internal Assessment (CIA)*

***Term End Examination (TEE)*

TAMIL NADU OPEN UNIVERSITY
School of Sciences
Department of Physics
Chennai-15

M.Sc., Physics
First Year- I Semester (Distance Mode)

Course Title	**CLASSICAL MECHANICS**
Course Code	**MPH 11**
Course Credit	**4**

COURSE OBJECTIVES

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

- Solve the equationof motionusing Lagrangian, Hamilton and Hamilton-Jacobi equations.
- Study the kinematics of therigid body through Eulerequation.
- Get knowledge in central force field and relativity

COURSE OUTCOMES

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

- Explain clearly the notion of degrees of freedom and identify them for a given mechanical system
- Explain clearly the notion of degrees of phasespace
- Demonstrate an understanding of intermediate classical mechanics topics such as coordinate transformations, oscillatory motion, gravitation and other central forces, and Lagrangian mechanics
- Apply knowledge of physics to become successful in national level examinations like NET, SLET, GATEetc.
- Engage in research in the field of pure and applied physics and involve in lifelong learning

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'SEQUATION AND CANONICALTRANSFORMATION

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 13 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.

TAMIL NADU OPEN UNIVERSITY
School of Sciences
Department of Physics
Chennai-15

M.Sc. Physics

First Year- I Semester (Distance Mode)

Course Title	MATHEMATICAL PHYSICS- 1
Course Code	MPH 12
Course Credit	4

COURSE OBJECTIVES

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

- Develop knowledge in mathematical physics and its applications.
- Develop expertise in mathematical techniques required in physics.
- Enhance problem solvingskills.
- Enable students to formulate, interpret and draw inferences from mathematical solutions.

COURSE OUTCOMES

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

- Master the basic elements of mathematical physics and demonstrate an ability to use vector analysis, matrices and special functions in the solution of physical problems
- Apply knowledge of physics to become successful in national level examinations like NET, SLET, GATE etc.
- Engage in research in the fieldof pure and applied physics and involve in life long learning

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- 16
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.

TAMIL NADU OPEN UNIVERSITY
School of Sciences
Department of Physics
Chennai-15

M.Sc. Physics
First Year- I Semester (Distance Mode)

Course Title	**LINEAR AND INTEGRATED ELECTRONICS**
Course Code	**MPH 13**
Course Credit	**4**

COURSE OBJECTIVES

While studying the **LINEARANDINTEGRATED ELECTRONICS**, the Learner shall be able to:

- The objective of the course is to impart in depth knowledge about Semi conductors, diodes, Transistors, Operational Amplifiers, Memories and converters etc., to the students. The theoretical knowledge gained in the class room can be experimented in the practical classes.

COURSE OUTCOMES

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

- Discuss the op-amp's basic construction, characteristics, parameter limitations, various configurations and countless applications ofop-amp
- Analyze and design basic op-amp circuits, particularly various linear and non-linear circuits, active filters, signal generators, and data converters
- Apply knowledge of physics to become successful in national level examinations like NET, SLET, GATE etc.
- Engage in research in the fieldof pure and applied physics and involve in life long learning

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, 4^{th} Edition, Prentice Hall. 2007.

TAMIL NADU OPEN UNIVERSITY
School of Sciences
Department of Physics
Chennai-15

M.Sc. Physics
First Year- I Semester (Distance Mode)

Course Title	**NUMERICAL METHODS**
Course Code	**MPH EL-1**
Course Credit	**3**

COURSE OBJECTIVES

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

- Understand the numerical techniques to solve the physical problems.
- Understand various method used to solve the physical problems.
- Provide knowledge about various mathematical methods.

COURSE OUTCOMES

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

- the ability to solve equation using an appropriate numerical method
- Apply knowledge of physics to become successful in national level examinations like NET, SLET, GATEetc.
- Engage in research in the fieldof pure and applied physics and involve in life long learning

BLOCK I : INTERPOLATION

Introduction, Polynomial Forms, Linear interpolation,Lagrange Interpolation Polynomial, Newton Interpolation Polynomial,Divided differencetable, 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 ATIONS

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 ANDINTEGRATION

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: NUMERICALSOLUTIONS OF ORDINARY DIFFERENTIAL EQUATIONS

Need and Scope, Tailor Series Method – Improving accuracy, Picard's method, Euler's Method – accuracyofEuler'smethod,Heun'sMethod–Error analysis,PolygonMethod,Runge-KuttaMethods- Determination ofweights, Fourth orderRunge-Kuttamethods.

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 Methodsfor Engineers, Steven C. Chapra and Raymond P. Canale, Mc Graw Hill Internationaleditions, 2ndedtion, 1990.

TAMIL NADU OPEN UNIVERSITY
School of Sciences
Department of Physics
Chennai-15

M. Sc. Physics

First Year- II Semester (Distance Mode)

Course Title	MATHEMATICAL PHYSICS- II
Course Code	MPH 21
Course Credit	4

COURSE OBJECTIVES

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

- Develop knowledge in mathematical physics and its applications.
- Develop expertise in mathematical techniquesrequired in physics.
- Enhance problem solving skills.
- Enable students to formulate, interpret and draw inferences from Mathematical solutions.

COURSE OUTCOMES

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

- Create and solve mathematical models of physical phenomena using analytic and numerical methods
- Design, execute, and interpret experiments to test hypotheses and mathematical models
- Apply knowledge of physics to become successful in national level examinations like NET, SLET, GATEetc.
- Engage in research in the fieldof pure and applied physics and involve in life long learning

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 24 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 - Transverse 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.

TAMIL NADU OPEN UNIVERSITY
School of Sciences
Department of Physics
Chennai-15

M.Sc. Physics

First Year- II Semester (Distance Mode)

Course Title	**QUANTUM MECHANICS –I**
Course Code	**MPH 22**
Course Credit	**4**

COURSE OBJECTIVES

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

- Study the stationary state and eigen spectrum of systems using time dependent Schrodinger equation.
- Solve the exactly soluble eigen value problems.
- Know the matrix formulation of quantum theory and how it can be used to understand the equation of motion.
- Understand the theory of identical particles and Angular momentum.

COURSE OUTCOMES

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

- Know the background for the main features in the historical development of quantum mechanics
- 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)
- Understand the central concepts and principles of quantum mechanics: the Schrödinger equation, the wave function and its physical interpretation, stationary and non-stationary states, time evolution and expectation values
- Apply knowledge of physics to become successful in national level examinations like NET, SLET, GATE etc.
- Engage in research in the field of pure and applied physics and involve in lifelong learning

BLOCK I: FOUNDATIONS OFWAVE MECHANICS

Postulates of wave mechanics -adjoint and self-adjoint operators-degeneracy-eigenvalue,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–eigenvalues,eigenfunctions–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 andPauli'smatrices.

BLOCK III: EXACTLY SOLUBLEEIGENVALU EPROBLEMS

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.

BLOCKIV: MATRIX FORMULATIONOFQUANTUM THEORY, EQUATION OF MOTION & ANGULAR MOMENTUM

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

Angular Momentum

Angular momentum-commutation relation of J_z, J_+, J_- -eigenvalues and matrix representation ofJ^2, J_z, J_+, J_-– Spin angular momentum –spin½, 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 potentials cattering from Born approximation.

Partialwaveanalysis

Asymptotic behavior–phase shift –scattering amplitude interms of phase shifts–differential and total crosss ections–optical theorem–low energy scattering–resonant scattering–non-resonant scattering-scattering length and effective range–Ramsauer-Towns end 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 andCo. Publications, 2018.

BOOKS FORREFERENCE:

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

TAMIL NADU OPEN UNIVERSITY
School of Sciences
Department of Physics
Chennai-15

M. Sc. Physics
First Year- II Semester (Distance Mode)

Course Title	**ELECTROMAGNETIC THEORY**
Course Code	**MPH 23**
Course Credit	**4**

COURSE OBJECTIVES

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

- Develop the theortical knowledgein electromagnetism.
- Develop skills on solving analytical problems in electromagnetism.
- Give basics of defining the complete electro magneticresponse of complexsystems.

COURSE OUTCOMES

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

- Learn the concepts of electromagnetics and apply it in communucationphysics.
- Spread over knowledge of physics as a basic science in solving real life and scientific Problems
- Apply knowledge of physics to become successful in national level examinations like NET, SLET, GATEetc.
- Engage in research in the fieldof pure and applied physics and involve in life long learning

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.

TAMIL NADU OPEN UNIVERSITY
School of Sciences
Department of Physics
Chennai-15

M. Sc. Physics

First Year- II Semester (Distance Mode)

Course Title	MICROPROCESSORS AND MICROCONTROLLER
Course Code	MPH EL-2
Course Credit	3

COURSE OBJECTIVES

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

- This paper presents an extensive knowledge about the architecture and assembly language programming of microprocessors 8085 & 8086 and microcontroller 8051. It also explains interfacing of 8085 microprocessor.

COURSE OUTCOMES

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

- Understand the basic operations in electroniccircuits
- Develop the programming skills of Microprocessor
- Appreciate the applications of Microprocessor programming
- Apply knowledge of physics to become successful in national level examinations like NET, SLET, GATE etc.
- Engage in research in the fieldof pure and applied physics and involve in life long learning

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 ANDPROGRAMMING

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.

TAMIL NADU OPEN UNIVERSITY
School of Sciences
Department of Physics
Chennai-15

M. Sc. Physics - Second Year
III Semester (Distance Mode)

Course Title	**QUANTUM MECHANICS – II**
Course Code	**MPH 31**
Course Credit	**4**

COURSE OBJECTIVES

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

- Study the fundamentals of wave mechanics.
- Learn about the approximation methods for time independentand time dependent perturbation theory.
- Underst and the kinematics of scattering process and partialwave analysis.
- Study the theory of relativistic quantum mechanics and field quantization.
- Study the quantum theory of atomic and molecular structures.

COURSE OUTCOMES

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

- Apply principles of quantum mechanics to calculate observables on known wavefunctions
- Grasp the concepts of spin and angular momentum, as well astheir quantization- and additionrules
- Explain physical properties of elementary particles, nucleons, atoms, molecules and solids (band structure) based on quantum mechanics
- Apply knowledge of physics to become successful in national level examinations like NET, SLET, GATEetc.

BLOCK I: APPROXIMATION METHODS FORTIMEINDEPENDENTPROBLEMS

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 effectin hydrogen atom.

BLOCK II: APPROXIMATION METHODS FORTIME DEPENDENT PERTURBATION THEORY

Time dependent Perturbation theory -first order transitions–constant perturbation-transition probability:Fermi Golden Rule–Periodicperturbation –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 THEORYOFATOMICAND MOLECULARSTRUCTURE

Central field approximation: Residual electrostatic interaction-spin-orbit interaction-Determination of central field: Thomas Fermi statistical method-Hartree and Hartree-Fock approximations (self consistentfields) –Atomicstructureand Hund'srule.

Molecules

Born-Oppen heimer approximation–An application: the hydrogen moleculeI on (H_2^+) – Molecular orbital theory:LCAO- Hydrogen molecule.

BLOCK V: RELATIVISTIC QUANTUMMECHANICS &QUANTIZATION OFTHEFIELD

Schrodinger relativistic equation-Klein-Gordane quation-charge and current densities–interaction with electro magnetic field-Hydrogen like atom –nonrelativistic limit-Dirac relativistic equation:Dirac relativistic Hamiltonian–probability density-Diracmatrices-plane wave solution–eigen spectrum –spin of Dirac particle –significance of negative eigenstates–electronin a magnetic field– spin magneticmoment.

Quantization oftheField

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 Mc Graw–Hill Publications, Second Edition,2010.
2. Quantum Mechanics- Satya Prakash, Kedar Nath RamNath andCo. Publications,2018.
3. Claude Cohen-Tannoudji, BernardDiu, FranckLaloë , 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. Publication,Second Edition,2003.
2. Quantummechanics - Franz Schwabl,NarosaPublications, Fourth Edition, 2007.
3. Molecular Quantum mechanics - P.W.Atkins and R.S. Friedman,),Oxford University Press publication, Fifth Edition,2010.
4. Quantum Mechanics–Theory and Applications,A.K. Ghatak and Lokanathan, Macmillan India Ltd Publication,Fifth Edition,2015.
5. Quantum Mechanics- Leonard I. Schiff,McGraw-Hill International Publication,Third Edition,1968.
6. Quantum Mechanics- E. Merzbacher,John Wiley Interscience Publications, Third Edition,2011.
7. Fundamental principles of Quantummechanics with elementary applications - Edwin C. Kemble,Dover Publications, ReIssueEdition,2005.
8. Principle of Quantum Mechanics - R. Shankar,Plenum US Publication,Second Edition, 1994.

TAMIL NADU OPEN UNIVERSITY
School of Sciences
Department of Physics
Chennai-15

M. Sc. Physics - Second Year
III Semester (Distance Mode)

Course Title	**THERMODYNAMICS AND STATISTICAL MECHANICS**
Course Code	**MPH 32**
Course Credit	**4**

COURSE OBJECTIVES

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

- Provide a phenomenological introduction to thermodynamics through thermodynamics postulates, quantities and relations.
- Studying the micro and macroscopic properties of the mater through the statistical probability laws and distribution of particles.
- Understanding the classical and quantum distribution laws and their relations.
- Studying transport properties, different phases of maters, equilibrium and non-equilibrium process.

COURSE OUTCOMES

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

- Spread on knowledge ofphysics as a basic science in solving real life and scientificProblems.
- Smear the usefulness of micro- canonical, canonical and grand canonicalensembles.
- Identify the application aspectsof statisticalmechanics
- Apply knowledge of physics to become successful in national level examinations like NET, SLET, GATEetc.

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, 20^{th} Edition, Pragati Prakashan, Meerut, 2003.
6. Statistical Mechanics, B.K.Agarwal and M.Eisner, Second Edition, New Age International Private Limited, Delhi, 2016.
7. Statistical Mechanics and Properties of Matter (Theory and Applications), E.S.R.Gopal, Ellis Horwood Ltd, 1974.

TAMIL NADU OPEN UNIVERSITY
School of Sciences
Department of Physics
Chennai-15

M. Sc. Physics - Second Year
III Semester (Distance Mode)

Course Title	CONDENSED MATTER PHYSICS – I
Course Code	MPH 33
Course Credit	4

COURSE OBJECTIVES

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

- Give strong foundation in the conceptual understanding of the development of soid state physics with appropriate theoretical background.

COURSE OUTCOMES

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

- Identify the importance of crystal physics to analyze the materials properties.
- Put on knowledge of physical phenomena taking place, which are responsible for theparticular characteristics of thematerials.
- Recognize the analytical techniques for studying the Structural, Microstructural, Optical and Transportproperties.
- Apply knowledge of physics to become successful in national level examinations like NET, SLET, GATEetc.

BLOCKI: 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 Nanotechnolog, PHI Learning private Ltd., Delhi 2014.
6. 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 emphasis 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.

TAMIL NADU OPEN UNIVERSITY
School of Sciences
Department of Physics
Chennai-15

M. Sc. Physics - Second Year
III Semester (Distance Mode)

Course Title	**ELEMENTS OF NANOSCIENCE AND NANO TECHNOLOGY**
Course Code	**MPH- EL3**
Course Credit	**3**

COURSE OBJECTIVES

While studying the **ELEMENTS OFNANOSCIENCEAND NANOTECHNOLOGY,** the Learner shall be able to:

- Provide the basic Knowledge about basics nanoscienceand technology
- Aqcuire the knowledgeabout synthesis methodsand characterization techniques andits applications
- Identify the various techniques to investigate the different properties such as optical, structural and morphology ofnanoparticles.

COURSE OUTCOMES

After completion of the **ELEMENTS OFNANOSCIENCEAND NANOTECHNOLOGY**, the Learner will be able to:

- Apply their acquired knowledge in research level to synthesis and characterize the nanomaterials.
- Identify the various techniques to investigate the different properties such as optical, structural and morphology of nanoparticles.
- Apply knowledge of physics to become successful in national level examinations like NET, SLET, GATEetc.

BLOCKI: 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 SinghNalwa,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 andInorganicNanostructures, A. Nabok-ArtechHouse,2005
2. Nanoscience: "Nanotechnologies andNanophysics", C. Dupas, P.Houdy, M.Lahmani, Springer-Verlag Berlin Heidelberg, 2007
3. Introduction to Nanotechnology, Charles P. Poole, Frank JOwens, Wiley- Interscience.
4. Nanosystem Characterization Tools in the LifeSciencesedited byChallaKumar
5. Nanostructures and Nanomaterials (Synthesis, Properties and Applications), Guozhong Cao. World Scientific Publishing Co Pvt. Ltd.2004

TAMIL NADU OPEN UNIVERSITY
School of Sciences
Department of Physics
Chennai-15

M. Sc. Physics - Second Year
IV Semester (Distance Mode)

Course Title	**SPECTROSCOPY**
Course Code	**MPHY 41**
Course Credit	**4**

COURSE OBJECTIVES

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

- Give advanced knowledge about the interactions of EM radiation with matter and their applications in spectroscopy like IR, RAMAN, NMR, ESR, NQR and Mossbauer spectroscopy.

COURSE OUTCOMES

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

- Gain the thorough understanding of the basic structure of hydrogen likeatoms
- Learn the selection rules for two- electron atoms and many- electronatoms
- Spread on variousmolecular spectroscopyprinciples
- Apply knowledge of physics to become successful in national level examinations like NET, SLET, GATEetc.
- Engage in research in the fieldof pure and applied physicsand involve in lifelong learning

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 & Mossabauer Spectroscopy:

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

Mossabauer Spectroscopy: Mossabauer Effect-Recoilless Emission and Absorption-Mossabauer 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.

TAMIL NADU OPEN UNIVERSITY
School of Sciences
Department of Physics
Chennai-15

M. Sc. Physics - Second Year
IV Semester (Distance Mode)

Course Title	**NUCLEAR PHYSICS**
Course Code	**MPH 42**
Course Credit	**4**

COURSE OBJECTIVES

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

- IntroduceLearners to the fundamental principles and conceptsgoverning nuclear and particle physics.
- Know about nuclear physics'scientific and technologicalapplications as wellas theirsocial, economicand environmental implications.
- Understand the concept of elementaryparticles.

COURSE OUTCOMES

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

- Acquire the analytical techniques for studying the Structural, Microstructural, Optical and Transportproperties.
- Appreciate the mostadvanced imaging instruments and their workings.
- Spread over knowledge of physics as a basic science in solving real life and scientific problems
- Apply knowledge of physics to become successful in national level examinations like NET, SLET, GATEetc.
- Engage in research in the fieldof pure and applied physicsandinvolve in lifelong learning

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.

BLOCKII: 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 kinematics – 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

TAMIL NADU OPEN UNIVERSITY
School of Sciences
Department of Physics
Chennai-15

M. Sc. Physics - Second Year
IV Semester (Distance Mode)

Course Title	CONDENSED MATTER PHYSICS – II
Course Code	MPH 43
Course Credit	4

COURSE OBJECTIVES

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

- Develop analytical thinking to understand the phenomenon that decide various properties of solids thereby equip students to pursue higher learning confidently.

COURSE OUTCOMES

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

- Obtain the basis for understanding the link between different processing techniques and the characteristics ofmaterials
- Provide insight into someof the steps in the Behaviour of Dilectric and Magnetic materials
- Provide an introduction to experimental methods that are used in parts of materialsscience
- Apply knowledge of physics to become successful in national level examinations like NET, SLET, GATEetc.

BLOCKI: 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 – Buckminster fullerene – 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 emphasis 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.

TAMIL NADU OPEN UNIVERSITY
School of Sciences
Department of Physics
Chennai-15

M. Sc. Physics - Second Year
IV Semester (Distance Mode)

Course Title	**INSTRUMENTAL METHODS OF ANALYSIS**
Course Code	**MPH- EL4**
Course Credit	**3**

COURSE OBJECTIVES

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

- To study different analytical techniques to characterize the samples

COURSE OUTCOMES

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

- Understand the basic principles of theexperiments
- Understand simple concepts to demonstrate anexperiment
- Apply knowledge of physics to become successful in national level examinations like NET, SLET, GATEetc.

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: THERMALANALYSIS

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.

TAMIL NADU OPEN UNIVERSITY
School of Sciences
Department of Physics
Chennai-15

M. Sc. Physics - First Year
I Semester (Distance Mode)

Course Title	**PRACTICAL – I**
Course Code	**MPH-P1**
Course Credit	**4**

(Practical Examination at the end of the Second semester)

(Any 10 experiment)

1. De Sauty'sbridge
2. Fresnel's Biprism – Spectrometer
3. Polarimeter
4. Cornu's method – Young's modulus and Poisson's ratio – EllipticFringes
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 visibleSpectrometer
11. Study of RS, Clocked RS, D flip flops using NAND andNOR
12. Arithmetic Operations 4 bit binary addition 7483 andsubtraction
13. OP-AMP 4 bit Digital – Analog R – 2R Ladder
14. OP-AMP Waveformgenerators
15. Multi vibrators – Monostable and astable using 555timer
16. Microprocessor 8085 Sum of Set of n data (8 bit numbers)
17. Microprocessor 8085 Traffic SignalController
18. Microprocessor 8085 CodeConversion
19. Microprocessor 8085 Stepper motor interface
20. Microprocessor 8085 interfacing of R-2Rladder
21. Microprocessor 8085 interfacing of 7 segmenteddisplay

M. Sc. Physics - First Year
II Semester (Distance Mode)

Course Title	**PRACTICAL – II**
Course Code	**MPH-P2**
Course Credit	**4**

(Any 10 experiment)

1. e/m Magnetronmethod
2. HallEffect
3. Thickness of insulation of a wire by interference method(airwedge)
4. Viscosity of a liquid by Mayer'smethod
5. Hydrogen spectra – Rydberg'sconstant
6. Cornu's method – Young's modulus and Poisson's ratio – HyperbolicFringes
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 differentialequation
12. OP-AMP - Low pass, band pass and high passfilter
13. Shift register, Ring counter and Johnson twisted ringcounter
14. OP-AMP phase shiftoscillator
15. OP-AMP – Pulse generator and application as Frequencydivider
16. OP-AMP – Triangular WaveOscillator.
17. UJT relaxationoscillator
18. Microprocessor 8085 sorting ascending anddescending
19. Microprocessor 8085 programmable counter 8255 interface
20. Microprocessor 8086 Arithmeticoperations

TAMIL NADU OPEN UNIVERSITY
School of Sciences
Department of Physics
Chennai-15

M. Sc. Physics - Second Year
III Semester (Distance Mode)

Course Title	**PRACTICAL – III**
Course Code	**MPH-P2**
Course Credit	**4**

(Practical Examination at the end of Fourth semester)

(Any 10 experiment)

1. Fabry ParotEtalon
2. Thickness of Edser and Butlerfringes
3. B-H loop byCRO
4. Band gap of athermistor
5. OP-AMP triangle waveoscillator
6. Susceptibility – Guoy'smethod
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 ZC723
12. Study of JK, DT flip-flops using 7476 and7473
13. Study of binary up and down counters using 7473 and7486
14. Shift register, Ring counter and Johnsoncounter
15. Microcontroller 8051 interfacing seven segmenteddisplay
16. OP-AMP Wein bridgeoscillator
17. OP-AMP pulse generator and applications and frequencydivider
18. Microprocessor 8086 multi byte addition andsubtraction
19. Microprocessor 8086 sum of set of n data average of nnumbers
20. Microcontroller 8051 ArithmeticOperations

TAMIL NADU OPEN UNIVERSITY
School of Sciences
Department of Physics
Chennai-15

M. Sc. Physics - Second Year
IV Semester (Distance Mode)

Course Title	**PRACTICAL – IV**
Course Code	**MPH-P2**
Course Credit	**4**

(Any 10 experiment)

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