Shri Vile Parle Kelavani Mandal's

MITHIBAI COLLEGE OF ARTS, CHAUHAN INSTITUTE OF SCIENCE & AMRUTBEN JIVANLAL COLLEGE OF COMMERCE AND ECONOMICS (AUTONOMOUS)

NAAC Reaccredited 'A' grade, CGPA: 3.57 (February 2016),
;ranted under RUSA, FIST-DST & -Star College Scheme of DBT, Government of Indi
Best College (2016-17), University of Mumbai

Affiliated to the

UNIVERSITY OF MUMBAI

Program: Master of Science (By paper)

Course: Physics

Semester: I and II

Choice Based Credit System (CBCS) with effect from the Academic year 2020-21

PROGRAMME SPECIFIC OUTCOMES (PSO'S)

On completion of the M.Sc Physics, the learners should be enriched with knowledge and be able to-

PSO1: **Physics knowledge**: Understand current development in various dolmens of modern Physics like Nuclear Physics, Electrodynamics, Atomic and Molecular Physics, Classical Mechanics, Quantum Mechanics, Statistical Mechanics, Mathematical Physics, Solid state Physics, Advanced Electronics, Solid state devices, Experimental techniques and electronic communication technology.

PSO2: **Practical Skills and Analytical Abilities:** Develop analytical abilities and acquire practical skill in handling measuring equipment required to carry out experiments in different areas of Physics, verify complex Physics problems through experimentation and use them to develop science and technology.

PSO3: **Motivation and life-long learning**: Acquire skills like collaborative work, communication and independent learning required for lifelong learning to overcome challenges ahead.

PSO4: **Research:** Clear competitive examination like SET, NET, JRF, PET and JEST required for pursue research at different research institutes and Universities. Get trained for a career in basic sciences and contribute in educational institutes, industries and emerging branches of science

PSO5: **Ethics:** Demonstrate professional behaviour such as (i) being objective, unbiased and truthful in all aspects of work and avoiding unethical, irrational behaviour such as fabricating, falsifying or misrepresenting data or committing plagiarism; (ii)the ability to identify the potential ethical issues in work-related situations; (iii) appreciation of intellectual property, environmental and sustainability issues; and (iv) promoting safe learning and working environment.

PREAMBLE

Physics is a scientific knowledge of natural phenomenon at macro as well as micro level and proved as key for development of modern science and technology. The courses offered in this M.Sc Physics program gives adequate knowledge of Physics and necessary practical skills to students who may go on to work in different areas like Nuclear Physics, Material science, advanced electronics, Astrophysics, Theoretical Physics and Instrumentations.

This M. Sc. in Physics Program to be taught from the academic year 2020-21 onwards consists of total 16 theory courses, total 6 practical lab courses and 2 projects spread over four semesters. Each theory course will be of 4 (four) credits, each practical lab course will be of 4 (four) credits and each project will be of 4 (four) credits. A project can be on theoretical physics, experimental physics, applied physics, development physics, computational physics or industrial product development. A student earns 24credits per semester and total 96 credits in four semesters.

SVKM's Mithibai College of Arts, Chauhan Institute of Science & Amrutben Jivanlal College of Commerce & Economics (AUTONOMOUS)

SYLLABUS
MSC, PHYSICS, SEMESTER-I

Program: Master of Science (Physics)				**Semester : I**	
Course: Mathematical methods				**Course Code: PSMAPH101**	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week)	**Practical** (Hours per week)	**Tutorial** (Hours per week)	**Credit**	**Continuous Assessment and Evaluation (CAE) (Marks -)**	**Term End Examinations (TEE) (Marks)**
4	-	-	4	25	75

Pre-requisite:
Basic knowledge of Mathematical Physics, Fourier series and its transform.

Learning Objectives:

1. To teach differential equations, power series solutions, theory of complex variable analysis, matrices, tensors, polynomials, special functions, Laplace transform and its applications.
2. To use mathematical tools to develop analytical abilities towards real world problems.
3. To enrich knowledge through problem solving, hands on activities, study visits and projects.

Learning outcomes:
Course Outcomes:
After completion of the course, learners would be able to:

CO1: Describe and recognize different types of complex equations, Matrices, tensors, power series solutions and integral transform.
CO2: Discuss and explain CR equation and their conditions, Taylor and Laurent series, residues problems, Matrices, tensors, differential equation, Frobenius methods, special function and integral transform
CO3: Solve problems on all units based on CR equation, infinite series problems, residues problems, Matrices, tensors, differential equation, and integral transform
CO4: Investigate the Analytics functions, improper real integral, definite integral, eigen vectors, diagonalization of matrix, addition and subtraction of tensors, power series solution, green's function and integral transform.
CO5: Evaluate the Complex integral, CR equations, Harmonic function, Parameters of matrices and tensors, Differential equation, Special functions, green's function and Laplace and Fourier transform.
CO6: Derive solutions to theorem, derive formulas in topic covered from all four units.

Outline of Syllabus: (per session plan)

Unit	Description	Duration
1	**Complex Variables**	**15**

2	**Matrices and Tensor Analysis.**	**15**
3	**Second Order Differential Equation, Power Series Solution, and Green's Function.**	**15**
4	**Integral Transform.**	**15**
	Total	**60**

DETAILED SYLLABUS

Unit	Description	No. of lectures
1	Complex Variables, Limits, Continuity, Derivatives, Cauchy-Riemann Equations, Analytic functions, Harmonic functions, Elementary functions: Exponential and Trigonometric, Taylor and Laurent series, Residues, Residue theorem, Principal part of the functions, Residues at poles, zeroes and poles of order m, Contour Integrals, Evaluation of improper real integrals, improper integral involving Sines and Cosines, Definite integrals involving sine and cosine functions.	15
2	Matrices, Eigenvalues and Eigen vectors, orthogonal, unitary and hermitian matrices, Diagonalization of Matrices, Applications to Physics problems. Introduction to Tensor Analysis, Addition and Subtraction of Tensors, summation convention, Contraction, Direct Product, Levi-Civita Symbol.	15
3	General treatment of second order linear differential equations with non-constant coefficients, Power series solutions, Frobenius method, Legendre, Hermite and Laguerre polynomials, Bessel equations, Nonhomogeneous equation – Green's function, Sturm-Liouville theory.	15
4	Integral transforms: three dimensional fourier transforms and its applications to PDEs (Green function of Poisson's PDE), convolution theorem, Parseval's relation, Laplace transforms, Laplace transform of derivatives, Inverse Laplace transform and Convolution theorem, use of Laplace's transform in solving differential equations.	15

Reference Books:

1. S. D. Joglekar, Mathematical Physics: The Basics, Universities Press 2005
2. S. D. Joglekar, Mathematical Physics: Advanced Topics, CRC Press 2007
3. M.L. Boas, Mathematical methods in the Physical Sciences, Wiley India 2006
4. G. Arfken and H. J. Weber: Mathematical Methods for Physicists, Academic Press 2005

Additional Reference Books:

1. A.K. Ghatak, I.C. Goyal and S.J. Chua, Mathematical Physics, McMillan
2. A.C. Bajpai, L.R. Mustoe and D. Walker, Advanced Engineering Mathematics, John Wiley
3. E. Butkov, Mathematical Methods, Addison-Wesley
4. J. Mathews and R.L. Walker, Mathematical Methods of physics
5. P. Dennery and A. Krzywicki, Mathematics for physicists
6. T. Das and S.K. Sharma, Mathematical methods in Classical and Quantum Mechanics
7. R. V. Churchill and J.W. Brown, Complex variables and applications, V Ed. Mc Graw. Hill
8. A W.Joshi, Matrices and Tensors in Physics, Wiley India

Program: Master of Science (Physics)				**Semester : I**	
Course : Classical Mechanics				**Course Code: PSMAPH102**	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week)	**Practical** (Hours per week)	**Tutorial** (Hours per week)	**Credit**	**Continuous Assessment and Evaluation (CAE) (Marks - ______)**	**Term End Examinations (TEE) (Marks- ______ in Question Paper)**
4	-	-	4	25	75

Pre-requisite: Basic Knowledge of Newtonian Mechanics.

Learning Objectives:

1. To teach theory of Lagrangian and Hamiltonian formulations, variational Principle, central force field problems, conservation laws, theory of small oscillations, canonical transformations, and angular momentum and Poission bracket relations.
2. To teach how to apply theories for solving complex mechanics problems.

Course Outcomes:

After completion of the course, learners would be able to:

CO1: Describe theory of Lagrangian and Hamiltonian formulations, variational Principle, central force field problems, conservation laws, theory of small oscillations, canonical transformations, and angular momentum and Poission bracket relations.

CO2: Explain the two-body central force system, Legendre transformation, cyclic coordinates and conservation theorems, the sympletic approach to canonical transformation.

CO3: Application of Lagrangian formulism, Hamiltonian formalism.

CO4: Compare Newtonian, Lagrangian and Hamiltonian formalism.

CO5: Evaluate energy, orbits for system in central force. Evaluate frequencies of free vibration and normal coordinates for small oscillations systems. Evaluate canonical transformation for given sytems.

CO6: Derive Lagrange equation of motion from Dalembert's principle, from Hamiltonian principle, derive Hamiltonian equation of motions. Derivation of Hamilton's equations from a variational principle.

Outline of Syllabus: (per session plan)

Unit	Description	Duration
1	**Variational Principal and Lagrangian Formulation**	**15**
2	**Motion under central force field**	**15**

3	**Mechanics of small oscillations and Hamiltonian equation of motion.**	**15**
4	**Canonical transformations and Poisson brackets.**	**15**
	Total	**60**
DETAILED SYLLABUS		
1	(Review of Mechanics of a particle, Mechanics of a system of particles, Frames of references, rotating frames, Centrifugal and Coriolis force, Constraints) D'Alembert's principle and Lagrange's equations, Velocity-dependent potentials and the dissipation function, Simple applications of the Lagrangian formulation. Hamilton's principle, Calculus of variations, Derivation of Lagrange's equations from Hamilton's principle, Lagrange Multipliers and constraint exterimization problems, Extension of Hamilton's principle to no holonomic systems, Advantages of a variational principle formulation	**15**
2	Conservation theorems and symmetry properties, Energy Function and the conservation of energy. The Two-Body Central Force Problem: Reduction to the equivalent one body problem, The equations of motion and first integrals, The equivalent one-dimensional problem and classification of orbits, The virial theorem, The differential equation for the orbit and integrable power-law potentials, The Kepler problem: Inverse square law of force, The motion in time in the Kepler problem, Scattering in a central force field, Transformation of the scattering problem to laboratory coordinates.	**15**
3	Small Oscillations: Formulation of the problem, the eigenvalue equation and the principal axis transformation, Frequencies of free vibration and normal coordinates, Forced and damped oscillations, Resonance and beats. Legendre transformations and the Hamilton equations of motion, Cyclic coordinates and conservation theorems, Derivation of Hamilton's equations from a variational principle.	**15**
4	Canonical Transformations, Examples of canonical transformations, The symplectic approach to canonical transformations, Poisson brackets and other canonical invariants, Equations of motion, infinitesimal canonical transformations and conservation theorems in the Poisson bracket formulation, The angular momentum Poisson bracket relations.	**15**
Reference Books: **Main Reference:**		

Classical Mechanics, H. Goldstein, Poole and Safko, 3rd Edition, Narosa Publication (2001)

Additional References:
1. Classical Mechanics, N. C. Rana and P. S. Joag. Tata McGraw Hill Publication.
2. Classical Mechanics, S. N. Biswas, Allied Publishers (Calcutta).
3. Classical Mechanics, V. B. Bhatia, Narosa Publishing (1997).
4. Mechanics, Landau and Lifshitz, Butterworth, Heinemann.
5. The Action Principle in Physics, R. V. Kamat, New Age Intnl. (1995).
6. Classical Mechanics, Vol I and II, E. A. Deslougue, John Wiley (1982).
7. Theory and Problems of Lagrangian Dynamics, Schaum Series, McGraw (1967).
8. Classical Mechanics of Particles and Rigid Bodies, K. C. Gupta, Wiley Eastern (2001)
9. Classical Mechanics , Gupta Kumar and Sharma, Pragati Prakashan.

Program: Master of Science (Physics)				**Semester : I**	
Course: Quantum Mechanics-I				**Course Code: PSMAPH103**	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week)	**Practical** (Hours per week)	**Tutorial** (Hours per week)	**Credit**	**Continuous Assessment and Evaluation (CAE) (Marks - ______)**	**Term End Examinations (TEE) (Marks- ______ in Question Paper)**
4	-	-	4	25	75

Pre-requisite: Basic Knowledge of Quantum Mechanics and linear algebra.

Learning Objectives:
To familiarize students with the theoretical framework of non-relativistic quantum mechanics and its applications to simple problems.

Course Outcomes:
After completion of the course, learners would be able to:

CO1: Describe fundamentals of Schrodinger's equations, operators, Eigen value, Eigen function, Harmonic oscillator, potential well, Hydrogen atom, Linear vector space, Hilbert space, Hermitian operators, matrix mechanics, , angular momentum and Pauli spin matrices.

CO2: Explain Schrodinger, Heisenberg and interaction picture. Discuss time development of expectation values, conservation theorem and parity. Discuss general properties of one dimensional Schrodinger equations.

CO3: Solve Schrodinger equation for 1-D, 2-D and 3-D system. Apply spherical harmonics to find Eigen functions of L^2 and L_z Apply addition of angular momentum to find Clebsch Gordan coefficients.

CO4: Distinguish LS and JJ coupling, Angular momentum matrices, Pauli spin matrices
CO5: Evaluate eigen values and eigen states for quantum mechanical systems.
CO6: Derive expression for reflection and transmission coefficient for quantum mechanical systems. Derive expression of energy for hydrogen atom.

Outline of Syllabus: (per session plan)

Unit	Description	Duration
1	**Review of concepts, Linear Vector Spaces and operators.**	**15**
2	**Schrodinger equation solutions: one dimensional problems, Gaussian wave packet, Fourier transform.**	**15**
3	**Schrodinger equation solutions: Three dimensional problems.**	**15**
4	**Quantum theory of Angular momentum and rotations**	**15**
	Total	**60**

DETAILED SYLLABUS

Unit	Description	Duration
1	**Review of concepts:** Postulates of quantum mechanics, observables and operators, measurements, state function and expectation values, the time-dependent Schrodinger equation, time development of state functions, solution to the initial value problem. The Superposition principle, commutator relations, their connection to the uncertainty principle, complete set of commuting observables. Time development of expectation values, conservation theorems and parity. Formalism: Linear Vector Spaces and operators, Dirac notation, Hilbert space, Hermitian operators and their properties, Matrix mechanics: Basis and representations, unitary transformations, the energy representation. Schrodinger, Heisenberg and interaction picture.	**15**
2	**Wave packet:** Gaussian wave packet, Fourier transform. Schrodinger equation solutions: one dimensional problems: General properties of one dimensional Schrodinger equation, Particle in a box, Harmonic oscillator by raising and lowering operators and Frobenius method, unbound states, one dimensional barrier problems, finite potential well.	**15**
3	**Schrodinger equation solutions:** Three dimensional problems: Orbital angular momentum operators in cartesian and spherical polar coordinates, commutation and uncertainty relations, spherical harmonics, two	**15**

	particle problem- coordinates relative to centre of mass, radial equation for a spherically symmetric central potential, hydrogen atom, eigenvalues and radial eigenfunctions, degeneracy, probability distribution.	
4	**Angular Momentum:** Ladder operators, eigenvalues and Eigen functions of L^2 and L_z using spherical harmonics, angular momentum and rotations. Total angular momentum J; LS coupling; eigenvalues of J^2 and J_z. Addition of angular momentum, coupled and uncoupled representation of eigenfunctions, Clebsch Gordan coefficient for $j_1 = j_2 = ½$ and $j_1 = 1$ and $j_2 = ½$. Angular momentum matrices, Pauli spin matrices, spin Eigen functions, free particle wave function including spin, addition of two spins.	**15**

Reference Books:

Main references:

1. Richard Liboff, Introductory Quantum Mechanics, 4th edition, Pearson.
2. D J Griffiths, Introduction to Quantum Mechanics 4th edition
3. A Ghatak and S Lokanathan, Quantum Mechanics: Theory and Applications, 5th edition.
4. N Zettili, Quantum Mechanics: Concepts and Applications, 2nd edition, Wiley.

Additional references:

1. W Greiner, Quantum Mechanics: An introduction, Springer, 2004
2. R Shankar, Principles of Quantum Mechanics, Springer, 1994
3. P.M. Mathews and K. Venkatesan, A Textbook of Quantum Mechanics, Tata McGraw Hill (1977).
4. J.J. Sakurai Modern Quantum Mechanics, Addison-Wesley (1994).

Program: Master of Science (Physics)				**Semester: I**	
Course:	**Solid State Physics**			**Course Code: PSMAPH104**	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week)	**Practical** (Hours per week)	**Tutorial** (Hours per week)	**Credit**	**Continuous Assessment and Evaluation (CAE) (Marks)**	**Term End Examinations (TEE) (Marks)**
4	--	-	4	25	75
Pre-requisite: Basic Knowledge of Material Science.					

Learning Objectives:

To familiarise the students with fundamentals of crystal structures of materials, concept of Brillouin zones, reciprocal lattice, and theory of diffractions and scattering of EM waves by crystals, Lattice vibrations and thermal properties, concept of phonon wave, theory diamagnetic and paramagnetic materials, superconductivity, and theory of ferromagnetism, magnetic ordering.

Course Outcomes:

After completion of the course, learners would be able to:

- **CO1:** Describe fundamentals of crystal structures of materials, magnetism and Thermodynamics of superconductors.
- **CO2:** Discus concept of Brillouin zones and reciprocal lattice. Discuss the Lattice Vibration and thermal properties of matter. Explain the magnetic ordering of materials
- **CO3:** Solve the problems covered in the topics.
- **CO4:** Investigate the various magnetic properties of materials. Investigate the Lattice Vibration and thermal properties of matter
- **CO5:** Asses the application of magnetism. Summarize the BCS theory.
- **CO6:** Derive the London equation and Josephson's equation. Derive the theory of magnetism. Derive the dispersive relation for various crystal lattice.

Outline of Syllabus: (per session plan)

Unit	Description	Duration
1	Diffraction of Waves by Crystals, Reciprocal Lattice, Lattice Vibrations and thermal properties.	**15**
2	Superconductivity	**15**
3	Diamagnetism and Paramagnetism	**15**
4	Magnetic Ordering	**15**
	Total	60

DETAILED SYLLABUS

Unit	Description	Duration
1	**Diffraction of Waves by Crystals and Reciprocal Lattice** Bragg law, Scattered Wave Amplitude – Fourier analysis, Reciprocal Lattice Vectors, Diffraction Conditions, Brillouin Zones, Reciprocal Lattice to SC, BCC and FCC lattice. Interference of Waves, Atomic Form Factor, Elastic Scattering by crystal, Ewald Construction, Structure Factor. **Lattice Vibrations and thermal properties:** Vibrations of Monoatomic Lattice, normal mode frequencies, dispersion relation. Lattice with two atoms per unit cell, normal mode frequencies, dispersion relation., Quanization of lattice vibrations, phonon momentum , Inelastic scattering of neutrons by phonons and thermal properties of solids.	**15**
2	**Superconductivity**: Experimental survey-Meissner effect, Heat capacity, energy gap, Microwave and IR properties, isotope effect, Thermodynamics of superconductors, London's Equations, coherence length, Highlights of BCS theory results-Persistent currents, Josephson superconductor tunneling High, temperature superconductors-literature survey of recent research.	**15**

3	**Diamagnetism and Paramagnetism:** Langevin diamagnetic equation, diamagnetic response, Quantum mechanical formulation, core diamagnetism. Quantum Theory of Paramagnetism, Rare Earth Ions, Hund's Rule, Iron Group ions, Crystal Field Splitting and Quenching of orbital angular momentum; Adiabatic Demagnetisation of a paramagnetic Salt, Paramagnetic susceptibility of conduction electrons;	**15**
4	**Magnetic Ordering:** Ferromagnetic order- Exchange Integral, Saturation magnetisation, Magnons, neutron magnetic scattering; Ferrimagnetic order, spinels, Yttrium Iron Garnets, Anti Ferromagnetic order. Ferromagnetic Domains – Anisotropy energy, origin of domains, transition region between domains, Bloch wall, Coercive force and hysteresis.	**15**

Reference Books:

1. Charles Kittel "Introduction to Solid State Physics", 7th edition John Wiley & sons.
2. N.W. Ashcroft and N.D. Mermin, Solid State Physics, Brooks/Cole
3. J.M. Ziman, Principles of the Theory of Solids, Cambridge University Press
4. A.J. Dekker, Solid State Physics, Macmillan
5. J.Richard Christman "Fundamentals of Solid State Physics" John Wiley & sons
6. M.A.Wahab "Solid State Physics –Structure and properties of Materials" Narosa Publications 1999.
7. M. Ali Omar "Elementary Solid State Physics" Addison Wesley (LPE)
8. H.Ibach and H.Luth 3rd edition "Solid State Physics – An Introduction to Principles of Materials Science" Springer International Edition (2004)

Program: Master of Science				**Semester : I**	
Course : Physics Practical-I				**Course Code: PSMAPHP112**	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week)	**Practical** (Hours per week)	**Tutorial** (Hours per week)	**Credit**	**Continuous Assessment and Evaluation (CAE) (Marks)**	**Term End Examinations (TEE) (Marks)**
--	8	-	4	20	80

Pre-requisite:

Knowledge of LCR meter, CRO and DSO. Instruments accuracy, precision, sensitivity, resolution range. Errors in measurements.

Learning Objectives:

4. To teach standard methods of performing practicals based on advanced Optics, Laser, and Electronics.
5. To familiarize with current and recent scientific and technological developments.

Course Outcomes:

On successful completion of this course students will be able to:

1. Plan and perform standard Physics experiments like Michelson Interferometer, Analysis of sodium spectrum, h/e by vacuum photocell,, Study of He-Ne laser- Measurement of divergence and wavelength, Susceptibility measurement by Quincke's method /Guoy's balance method, Absorption spectrum of specific liquids, Coupled Oscillations and various electronic experiment based on IC.
2. Demonstrate an understanding of laboratory procedures including safety, and scientific methods
3. Acquire practical skill in handling measuring equipment, electronic circuit analysis and data interpretations required to practically verify theoretical knowledge of Physics and transform it to real life applications in different area of science and technology.

DETAILS OF PRACTICALS		Duration
1.	**Regular Experiments:** **Group-A** 1. Michelson Interferometer: measurement of wavelength of light/thickness of glass plate.. 2. Analysis of sodium spectrum. 3. h/e by vacuum photocell. 4. Study of He-Ne laser- Measurement of divergence and wavelength. 5. Susceptibility measurement by Quincke's method /Guoy's balance method. 6. Absorption spectrum of specific liquids. 7. Coupled Oscillations. 8. Practicals using any programming language like Python/C++ or software like Matlab/Scilab/ Mathematica. Numerical Techniques: i) Midpoint method ii) Secant method iii) Trapozoidal Rule iv) Simposon's Rule v) Multidimension integration 9. Practicals using any programming language like Python/C++ or software like Matlab/Scilab/ Mathematica. Matrix Algebra: i) Finding the inverse of the matrix. ii) Matrix multiplication iii) Diagonalization of the matrix	Per Week 8 Hours

	iv) Finding the eigenvalues of the matrix 10. Practicals using any programming language like Python/C++ or software like Matlab/Scilab/ Mathematica. Differential equations: i) Euler method ii) Runge- Kutta method **Broup - B :** 1. Diac and Triac phase control circuit. 2. Delayed linear sweep using 1C 555 3. Regulated power supply using 1C LM 317 voltage regulator IC 4. Regulated dual power supply using IC LM 317 & 1C LM 337 voltage regulator ICs 5. Constant current supply using IC 741 and LM317. 6. Active filter circuits (second order) 7. Study of 4 digit multiplex display system.	

Reference Books:

1. Experiments in modern Physics – Mellissinos
2. Elementary experiments with Laser-G. White
3. HBCSE Selection camp 2007 Manual
4. Advanced Practical Physics – Worsnop & Flint.
5. Atomic spectra- H.E. White
6. Electronic text lab manual - P.B. Zbar
7. Electronic Principles - A. P. Malvino
8. Opeational amplifiers and linear Integrated circuits - Coughlin & Driscoll
9. Practical analysis of electronic circuits through experimentation - L.MacDonald
10. Integrated Circuits - K. R. Botkar
11. Op-amps and linear integrated circuit technology- R. Gayakwad

Note:

Minimum number of experiments to be performed and reported in the journal = 10 with minimum 4 experiments from each Group. Exemption of two experiments may be given if perform a mini project under the guidance on teacher in-charge of practical.

Program: Master of Science (Physics)				Semester : I	
Course : Physics Practical-II				Course Code: PSMAPHP134	
Teaching Scheme				Evaluation Scheme	
Lecture (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Assessment and Evaluation (CAE) (Marks - ______)	Term End Examinations (TEE) (Marks- ______ in Question Paper)
--	8	-	4	20	80

Pre-requisite:
Knowledge of LCR meter, DMM, CRO, DSO, instruments accuracy, precision, sensitivity, resolution range and Errors in measurements.

Learning Objectives:

1. To teach standard methods of performing practicals based on advanced material properties and Electronics.
2. To familiarize with current and recent scientific and technological developments.

Learning Outcomes:

On successful completion of this course students will be able to:

1. Plan and perform standard Physics experiments like carrier life time measurement, Four probe resistivity, Hall effect, magnetoresistance and various electronic experiment based on IC.
2. Demonstrate an understanding of laboratory procedures including safety, and scientific methods
3. Acquire practical skill in handling measuring equipment, electronic circuit analysis and data interpretations required to practically verify theoretical knowledge of Physics and transform it to real life applications in different area of science and technology.

DETAILS OF PRACTICALS		Duration
2.	**Regular Experiments:** **Group: A** 1. Carrier lifetime by pulsed reverse method 2. Resistivity by four probe method 3. Temperature dependence of avalanche and Zener breakdown diodes 4. DC Hall effect 5. Determination of particle size of lycopodium particles by laser diffraction method 6. Magneto resistance of Bi specimen 7. Microwave oscillator characteristics **Group: B**	Per Week 8 hours

1. Temperature on-off controller using IC
2. Waveform Generator using ICs
3. Instrumentation amplifier and its applications
4. Study of 8 bit DAC
5. 16 channel digital multiplexer
6. Study of elementary digital voltmeter

Reference Books:

1. Op-amps and linear integrated circuit technology by Gayakwad
2. Semiconductor electronics, Gibson.
3. Physics of semiconductor devices by S.M. Sze.
4. Digital principles and applications by Malvino and Leach
5. Digital circuit practice by RP Jain
6. Digital theory and experimentation using integrated circuits - Morris E. Levine (Prentice Hall)
7. Practical analysis of electronic circuits through experimentation - Lome Macronaid (Technical Education Press)
8. Logic design projects using standard integrated circuits - John F. Waker (John Wiley & sons)
9. Practical applications circuits handbook - Anne Fischer Lent & Stan Miastkowski (Academic Press)
10. Digital logic design, a text lab manual - Anala Pandit (Nandu printers and publishers Pvt.Ltd.)

Any other information :

Note:

1. Minimum number of experiments to be performed and reported in the journal = 10 with minimum 4 experiments from each Group. Certified journal is a must to be eligible to appear for the semester end practical.
2. Exemption of two experiments may be given if student carries out any one of the following activity.
    - Execute a mini project to the satisfaction of teacher in-charge of practical.
    - Participate in a study tour or visit & submit a study tour report.

SYLLABUS
MSC, PHYSICS, SEMESTER-II

Program: Master of Science (Physics)				Semester : II	
Course : Advanced Electronics				Course Code: PSMAPH201	
Teaching Scheme				Evaluation Scheme	
Lecture (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Assessment and Evaluation (CAE) (Marks - ______)	Term End Examinations (TEE) (Marks- _______ in Question Paper)
4	-	-	4	25	75

Pre-requisite:
Basic knowledge of Microprocessors and microcontrollers and Analog and digital signals.

Learning Objectives:

1. To teach the students concept of microprocessors and microcontrollers and its interfacing with electronic circuits.
2. To familiarize with current and recent scientific and technological developments.

Course Outcomes:
After completion of the course, learners would be able to:

CO1: Describe fundamentals of 8085 microprocessors, 8051 microcontroller their instruction set and programming language, signal conditioning. State and label power supply and inverters, instrumentation circuits and design.

CO2: Explain working of counters, timers and subroutine in 8085 and 8051, principle behind power supply and inverters, various circuits using OP-AMP, Digital and analog transmission system, optical fiber.

CO3: Use of instruction set in 8085 and 8051 to construct small assembly language programs. Examine and classify different types of power supply and inverters, digital and analog transmission system, apply various types of peripheral devices to interfacing circuits.

CO4: Analyze the various instrumentation of circuits and implement it on proto board. Inspect various Assembly language programs in 8085 and 8051. Op-Amp based circuits, optical fiber.

CO5: Summarize the instructions sets, flags, special function registers, power supply, inverters, signal conditioning circuits, various types of digital transmission system, and different types of optical fibers.

Design simple/interfacing circuits for commercial use in consumer and industrial applications, create small assembly language program for simple household applications.

Outline of Syllabus: (per session plan)

Unit	Description	Duration

1	**Microprocessors and Microcontrollers.**	**15**
2	**Analog and Data Acquisition Systems.**	**15**
3	**Data Transmissions, Instrumentations Circuits& Designs.**	**15**
4	**Instrumentation Circuit Interfacing and Designs**	**15**
	Total	**60**

DETAILED SYLLABUS :

Unit	Description	Duration
1	1. Microprocessors: Counters and Time Delays, Stack and Sub-routines 2. Introduction to Microcontrollers: Introduction, Microcontrollers and Microprocessors, History of Microcontrollers and Microprocessors, Embedded versus External Memory Devices, 8–bit and 16–bit Microcontrollers, CISC and RISC Processors, Harvard and Von Neumann Architectures, Commercial Microcontroller Devices. 3. 8051 Microcontrollers: Introduction, MCS–51 Architecture, Registers in MCS-51, 8051 Pin Description, Connections,8051 Parallel I/O Ports and Memory Organization. 4. 8051 Instruction set and Programming: MCS-51 Addressing Modes and Instruction set. 8051 Instructions and Simple programs using Stack Pointer.	**15**
2	1. Power Supplies: Linear Power supply, Switch Mode Power supply, Uninterrupted Power Supply, Step up and Step down Switching Voltage Regulators. 2. Inverters: Principle of voltage driven inversion, Principle of current driven inversion, sine wave inverter, Square wave inverter. 3. Signal Conditioning: Operational Amplifier, Instrumentation Amplifier using IC, Precision Rectifier, Voltage to Current Converter, Current to Voltage Converter, Op-Amp Based Butterworth Higher Order Active Filters and Multiple Feedback Filters, Voltage Controlled Oscillator, Analog Multiplexer, Sample and Hold circuits, Analog to Digital Converters, Digital to Analog Converters.	**15**
3	1. Data Transmission Systems: Analog and Digital Transmissions, Pulse Amplitude Modulation, Pulse Width Modulation, Time Division Multiplexing, Pulse Modulation, Digital Modulation, Pulse Code Format, Modems.	**15**

	2. Optical Fiber: Introduction to optical fibers, wave propagation and total internal reflection in optical fiber, structure of optical fiber, Types of optical fiber, numerical aperture, acceptance angle, single and multimode optical fibers, optical fiber materials and fabrication, attenuation, dispersion, splicing and fiber connectors, fiber optic communication system, fiber sensor, optical sources and optical detectors for optical fiber.	
4	Light Emitting Diodes (LED), Push Buttons, Relays and Latch Connections, Keyboard Interfacing, Interfacing 7-Segment Display, LCD interfacing. Measurement applications, Automation and Control Application. Optical analog communication system using fiber link. Electronic intensity meter using optical sensor. IR remote controlled ON/OFF switch.	**15**

Reference Books:

1. Microprocessor Architecture, Programming and Applications with the 8085 R. S. Gaonkar, 4th Edition. Penram International.
2. Microcontrollers Theory and Applications by Ajay V. Deshmukh.
3. The 8051 Microcontroller and Embedded Systems, Dr. Rajiv Kapadia, Jaico Publishing House.
4. The 8051 Microcontroller & Embedded Systems by M.A. Mazidi, J.G. Mazidiand R.D. Mckinlay
5. The 8051 Microcontroller: K.J.Ayala: Penram International
6. Programming & customizing the 8051 Mocrocontroller: Myke Predko, TMH
7. Power Electronics and its applications, Alok Jain, 2nd Edition, Penram International India.
8. Op-Amps and Linear Integrated Circuits - R. A. Gayakwad, 3rd Edition Prentice Hall India.
9. Operational Amplifiers and Linear Integrated Circuits, Robert F. Coughlin and Frederic F. Driscoll, 6th Edition, Pearson Education Asia.
10. Optical Fiber Communications, Keiser, G. Mcgraw Hill, Int. Student Ed.
11. Electronic Communication Systems; 4th. Ed. Kennedy and Davis, (Tata- McGraw. Hill, 2004.
12. Electronic Instrumentation, H.S. Kalsi, Tata-McGraw. Hill, 1999

Program: Master of Science (Physics)				**Semester : II**	
Course : Electrodynamics				**Course Code:PSMAPH202**	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week)	**Practical** (Hours per week)	**Tutorial** (Hours per week)	**Credit**	**Continuous Assessment and Evaluation (CAE) (Marks - ______)**	**Term End Examinations (TEE) (Marks- ______**

					in Question Paper)
4	-	-	4	25	75

Pre-requisite: Basic of Knowledge of electrostatics, Magnetostatics and Maxwell's Equation.

Learning Objectives: **Learning Objectives:**
Familiarizing students with the theoretical framework of Maxwell's equations, Maxwell equations in covariant notation, Electromagnetic waves in vacuum, Moving charges in vacuum, Radiations and its properties, Relativistic electrodynamics.

Course Outcomes:
After completion of the course, learners would be able to:

- **CO1:** Describe the Maxwellian stress tensor, Lorentz Transformations, Four Vectors and Four Tensors, Electromagnetic waves in vacuum and medium, boundary conditions. Relativistic covariant Lagrangian formalism.
- **CO2:** Explain gauge transformation, Lagrangian formalism for relativistic point charge, The energy-momentum tensor, Conservation laws.
- **CO3:** Application of charged particle to fields-radiation, Antennas, Radiation by multipole moments. Calculate Lagrangian formalism for relativistic system, tensors.
- **CO4:** Distinguish phase velocity and group velocity, Categorize fields in wave guides. Investigate relativistic charge particle in EM field, and energy momentum tensor, conservation law.
- **CO5:** Compare properties of multipole radiations. Evaluate conservation law.
- **CO6:** Derive expression for frequency dependence of conductivity, frequency dependence of polarizability, frequency dependence of refractive index for electromagnetic waves in matter, The Lienard- Wiechert potentials, Lagrangian formalism for relativistic charge particle in field.

Outline of Syllabus: (per session plan)

Unit	Description	Duration
1	**Maxwell's equations and Maxwellian stress tensors.**	15
2	**Electromagnetic waves in vacuum and matter**	15
3	**Electrodynamics of Moving charges**	15
4	**Relativistic covariant Lagrangian Formulations.**	15
	Total	60

DETAILED SYLLABUS

Unit	Description	Duration

1	Maxwell's equations, The Pointing vector, The Maxwellian stress tensor, Lorentz Transformations, Four Vectors and Four Tensors, The field equations and the field tensor, Maxwell equations in covariant notation.	**15**
2	Electromagnetic waves in vacuum, Polarization of plane waves. Electromagnetic waves in matter, frequency dependence of conductivity, frequency dependence of polarizability, frequency dependence of refractive index. Wave guides, boundary conditions, classification of fields in wave guides, phase velocity and group velocity, resonant cavities.	**15**
3	Moving charges in vacuum, gauge transformation, The time dependent Green function, The Lienard- Wiechert potentials, Leinard- Wiechert fields, application to fields-radiation from a charged particle, Antennas, Radiation by multipole moments, Electric dipole radiation, Complete fields of a time dependent electric dipole, Magnetic dipole radiation, , Larmor formula, Lienard's generalization of Larmor formula, bremsstrahlung and synchrotron radiation.	**15**
4	Relativistic covariant Lagrangian formalism: Covariant Lagrangian formalism for relativistic point charges. The energy-momentum tensor, Conservation laws	**15**

Reference Books:

Main Reference:

1. Greiner, Classical Electrodynamics (Springer- Verlag, 2000) (WG).
2. A. Heald and J.B. Marion, Classical Electromagnetic Radiation, 3rd edition (Saunders, 1983) (HM)

Additional references:

1. J.D. Jackson, Classical Electrodynamics, 4Th edition, (John Wiley & sons) 2005 (JDJ)
2. W.K.H. Panofsky and M. Phillips, Classical Electricity and Magnetism,2nd edition, (Addison - Wesley) 1962.
3. D.J. Griffiths, Introduction to Electrodynamics,2nd Ed., Prentice Hall, India,1989.
4. J.R. Reitz ,E.J. Milford and R.W. Christy, Foundation of Electromagnetic Theory, 4th ed., Addison -Wesley, 1993.
5. Y.K. Lim, Problems and Solutions on Electromagnetism (Major American Universities PH.D. Qualifying Questions and S), World Scientific Publishing Company (March 19, 1993).

Program: Master of Science (Physics)				Semester :II	
Course : Quantum Mechanics-II				Course Code: PSMAPH203	
Teaching Scheme				Evaluation Scheme	
Lecture (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Assessment and Evaluation (CAE) (Marks - ______)	Term End Examinations (TEE) (Marks- ______ in Question Paper)
4	--	-	4	25	75

Pre-requisite: Basic Knowledge of Quantum mechanics & Modern Physics.

Learning Objectives: Familiarizing students with the theoretical framework of perturbation techniques, scattering theory and relativistic quantum mechanics.

Course Outcomes:

After completion of the course, learners would be able to:

- **CO1:** Describe perturbation theories, approximations methods, quantum scattering theory, identical particles and relativistic quantum mechanics.
- **CO2:** Explain time independent and dependent perturbation theory, variational methods. WKB approximations
- **CO3:** Apply perturbation theory to remove degeneracy in energy states of quantum systems. applications to variation methods to simple potential problems
- **CO4:** Compare energy and scattering amplitude in lab and CM frame. Distinguish symmetric and antisymmetric wave functions, Bosons and fermions.
- **CO5:** Calculation of cross sections in first Born approximations. Evaluate the effect of external fields on quantum mechanical systems.
- **CO6:** Derive first and second order corrections of energy and eigenfunction. Derive the quantization rules using WKB approximation. Derive fermi Golden rule, The Klein Gordon and Dirac equations ,first order transition probability, Calculation of cross sections in first Born approximations, Scattering amplitude.

Outline of Syllabus: (per session plan)

Unit	Description	Duration
1	Perturbation Theory.	15
2	Approximation Methods	15

3	Scattering Theory.	15
4	Relativistic quantum Mechanics, Identical particles.	15
	Total	60

DETAILED SYLLABUS

Unit	Description	Duration
1	**Unit-I: Perturbation Theory.** Time independent perturbation theory: First order and second order corrections to the energy eigenvalues and Eigen functions. Degenerate perturbation Theory: first order correction to energy. Time dependent perturbation theory: Harmonic perturbation, Fermi's Golden Rule, sudden and adiabatic approximations, applications.	**15**
2	**Unit-II: Approximation Methods :** Variation Method: Basic principle, applications to simple potential problems, He- atom. WKB Approximation: WKB approximation, turning points, connection formulas, Quantization conditions, applications.	**15**
3	**Unit-III: Scattering Theory.** Laboratory and centre of mass frames, differential and total scattering cross-sections, scattering amplitude, Partial wave analysis and phase shifts, optical theorem, S-wave scattering from finite spherical attractive and repulsive potential wells, Born approximation	**15**
4	**Unit-IV: Relativistic quantum Mechanics, Identical particles.** 1. Identical Particles: Symmetric and antisymmetric wave functions, Bosons and Fermions, Pauli Exclusion Principle, slater determinant. 2. Relativistic Quantum Mechanics 3. The Klein Gordon and Dirac equations. Dirac matrices, spinors, positive and negative energy solutions physical interpretation. Nonrelativistic limit of the Dirac equation.	**15**

Reference Books:
Main references:

1. Richard Liboff, Introductory Quantum Mechanics, 4th edition, Pearson.
2. D J Griffiths, Introduction to Quantum Mechanics 4th edition
3. A Ghatak and S Lokanathan, Quantum Mechanics: Theory and Applications, 5th edition.
4. N Zettili, Quantum Mechanics: Concepts and Applications, 2nd edition, Wiley.

5. J. Bjorken and S. Drell, Relativistic Quantum Mechanics, McGraw-Hill (1965).

Additional References:

1. W Greiner, Quantum Mechanics: An introduction, Springer, 2004
2. R Shankar, Principles of Quantum Mechanics, Springer, 1994
3. P.M. Mathews and K. Venkatesan, A Textbook of Quantum Mechanics, Tata McGraw Hill (1977)
4. J.J. Sakurai Modern Quantum Mechanics, Addison-Wesley (1994).

Program: Master of Science (Physics)					**Semester: II**
Course: **Solid State Devices**					**Course Code: PSMAPH204**
Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week)	**Practical** (Hours per week)	**Tutorial** (Hours per week)	**Credit**	**Continuous Assessment and Evaluation (CAE) (Marks - ______)**	**Term End Examinations (TEE) (Marks- ______ in Question Paper)**
4	--	-	4	25	75

Pre-requisite: Knowledge of Basic Semiconductor Bipolar devices and Multilayer Devices.

Learning Objectives:

To understand the quantum Physics phenomenon behind the semiconductors diode, transistors and multilayer devices.

Learning Outcomes:

After completion of the course, students would be able to :

CO1: Understand fundamentals of energy structures in semiconductors, temperature dependent of carries properties in semiconductors, Carrier life time, Hall Effect, resistivity and carrier life time measurement, properties of P-N junctions, Varactor characteristics, solar cell, metal-semiconductor contacts, heterojunctions, Quantum well structure, field effect transistors, MESFET, MODFET, MOSFET and integrated circuits.
CO2: Classify the various semiconductor devices, intrinsic and extrinsic properties.
CO3: Solve the problems covered in the topic.
CO4: Investigate the various characteristic properties of the semiconductor devices.
CO5: Summarize the various properties and application of semiconductor devices
CO6: Construct various solid-state devices

Outline of Syllabus: (per session plan)

Unit	Description	Duration
1	**Semiconductor Physics**	**15**

2	**Semiconductor Devices I**	**15**
3	**Semiconductor Devices II**	**15**
4	**Semiconductor Devices III**	**15**
	Total	**60**
DETAILED SYLLABUS		
Unit	**Description**	**Duration**
1	**Semiconductor Physics**: Classification of Semiconductors; Crystal structure with examples of Si, Ge & GaAs semiconductors; Energy band structure of Si, Ge & GaAs; Extrinsic and compensated Semiconductors; Temperature dependence of Fermi-energy and carrier concentration. Drift, diffusion and injection of carriers; Carrier generation and recombination processes- Direct recombination, Indirect recombination, Surface recombination, Auger recombination; Applications of continuity equation-Steady state injection from one side, Minority carriers at surface, Haynes Shockley experiment, High field effects. Hall Effect; Four – point probe resistivity measurement; Carrier life time measurement by light pulse technique.	**15**
2	**Semiconductor Devices I:** p-n junction : Fabrication of p-n junction by diffusion and ion-implantation; Abrupt and linearly graded junctions; Thermal equilibrium conditions; Depletion regions; Depletion capacitance, Capacitance – voltage (C-V) characteristics, Evaluation of impurity distribution, Varactor; Ideal and Practical Current-voltage (I-V) characteristics; Tunneling and avalanche reverse junction break down mechanisms; Minority carrier storage, diffusion capacitance, transient behavior; Ideality factor and carrier concentration measurements; Carrier life time measurement by reverse recovery of junction diode;; p- i-n diode; Tunnel diode, Introduction to p-n junction solar cell and semiconductor laser diode.	**15**
3	**Semiconductor Devices II:** Metal – Semiconductor Contacts: Schottky barrier – Energy band relation, Capacitance- voltage (C-V) characteristics, Current-voltage (I-V) characteristics; Ideality factor, Barrier height and carrier concentration measurements; Ohmic contacts. Bipolar Junction Transistor (BJT): Static Characteristics; Frequency Response and Switching. Semiconductor heterojunctions, Heterojunction bipolar transistors, Quantum well structures.	**15**
4	**Semiconductor Devices III:**	**15**

	Metal-semiconductor field effect transistor (MESFET)- Device structure, Principles of operation, Current voltage (I-V) characteristics, High frequency performance. Modulation doped field effect transistor (MODFET); Introduction to ideal MOS device; MOSFET fundamentals, Measurement of mobility, channel conductance etc. from Ids vs, Vds and Ids vs Vg characteristics. Introduction to Integrated circuits.	

Reference Books:

1. S.M. Sze; Semiconductor Devices: Physics and Technology, 2nd edition, John Wiley, New York, 2002.
2. B.G. Streetman and S. Benerjee; Solid State Electronic Devices, 5th edition, Prentice Hall of India, NJ, 2000.
3. W.R. Runyan; Semiconductor Measurements and Instrumentation, McGraw Hill, Tokyo, 1975.
4. Adir Bar-Lev: Semiconductors and Electronic devices, 2nd edition, Prentice Hall, Englewood Cliffs, N.J., 1984.

Additional References:

1. Jasprit Singh; Semiconductor Devices: Basic Principles, John Wiley, New York, 2001.
2. Donald A. Neamen; Semiconductor Physics and Devices: Basic Principles, 3rd edition, Tata McGraw-Hill, New Delhi, 2002.
3. M. Shur; Physics of Semiconductor Devices, Prentice Hall of India, New Delhi, 1995.
4. Pallab Bhattacharya; Semiconductor Optoelectronic Devices, Prentice Hall of India, New Delhi, 1995.

Program: Master of Science (Physics)				**Semester : II**	
Course : **Physics Practical-I**				**Course Code: PSMAPHP212**	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week)	**Practical** (Hours per week)	**Tutorial** (Hours per week)	**Credit**	**Continuous Assessment and Evaluation (CAE) (Marks - ______)**	**Term End Examinations (TEE) (Marks- ______ in Question Paper)**
--	8	-	4	20	80

Pre-requisite:
Knowledge of LCR meter, CRO and DSO. Instruments accuracy, precision, sensitivity, resolution range. Errors in measurements.

Learning Objectives:

6. To teach standard methods of performing practicals based on advanced Optics, Laser, and Electronics.
7. To familiarize with current and recent scientific and technological developments.

Learning Outcomes:

On successful completion of this course students will be able to:

1. Design and perform standard Physics experiments like Zeeman Effect using Fabry-Perot etalon /Lummer — Gehrecke plate, Characteristics of a Geiger Muller counter and measurement of dead time, Ultrasonic Interferometry-Velocity measurements in different Fluids, Measurement of Refractive Index of, Liquids using Laser, I-V/ C-V measurement on semiconductor specimen, Double slit- Fraunhofer diffraction, .Determination of Young's modulus.
2. Acquire practical skill in handling measuring equipment, electronic circuit analysis and data interpretations required to practically verify theoretical knowledge of Physics and transform it to real life applications in different area of science and technology.

List of practicals:		Duration
	Regular Experiments: **Group: A** 1. Zeeman Effect using Fabry-Perot etalon /Lummer Gehrecke plate 2. Characteristics of a Geiger Muller counter and measurement of dead time 3. Ultrasonic Interferometry-Velocity measurements in different Fluids 4. Measurement of Refractive Index of Liquids using Laser 5. I-V/ C-V measurement on semiconductor specimen 6. Double slit- Fraunhofer diffraction (missing order etc.) 7. Determination of Young's modulus of metal rod by interference method **Group: B** 1. Adder-subtractor circuits using ICs 2. Study of Presettable counters- 74190 and 74193 3. TTL characteristics of Totempole, Open collector and tristate devices 4. Pulse width modulation for speed control of dc toy motor 5. Study of sample and hold circuit 6. Switching Voltage Regulator	**Per Week 8 hours**

Reference Books:

1. Op-amps and linear integrated circuit technology by Gayakwad
2. Digital principles and applications by Malvino and Leach
3. Digital circuit practice by RP Jain
4. Digital theory and experimentation using integrated circuits - Morris E. Levine (Prentice Hall)

5. Practical analysis of electronic circuits through experimentation - Lome Macronaid (Technical Education Press)
6. Logic design projects using standard integrated circuits - John F. Waker (John Wiley & sons)
7. Practical applications circuits handbook - Anne Fischer Lent & Stan Miastkowski (Academic Press)
8. Digital logic design, a text lab manual - Anala Pandit (Nandu printers and publishers Pvt.Ltd.)
9. Manual of experimental physics --EV-Smith c). Experimental physics for students - Whittle &. Yarwood
10. Sirohi-A course of experiments with He-NeLaser; Wiley Eastern Ltd

Note:

1. Minimum number of experiments to be performed and reported in the journal = 10 with minimum 4 experiments from each Group Certified journal is a must to be eligible to appear for the semester end practical.
2. Exemption of two experiments may be given if student carries out any one of the following activity.
   - Execute a mini project to the satisfaction of teacher in-charge of practical.
   - Participate in a study tour or visit & submit a study tour report.

Program: Master of Science				**Semester : II**	
Course : Physics Practical-II				**Course Code: PSMAPHP234**	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week)	**Practical** (Hours per week)	**Tutorial** (Hours per week)	**Credit**	**Continuous Assessment and Evaluation (CAE) (Marks)**	**Term End Examinations (TEE) (Marks)**
--	8	-	4	20	80

Pre-requisite:

Knowledge of LCR meter, CRO and DSO. Instruments accuracy, precision, sensitivity, resolution range. Errors in measurements.

Learning Objectives:

1. To teach standard methods of performing practicals based on advanced Optics, Laser, and Electronics.
2. To familiarize with current and recent scientific and technological developments.

Learning Outcomes:

On successful completion of this course students will be able to:

1. Design and perform standard Physics experiments like Barrier capacitance of a junction diode, Linear Voltage Differential Transformer, Faraday Effect-Magneto Optics etc, advanced analog and digital electronic experiments based on IC.

2. Acquire practical skill in handling measuring equipment, electronic circuit analysis and data interpretations required to practically verify theoretical knowledge of Physics and transform it to real life applications in different area of science and technology.

List of practicals:	Duration
Regular Experiments: **Group: A** **1.** Carrier Mobility by conductivity **2.** Dielectric constant and Verification of Curie-Weiss law **3.** Barrier capacitance of a junction diode **4.** Linear Voltage differential Amplifier **5.** Faraday-Magneto optic effect **6.** Energy Band gap by four probe method, with varying temperature. **Group: B** **1.** Shift registers **2.** Study of 8085 microprocessor Kit and execution of simple Programmes. **3.** Waveform generation using 8085 **4.** SID& SOD using 8085 **5.** Ambient Light control powerswitch **6.** Interfacing TTL with buzzers,relays, motors and solenoids. **7.** Precision rectifiers using OpAmp. **8.** Automatic gain and volume controller. **9.** DC-DC converter.	**Per Week 8 hours**

Reference Books:

1. Semiconductor electronic by Gibson
2. Electronic Instrumentation and measurements, W D Cooper
3. Electronic engineering by Millman Halkias
4. Manual of experimental Physics, E V Smith
5. Solid state Physics, Dekkar.
6. Experiments in digital principles-D.P. Leach
7. Digital principles and applications - Malvino and Leach
8. Microprocessor Architecture, Programming andApplications with the 8085 - R. S. Gaonkar
9. Microprocessor fundamentals- Schaum Series-Tokheim
10. Electronic Instrumentation H. S. Kalsi

Note:

1. Minimum number of experiments to be performed and reported in the journal = 10 with minimum 4 experiments from each Group. Certified journal is a must to be eligible to appear for the semester end practical.
2. Exemption of two experiments may be given if student carries out any one of the following activity.

- Execute a mini project to the satisfaction of teacher in-charge of practical.
- Participate in a study tour or visit & submit a study tour report.

EVALUATION PATTERN

The performance of the learner will be evaluated in two components. The first component will be a Continuous Assessment with a weightage of 25% of total marks per course. The second component will be a Semester end Examination with a weightage of 75% of the total marks per course. The allocation of marks for the Continuous Assessment and Semester end Examinations is as shown below:

a) Continuous Evaluation – 25% of the total marks per theory course:

Particulars	Percentage
Component I -Class test	15
Component II - Assignment / Project/ VIVA	10

b) Semester end Examination-75% of the total marks per theory course:

i) Duration – These examinations shall be of a duration of two and a half hours.

ii) Question paper pattern of semester end examination for M.Sc, Semester-I to IV, to be implemented from academic year 2020-21.

Q1.	**Attempt any Two.** (Questions on unit- I : Theory and problem solving)		**(Marks)**
	i)		09
	ii)		09
	iii)		09
Q2.	**Attempt any Two.** (Questions on unit- II : Theory and problem solving)		
	i)		09
	ii)		09
	iii)		09
Q3.	**Attempt any Two.** (Questions on unit- III: Theory and problem solving)		
	i)		09
	ii)		09
	iii)		09
Q4.	**Attempt any Two.** (Questions on unit- IV: Theory and problem solving)		
	i)		09
	ii)		09
	iii)		09
Q5	**Attempt any One.**		

	i)	(Questions on unit –I/unit- II : Short answer type question)	3
	ii)	(Questions on unit- III/unit- IV: Short answer type question)	3

c) Details of Semester-end examination for practical courses:

A candidate will be allowed to appear for the semester end practical examination only if the candidate submits a certified journal at the time of practical. The duration of the practical examination will be four hours. There will be two experiments, one long experiment of 60 marks and one short of 20 marks, through which the candidate will be examined in practical.

d) Details of Continuous Assessment for practical courses:

Practical Skill in performing experiments, data presentation, analysis and interpretation of results: (Marks:20)

Signature	Signature	Signature
HOD	Approved by Vice –Principal	Principal