Resolution No. : AC/II (22-23).2.RPS10

S.P. Mandali's
Ramnarain Ruia Autonomous College
(Affiliated to University of Mumbai)

Syllabus for PG
Program: Master of Science (M.Sc.) Physics
Program Code: RPSPHY

(As per the guidelines of NEP 2020 Academic Year 2024-25)

PROGRAM OUTCOMES

S. P. Mandali's Ramnarain Ruia Autonomous College has adopted the Outcome Based Education model to make its science graduates globally competent and capable of advancing in their careers. The Master's Program in Science also encourages students to reflect on the broader purpose of their education.

A student completing Master's Degree in Physics (Electronics-I) Program will be able to:	
GA No.	**Description**
GA1	Demonstrate in depth understanding in the relevant science discipline. Recall, explain, extrapolate and organize conceptual scientific knowledge for execution and application and also to evaluate its relevance.
GA2	Critically evaluate, analyse and comprehend a scientific problem. Think creatively, experiment and generate a solution independently, check and validate it and modify if necessary.
GA3	Access, evaluate, understand and compare digital information from various sources and apply it for scientific knowledge acquisition as well as scientific data analysis and presentation.
GA4	Articulate scientific ideas, put forth a hypothesis, design and execute testing tools and draw relevant inferences. Communicate the research. work in appropriate scientific language.
GA5	Demonstrate initiative, competence and tenacity at the workplace. Successfully plan and execute tasks independently as well as with team members. Effectively communicate and present complex information accurately and appropriately to different groups.
GA6	Use an objective, unbiased and non-manipulative approach.in collection and interpretation of scientific data and avoid plagiarism and violation of Intellectual Property Rights. Appreciate and be sensitive to environmental and sustainability issues and understand its scientific significance and global relevance.
GA7	Translate academic research into innovation and creatively design scientific solutions to problems. Exemplify project plans, use management skills and lead a team for planning and execution of a task.
GA8	Understand cross disciplinary relevance of scientific developments and relearn and reskill so as to adapt to technological advancements.

PROGRAM SPECIFIC OUTCOMES

A student completing Master's Degree in Physics (Electronics-I) Program will be able to:	
PO No.	**Description**
PO1	To demonstrate procedural knowledge related to different areas of study in Physics including Quantum Mechanics, Nuclear Physics, Electronics, Microprocessor and Microcontroller, Embedded Systems and RTOS.
PO2	To demonstrate comprehensive, quantitative and conceptual understanding of the core areas of Physics and keeping update with current developments in the academic field of Physics
PO3	To demonstrate the ability to use analytical skills in Physics and its related areas of technology to solve a wide range of problems including open ended problems associated with Physics.
PO4	Utilize contemporary experimental apparatus and analysis tools to acquire, analyse and interpret scientific data in the extents of Physics with reference to Research.
PO5	Plan and execute Physics-related experiments or investigations, analyse and interpret data collected using appropriate methods, and report accurately the findings relating to relevant theories of Physics.
PO6	Develop skills in areas related to specialization in the subfields of physics-Microprocessor, Microcontroller, VHDL, ARM7 and Python.
PO7	Demonstrate communication skills, to present complex information in a concise manner and develop personal skills such as the ability to work both independently and in a group.

PROGRAM OUTLINE

Year	Semester	Course Code	Course Title	Credits
2024-25	I	RPSPHY.O501 (Discipline Specific Core)	Mathematical Methods	3
		RPSPHYP.O501 (Discipline Specific Core)	Practical based on RPSPHYP.O501	1
		RPSPHY.O502 (Discipline Specific Core)	Classical Mechanics	3
		RPSPHYP.O502 (Discipline Specific Core)	Practical based on RPSPHYP.O502	1
		RPSPHY.O503 (Discipline Specific Core)	Solid State Physics	3
		RPSPHYP.O503 (Discipline Specific Core)	Practical based on RPSPHYP.O503	1
		RPSPHY.O504 (Discipline Specific Core)	Python Programming	2
		RPSRMPHY.O505	Research Methodology	4
		RPSPHY.O506 (Discipline Specific Elective Course)	Microprocessor 8085 and 8086	3
		RPSPHYP.O506 (Discipline Specific Elective Course)	Practical based on RPSPHYP.O506	1
		Total Credits		**22**
Year	**Semester**	**Course Code**	**Course Title**	**Credits**
2024-25	II	RPSPHY.E511 (Discipline Specific Core)	Electrodynamics	3
		RPSPHYP.E511 (Discipline Specific Core)	Practical based on RPSPHYP.E511	1
		RPSPHY.E512 (Discipline Specific Core)	Quantum Mechanics - I	3
		RPSPHYP.E512 (Discipline Specific Core)	Practical based on RPSPHYP.E512	1
		RPSPHY.E513 (Discipline Specific Core)	Solid State Devices	3
		RPSPHYP.E513 (Discipline Specific Core)	Practical based on RPSPHYP.E513	1
		RPSPHY.E514 (Discipline Specific Core)	Advanced Electronics	2
		RPSRMPHY.E515	OJT/FP – Project	4
		RPSPHY.E516 (Discipline Specific Elective Course)	Microcontroller 8051	3
		RPSPHYP.E516 (Discipline Specific Elective Course)	Practical based on RPSPHYP.E516	1
		Total Credits		**22**

Resolution No. : AB/II (20-21).2.RPS10

S.P. Mandali's
Ramnarain Ruia Autonomous College
(Affiliated to University of Mumbai)

RUIA COLLEGE
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Syllabus for
Program: Master of Science (M.Sc.) Physics
Program Code: RPSPHY

(As per the guidelines of NEP 2020 Academic Year 2024-25)

Course Code: RPSPHY.O501

Course Title: Mathematical Methods

Academic Year: 2024-25

Course Outcomes:

Course Outcome	Description
CO1	A Student should gain a deep understanding of foundational mathematical concepts relevant to physics, such as calculus (differentiation, integration, and their applications), linear algebra, complex analysis, and differential equations.
CO2	A Student should develop the ability to apply mathematical methods to solve complex physics problems. This involves selecting appropriate mathematical techniques, performing calculations accurately, and interpreting the results in the context of physical phenomena.
CO3	A Student should be able to work with complex numbers, understand the concept of analytic functions, and use techniques such as contour integration to solve physics problems involving complex variables.
CO4	A Student should be able to solve ordinary and partial differential equations commonly encountered in physics, including equations describing physical processes like diffusion, wave propagation, and quantum mechanics.
CO5	A Student should understand the principles of linear algebra, including vector spaces, matrices, determinants, eigenvalues, and eigenvectors. These concepts are important for describing linear transformations and solving systems of linear equations.
CO6	A Student should be familiar with Fourier series, Fourier transforms, and Laplace transforms, which are essential for analyzing periodic and transient phenomena in physics.

Detailed Syllabus

RPSPHY.O501: Mathematical Methods

Units	Title	Credits - 03
I	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 Lectures**
II	Matrices, Eigenvalues and Eigen vectors, orthogonal, unitary and Hermitian matrices, Diagonalization of Matrices, Applications to Physics problems. General treatment of second order linear differential equations with non-constant coefficients, Power series solutions, Frobenius method, Legendre, Hermite and Laguerre polynomials, Bessel equations, non-homogeneous equation, Green's function, Sturm-Liouville theory.	**15 Lectures**
III	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 Lectures**

Course Code: RPSPHYP.O501	Practical based on RPSPHY.O501	Credits/Hours
1	Numerical Integration: Trapezoidal Method, Simpson's $1/3^{rd}$ Rule	1
2	Solution of Transcendental or Polynomial Equations by Newton Raphson Method	1
3	Solution of Differential Equation by Runge Kutta Method	1
4	Jacobi Method of Matrix Diagonalization	1

Main References:

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 References:

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, J 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, 5th Ed. McGraw Hill.
8. A. W. Joshi, Matrices and Tensors in Physics, Wiley India.

Course Code: RPSPHY.O502

Course Title: Classical Mechanics

Academic Year: 2024-25

Course Outcomes:

Course Outcome	Description
CO1	Understand formalism of Lagrange equation and D' Alembert's Principle, Hamilton's principle, variation principle. Its application to mechanics of particles.
CO2	Comprehend Conservation theorems, Two-Body Central Force Problem, Scattering in a central force field.
CO3	Application of the differential equation to the problem of the orbit, The Kepler's problem: Inverse square law of force.
CO4	Evaluate Legendre transformations and the Hamilton equations of motion
CO5	Analysis of Small Oscillations using Eigen function and Eigen value
CO6	Analysis of Equations of motion using concepts of Canonical Transformations and Poisson brackets.
CO7	Demonstrate problem solving skills in all above areas

Detailed Syllabus

RPSPHY.O502: Classical Mechanics

Unit/s	Title	Credits - 03
I	Historical context and advantages of the Lagrangian approach. Comparison with Newtonian mechanics and Hamiltonian mechanics. Variational calculus and the principle of least action. Deriving Lagrange's equations and understanding their significance. Coordinate transformations and generalized coordinates. Handling holonomic and non-holonomic constraints. Kinematics and dynamics of rotational motion. Euler's equations of motion for rigid bodies. Hamilton's principle and its connection to Lagrangian mechanics. Noether's theorem and its application to derive conservation laws.	**15 Lectures**
II	Introduction to central force problems. Non-Inertial frames of reference and pseudoforces: Centrifugal, Coriolis and Euler forces. Gravitational force and the two-body problem. Transformation to relative coordinates. Deriving the effective potential and analyzing equilibrium points. The Virial Theorem. Solutions to the central force equation of motion. Properties of conic sections and Kepler's laws. Analysis of scattering in central force motion. Transformation of the scattering problem to laboratory coordinates. Small oscillations Normal mode analysis. Normal modes of a harmonic chain.	**15 Lectures**
III	Legendre Transformations, Hamilton's equations of motion and Hamiltonian function. 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. Canonical transformations and Poisson brackets. Hamiltonian formulation of continuous systems.	**15 Lectures**

Course Code RPSPHYP.O502	Practical based on RPSPHY.O502	Credits/Hours
1	Coupled Oscillations	**1**
2	Ultrasonic Interferometry-Velocity measurements in different Fluids	**1**
3	Transient Response of LCR Circuit	**1**
4	M.I of a Flywheel	**1**

Main References:

1. Classical Mechanics, H. Goldstein, Poole and Safko, 3rd Edition, Narosa Publication (2001)
2. Classical Mechanics, N. C. Rana and P. S. Joag. Tata McGraw Hill Publication.
3. Classical Mechanics, G. Aruldhas, Prentice Hall India Learning Private Limited (1 January 2008)

Additional References:

1. Classical Mechanics, S. N. Biswas, Allied Publishers (Calcutta).
2. Classical Mechanics, V. B. Bhatia, Narosa Publishing (1997).

3. Mechanics, Landau and Lifshitz, Butterworth, Heinemann.
4. Classical Mechanics, Vol I and II, E. A. Deslougue, John Wiley (1982).
5. Theory and Problems of Lagrangian Dynamics, Schaum Series, McGraw (1967).
6. Classical Mechanics of Particles and Rigid Bodies, K. C. Gupta, Wiley Eastern (2001)

Course Code: RPSPHY.O503

Course Title: Solid State Physics

Academic Year: 2024-25

Course Outcomes:

Course Outcome	Description
CO1	Get a brief idea about crystalline and amorphous substances, about lattice, unit cell, miller indices, reciprocal lattice, and concept of Brillouin zones and diffraction of x-rays by different crystalline materials.
CO2	Gain knowledge of lattice vibrations the basics of the optical and acoustic phonons in crystals.
CO3	Understand about different types of magnetism like diamagnetism and Paramagnetism. Quantum mechanical formulation of magnetism and application of Langevin diamagnetic equation.
CO4	Carry out the experiments based on the theory that they have learned to measure carrier lifetime, magnetic susceptibility, and dielectric constant. They will also employ to four probe methods to determine electrical conductivity and the Hall setup to determine the hall coefficient of semiconductor.
CO5	Demonstrate cautious problem-solving skills in all above areas.

Detailed Syllabus

RPSPHY.O503 - Solid State Physics

Units	Title	Credits - 03
I	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, Quantization of lattice vibrations, phonon momentum, Inelastic scattering of neutrons by phonons, Surface vibrations, Inelastic Neutron scattering. Anharmonic Crystal Interaction. Thermal conductivity–Lattice Thermal Resistivity, Umklapp Process, Imperfections.	**15 Lectures**
II	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 Lectures**
III	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, Blochwall, Coercive force and hysteresis.	**15 Lectures**

Course Code RPSPHYP.O503	Practical based on RPSPHY.O503	Credits/Hours
1	DC Hall Effect	**1**
2	Measurement of dielectric constant, Curie temperature and verification of Curie—Weiss law for ferroelectric material	**1**
3	Hysteresis Loop for a Ferromagnetic Material (B-H Curve)	**1**
4	Four Probe Method: Semiconductor Resistivity and Energy Band Gap	**1**

Main References:

1. Charles Kittel, "Introduction to Solid State Physics", 7th edition John Wiley & sons.
2. J. Richard Christman, "Fundamentals of Solid-State Physics", John Wiley & sons.
3. M.A. Wahab, "Solid State Physics –Structure and properties of Materials", Narosa Publications 1999.
4. M. Ali Omar, "Elementary Solid-State Physics", Addison Wesley (LPE).
5. H. Ibach and H. Luth, 3rd edition "Solid State Physics–An Introduction to Principles of Materials Science", Springer International Edition (2004)

Course Code: RPSPHY.O504

Course Title: Python Programming

Academic Year: 2024-25

Course Outcomes:

Course Outcome	Description
CO1	By the end of the course, students should be proficient in Python's basic syntax, including variables, data types, operators, and basic input/output operations.
CO2	Students should be proficient in using control structures such as loops (for, while) and conditional statements (if, elif, else) to control the flow of a program.
CO3	Students should be able to define and use functions in Python, understanding concepts such as function parameters, return values, and scope.
CO4	Students should develop the ability to break down problems into smaller, solvable components and translate these solutions into Python code, fostering algorithmic thinking and problem-solving skills.

Detailed Syllabus

RPSPHY.O504 - Python Programming

Unit	Title	Credits - 02
I	The Python Programming Language, Program Meaning, Debugging, Formal and Natural Languages, The first program. Values and types, Variables, Variable names and Keywords, Statements, Evaluating Expressions, Operators and Operands, Order of Operations, Operation on Strings, Composition, Comments. Functions Calls, Type Conversion, Type coercion, Math Functions, Composition, Adding New Functions, Definitions and Use, Flow of Execution, Parameters and Arguments, Variables and Parameters are local, Stack Diagrams, Functions with results.	**15 Lectures**
II	The modulus operator, Boolean expressions, Logical operators, Conditional execution Alternative execution, Chained conditionals, Nested conditionals, the return statement, Recursion, Stack diagrams for recursive functions Infinite recursion Keyboard input, return values Program development, Composition, Boolean functions, more recursion, Leap of faith, Checking types, Multiple assignment, The while statement Tables Two-dimensional tables Encapsulation.	**15 Lectures**

Main References:

1. Allen Downey, Jeffrey Elkner, Chris Meyers - Learning with PYTHON How to Think Like a Computer Scientist-CreateSpace (2009).

Course Code: RPSRMPHY.O505

Course Title: Research Methodology

Academic Year: 2024-25

Course Outcomes:

Course Outcome	Description
CO1	Describe the fundamental concepts and principles of research, including the research process and various research methodologies.
CO2	Demonstrate the ability to design research studies, including selecting appropriate research methods, variables, and data collection techniques.
CO3	Conduct a comprehensive literature review to identify gaps in existing research and formulate research questions or hypotheses.
CO4	Understand and apply ethical principles in research, including the responsible conduct of research, informed consent, and ethical considerations in data collection and analysis.
CO5	Collect and record data using various research methods, such as surveys, interviews, experiments, observations, or archival research.
CO6	Analyse and interpret research data using appropriate statistical or qualitative analysis techniques, depending on the research design.
CO7	Develop critical thinking skills to evaluate research articles, methodologies, and findings critically.

Detailed Syllabus

RPSRMPHY.O505 - Research Methodology

Units	Title	Credits - 03
I	Introduction to research and its significance, Research process and steps, Types of research (qualitative, quantitative, mixed methods), Ethical considerations in research Introduction to research design, Experimental, quasi-experimental, and non-experimental designs, Survey research design, Case study and ethnographic research design.	**15 Lectures**
II	Importance of literature review in research, Searching and evaluating relevant sources, Organizing and synthesizing literature, Writing a literature review, References, Abstraction of a research paper, Possible ways of getting, oneself abreast of current literature	**15 Lectures**
III	Results and Conclusions, Preparation of manuscript for Publication of Research paper, Presenting a paper in scientific seminar, Thesis writing. Structure and Components of Research Report, Types of Report: research papers, thesis, Research Project Reports, Pictures and Graphs, citation styles, writing a review of paper, Bibliography.	**15 Lectures**
IV	Statistical analysis and fitting of data: Introduction to Statistics – Probability, Conditional Probability, Poisson Distribution, Binomial Distribution and Properties of Normal Distributions, Estimates of Means and Proportions; Chi-Square Test, Association of Attributes. t-Test Anova- Standard deviation, Co-efficient of variations. Co-relation and Regression Analysis.	**15 Lectures**

Main References:

1. C.R. Kothari-Research Methodology Methods and Techniques-New Age Publications (Academic) (2009).
2. Data Analysis for Physical Sciences (Featuring Excel®) Les Kirkup, 2nd Edition, Cambridge University Press (2012), Chapters1-6 and 9.
3. Statistical Methods in Practice for scientists and Technologists, Richard Boddy and Gordon Smith, John Wiley & Sons (2009)

Course Code: RPSPHY.O505

Course Title: Microprocessor 8085 and 8086

Academic Year: 2024-25

Course Outcomes:

Course Outcome	Description
CO1	Understand the concepts of serial I/O, data communication and the 8085 Interrupt.
CO2	Understand the basic concepts of Programmable Peripheral and Interface Devices like 8255 and 8259A with microprocessor 8085.
CO3	Understand the basic of architecture and of 8086 microprocessor and basic assembly language programming of 8086
CO4	Get exposure to the simulators and software which. mimics the behavior of the microprocessors
CO5	Demonstrate the practical utility of microprocessor through experiments.
CO6	In the laboratory course, student will gain hands-on experience of the working and applications of the microprocessors.

Detailed Syllabus

RPSPHY.O505 - Microprocessor 8085 and 8086

Units	Title	Credits - 03
I	**Microprocessor 8085** Counters and Time Delays, Stack and Sub-routines. 8085 Interrupts: The 8085 Interrupt, 8085 Vectored Interrupts, Restart as Software Instructions, Additional I/O Concepts and Processes. Programmable Peripheral and Interface Devices: The 8255A Programmable Peripheral Interface.	**15 Lectures**
II	The 8259A Programmable Interrupt Controller, Direct Memory Access (DMA) and 8237 DMA Controller, the 8279 Programmable Keyboard/Display Interface Serial I/O and Data Communication: Basic Concepts in Serial I/O, Software Controlled Asynchronous Serial I/O, The 8085 Serial I/O lines: SOD and SID.	**15 Lectures**
III	**Microprocessor 8086:** Register organization of 8086, Architecture, Signal Descriptions of 8086, Physical Memory Organization, General Bus operation, I/O Addressing Capability, Special Processor Activities, Minimum mode 8086 system and timings, Maximum mode of 8086 system and timings. 8086 Instruction set and assembler directives: Machine Language Instructions Formats, addressing modes of 8086, Instruction set of 8086. Introduction to Stack, Stack structure of 8086, Interrupts and Interrupt Service Routines, Interrupt cycle of 8086, non-maskable interrupt, Maskable interrupt (INTR).	**15 Lectures**

Course Code RPSPHYP.O506	**Practical based on RPSPHY.O506**	**Credits/Hours**
1	Study of 8085 microprocessor Kit and execution of simple Programs	**1**
2	Wave form generation using 8085	**1**
3	SID & SOD using 8085	**1**
4	Study of 8085 interrupts (Vector Interrupt7.5)	**1**
5	Study of PPI8255 as Handshake I/O (mode1): interfacing switches, LED's.	**1**
6	8086 assembly language programming: Simple data manipulation programs. (8/16-bit addition, subtraction, multiplication, division, 8/16-bit data transfer, finding greatest/smallest number, finding positive/negative numbers, finding odd/even numbers, ascending/descending of numbers, converting BCD nos. into Binary using INT20, displaying a string of characters using INT20) Please note: Assembly language programming of 8086 may be done by operating PC in real mode by using 'Debug' program. Separate 8086 study kit not needed.	**1**

Main References:

1. Microprocessor Architecture, Programming and Applications with the 8085, R. S. Gaonkar,4thEdition, Penram International.
2. Microprocessor Architecture, Programming and Applications with the 8085 by Ramesh S. Gaonkar, Fifth Edition Penram International Publication (India) Pvt Ltd.
3. Advanced Microprocessors and Peripherals by a K. Rayand K.M. Bhurchandi Second Edition Tata McGraw– Hill Publishing Company Ltd. (AB)
4. 8086 Microprocessor: Programming and Interfacing K. J. Ayala, Penram International
5. Microprocessors and interfacing, programming and hardware, By Douglas V. Hall

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Modality of Assessment – DSC / DSE

Theory Examination Pattern:

A) Internal Assessment – 40% - 30 Marks

Sr. No.	Evaluation Type	Marks
1	Internal Class Test	20
2	Class Test/ Project / Assignment / Presentation	10
Total		**30**

B) External Examination (Semester End) - 60%- 45 Marks

Semester End Theory Examination:

1. Duration – The duration for these examinations shall be of **two hours**.
2. Theory question paper pattern:

Paper Pattern:

Question	Options	Marks	Questions Based on
Q1.	3 questions of 5 M each from 4 Questions OR 7/8 marks questions with option to any one	15	Unit - I
Q2.	3 questions of 5 M each from 4 Questions OR 7/8 marks questions with option to any one	15	Unit - II
Q3.	3 questions of 5 M each from 4 Questions OR 7/8 marks questions with option to any one	15	Unit - III
TOTAL		**45**	

Practical Examination Pattern:

A) **External Examination (Semester End)- 25 Marks**
Semester End Theory Examination:
3. Duration – The duration for these examinations shall be of **two hours**.
4. Practical question paper pattern:

Paper Pattern:

Question		Marks
1	Major Experiment	25
	TOTAL	**25**

Modality of Assessment – Research Methodology

Theory Examination Pattern:

A) Internal Assessment – 40% - 40 Marks

Sr. No.	Evaluation Type	Marks
1	Scientific Writing assignment (Abstract /Research Article)	20
2	Research Review/ Research Proposal Writing	20
Total		**40**

B) External Examination (Semester End) - 60%- 60 Marks

Semester End Theory Examination:

5. Duration – The duration for these examinations shall be of **two hours**.
6. Theory question paper pattern:

Paper Pattern:

Question	Options	Marks	Questions Based on
Q1.	3 questions of 5 M each from 4 Questions OR 7/8 marks questions with option to any one	15	Unit - I
Q2.	3 questions of 5 M each from 4 Questions OR 7/8 marks questions with option to any one	15	Unit - II
Q3.	3 questions of 5 M each from 4 Questions OR 7/8 marks questions with option to any one	15	Unit - III
Q4.	3 questions of 5 M each from 4 Questions OR 7/8 marks questions with option to any one	15	Unit - IV
TOTAL		**60**	

Overall Examination and Marks Distribution Pattern:

Course	RPSPHY.O501	RPSPHY.O502	RPSPHY.O503	RPSPHY.O504	RPSRMPHY.O505	RPSPHY.O506	Total

	I	E	T	I	E	T	I	E	T	I	E	T	I	E	T	I	E	T	
Theory	30	45	**75**	30	45	**75**	30	45	**75**	-	50	**50**	40	60	**100**	30	45	**75**	**450**

Course	**RPSPHYP.O501**	**RPSPHYP.O502**	**RPSPHYP.O503**	**RPSPHYP.O506**	**Total**
Practical	**25**	**25**	**25**	**25**	**100**

[Grand Total Marks: 550]

Course Code: RPSPHY.E511

Course Title: Electrodynamics

Academic Year: 2024-25

Course Outcomes:

Course Outcome	Description
CO1	Understand formalism of Maxwell's equations, Pointing vector. Its application to Lorentz Transformations.
CO2	Comprehend concept of Four Vectors and Four Tensors.
CO3	Developing formalism of electromagnetic waves propagation and its application in wave guide and resonant cavity –related to Fiber optics and laser
CO4	Evaluate moving charges in vacuum and application of Leinerd-Wiechert fields to fields-radiation from a charged particle, Antennas
CO5	Analysis of moving charges with application to dipole radiation-electric and magnetic.
CO6	Application of relativity concepts to electrodynamics.
CO 7	Demonstrate problem solving skills in all above areas.

Detailed Syllabus

RPSPHY.E511: Electrodynamics

Units	Title	Credits - 03
I	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 Lectures
II	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 Lectures
III	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. Relativistic covariant Lagrangian formalism: Covariant Lagrangian formalism for relativistic point charges, The energy-momentum tensor, Conservation laws.	15 Lectures

Course Code: RPSPHYP.E511	Practical based on RPSPHY.E511	Credits/Hours
1	Study of Antenna Trainer Kit	1
2	Pulse Width Modulation using IC555 Timer	1
3	Visualization of Fields in a Rectangular Waveguide (Simulation) Using MATLAB	1
4	Amplitude Modulation	1
5	Phase Lock Loop using PLL IC565	1

Main Reference:

1. W. Greiner, Classical Electrodynamics (Springer-Verlag,2000) (WG).
2. M. 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

Course Code: RPSPHY.E512

Course Title: Quantum Mechanics - I

Academic Year: 2024-25

Course Outcomes:

Course Outcome	Description
CO1	Understand the theory of quantum measurements, wave packets and uncertainty principle.
CO2	Understand the concepts of quantum mechanics like wave -function, momentum and energy operators, the Schrodinger equation, time dependent and time independent cases, probability density and the normalization techniques, Commutator algebra, their connection to uncertainty principle, solution to the eigen value problems, etc.
CO3	Develop skills on problem solving for One dimensional rigid box, three-dimensional rigid box and Harmonic oscillator.
CO4	Understand the formalism of modern quantum mechanics, Dirac notation, Hilbert space and matrix mechanisms.
CO5	Learn the Schrodinger equation solutions for Hydrogen atom, determine its eigen value and radial eigen functions, degeneracy, etc.
CO6	Understand the angular momentum operators, its Commutator relations, ladder operators, their eigen functions and eigen values, learn spin eigen functions, Pauli Spin matrices, and understand the addition of angular momentum.
CO7	Understand the Clebsch. -Gordon coefficients

Detailed Syllabus

RPSPHY.E512: Quantum Mechanics – I

Unit/s	Title	Credits - 03
I	Postulates of quantum mechanics, observables and operators, measurements, state function and expectation values, the time-dependent Schrodinger equation, time development of state functions, The Superposition principle, Commutator relations, complete set of commuting observables, conservation theorems and parity. Linear Vector Spaces and operators, Dirac notation, Hilbert space, Hermitian operators and their properties, Matrix mechanics: Basis and representations, unitary transformations, the energy representation.	15 Lectures
II	Gaussian wave packet, Schrodinger equation solutions: one dimensional problem: General properties of one-dimensional Schrodinger equation, Particle in a box, Harmonic oscillator by raising and lowering operators, one dimensional barrier problems, finite potential well. Orbital angular momentum operators in Cartesian and spherical polar coordinates. Commutation and uncertainty relations, spherical harmonics, two particle problem-coordinates relative to centre of mass,	15 Lectures
III	Hydrogen atom, eigen-values and radial eigen-functions, degeneracy, probability distribution. Ladder operators, eigen-values and eigen-functions of L2 and Lz using spherical harmonics, angular momentum and rotations. Total angular momentum J; L-S coupling; eigen-values of J2 and Jz. Addition of angular momentum, Clebsch-Gordan coefficient for j1=j2=½ and j1=1 and j2=½. Angular momentum matrices, Pauli spin matrices, free particle wave function including spin, addition of two spins.	15 Lectures

Course Code: RPSPHYP.E512	Practical based on RPSPHY.E512	Credits/Hours
1	Double Slit Fraunhoffer Diffraction (Missing Order)	1
2	Stefan's Law of Radiation	1
3	Diameter of Lycopodium Powder Particles using Diffraction.	1
4	Simulation Based Practical	1

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).

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Course Code: RPSPHY.E513

Course Title: Solid State Devices

Academic Year: 2024-25

Course Outcomes:

Course Outcome	Description
CO1	Study about P-N junction diodes its fabrication by different processes. Characteristics like I-V and C-V characteristics and evaluate the dependence of reverse saturation current on minority carrier concentration and forward diffusion current on potential barrier.
CO2	Learn about Metal- Semiconductor contacts like Schottky and Ohmic Contacts and its I-V and C-V characteristics
CO3	Describe the principle and analyse the operation of Bipolar Junction Transistors, MOSFETs, MODFETs, MESFETs and study its I-V and C-V characteristics.
CO4	Demonstrate cautious problem-solving skills in all above areas.
CO5	Carry out the experiments based on the theory that they have learnt to measure I-V, C-V characteristics on semiconductor specimen, carrier mobility by conductivity, barrier capacitance of a junction diode and Energy band gap.

Detailed Syllabus

RPSPHY.E513 - Solid State Devices

Units	Title	Credits - 03
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; Tunnelling and avalanche reverse junction breakdown mechanisms; Minority carrier storage, diffusion capacitance, transient behaviour; 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 Lectures**
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 hetero-junctions, Hetero-junction bipolar transistors, Quantum well structures.	**15 Lectures**
III	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.	**15 Lectures**

Course Code: RPSPHYP.E513	**Practical based on RPSPHY.E513**	**Credits/Hours**
1	Carrier Lifetime by Pulse Reverse Method	**1**
2	Barrier capacitance of a junction Diode	**1**
3	Input Output Characteristics of a BJT	**1**
4	N-Channel MOSFET Output and Transfer Characteristics	**1**
5	Delayed linear sweep using IC 555	**1**
6	Active filter circuits (second order)	**1**
7	Instrumentation amplifier and its applications	**1**
8	Shift registers	**1**

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, NewDelhi,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.

Course Code: RPSPHY.E514

Course Title: Advanced Electronics

Academic Year: 2024-25

Course Outcomes:

Course Outcome	Description
CO1	Analyse, explain the operation of ideal and non-ideal Op-Amps and identify the key characteristics of Op-Amps, such as gain, input impedance, and output impedance.
CO2	Gain knowledge regarding inverting and non-inverting amplifiers, active filter circuits, instrumentation amplifiers for signal conditioning applications.
CO3	Understand different types of Oscillators such as Wein Bridge Oscillator, RC Oscillator, Colpitts Oscillators, LC oscillators.
CO4	Learn about IC555 timers in astable, monostable, and bistable modes. Design and understand circuits that generate precise timing signals and oscillations.
CO5	Develop an understanding regarding the logic gates, combinational logic circuits Data Processing Circuit: Multiplexers, demultiplexers, decoder, encoder, parity generators.
CO6	Study about flip-flops, RS, JK, D, edge triggering, registers, SISO, SIPO, PISO, PIPO, application of shift registers, counters, asynchronous counters, synchronous counter, modulus of a counter, counter design, design of synchronous and asynchronous sequential circuits.

RPSPHY.E514 - Advanced Electronics

Unit	Title	Credits - 02

I	Differential Amplifier, Instrumentation and operational amplifiers; Op-Amp Circuits: Characteristics of ideal and practical op-amp; inverting, noninverting and differential amplifier, Basic characteristics with detailed internal circuit of IC Op-Amp; Active filters; Nonlinear amplifiers using Op-Amps-log amplifier, anti-log amplifier, regenerative comparators; ADC and DAC circuits; Op-amp based self-oscillator circuits- RC phase shift, Wien bridge, non-sinusoidal oscillators.	**15 Lectures**
II	Oscillators: sinusoidal oscillation, Wein Bridge Oscillator, RC Oscillator, Colpitts Oscillators, LC oscillators, Quartz crystals, the 555 timer, astable operation of the 555 timers, 555 circuit applications, the phase locked loop. Digital Principle and Digital Logic: logic gates, combinational logic circuits Data Processing Circuit: Multiplexers, demultiplexers, decoder, encoder, parity generator and checker, arithmetic circuits, adder, subtractors, clocks and timing circuits, 555 timer-astable, monostable, flip-flops, RS, JK, D, edge triggering, registers, SISO, SIPO, PISO, PIPO, application of shift registers, counters, asynchronous counters, synchronous counter, modulus of a counter, counter design, design of synchronous and asynchronous sequential circuits.	**15 Lectures**

Main References:

1. Malvino, A., Bates, D., Electronic Principles, McGraw-Hill, 2016.
2. Leach, D. P., Malvino, A. P. and Saha, G., Digital Principles and Applications, TMH, 2014.
3. Horowitz, P. and Hill, W., The Art of Electronics, CUP, 2016.
4. Op-Amps and Linear Integrated Circuits R. A. Gayakwad, 3rd Edition Prentice Hall India.
5. Operational Amplifiers and Linear Integrated Circuits, Robert F. Coughlin and Frederic F. Driscoll, 6th Edition, Pearson Education Asia.

Course Code: RPSPHY.E516

Course Title: Microcontroller 8051

Academic Year: 2024-25

Course Outcomes:

Course Outcome	Description
CO1	Understand the basic architecture and the assembly language programming of 8051controller & PIC microcontrollers
CO2	Understand the basics of 8051 serial communication and serial port programming in assembly language
CO3	Understand the basic programming of the microcontroller with and without the interrupt service request.
CO4	Acquire knowledge of microcontrollers and their role in I/0 port programming and their interface with peripherals.
CO5	Get exposure to the simulators and software which. mimics the behaviour of a mainframe microcontrollers
CO6	Demonstrate the practical utility of microcontrollers through experiments
CO7	In the laboratory course, student will gain hands-on experience of the working and applications of the microcontrollers.

Detailed Syllabus

RPSPHY.E516 – Microcontroller 8051

Units	Title	Credits - 03
I	Introduction, Microcontrollers and Microprocessors, History of Microcontrollers and Microprocessors, Embedded versus External Memory Devices, 8–bit and16–bit Microcontrollers, CISC and RISC Processors, Harvard and Von-Neumann Architectures, Commercial Microcontroller Devices. 8051 Microcontrollers: Introduction, MCS–51 Architecture, Registers in MCS-51, 8051 Pin Description, Connections,8051 Parallel I/O Ports and Memory Organization.	**15 Lectures**
II	8051 Instruction set and Programming: MCS-51 Addressing Modes and Instruction set. 8051 Instructions and Simple programs using Stack Pointer.	**15 Lectures**
III	Counters, Interrupts, Serial communication. Programming 8051 Timers, Counter Programming, Basics of Serial Communication, 8051 Connection to RS232, 8051 Serial Port Programming in assembly. 8051 Interrupts, Programming. Timer, interrupts Programming External hardware Interrupts, Programming the Serial Communication Interrupt, Interrupt Priority in 8051/52	**15 Lectures**

Course Code: RPSPHYP.E516	**Practical based on RPSPHY.E516**	**Credits/Hours**
	Microcontroller 8051 Programming	
1	8031/51 assembly language programming: Simple data manipulation programs. (8/16-bit addition, subtraction, multiplication, division,8/16-bit data transfer, cubes of nos., to rotate a 32- bit number, finding greatest/smallest number from a block of data, decimal/ hexadecimal counter)	
2	Study of IN and OUT port of 8031/51 by Interfacing switches, LEDs and Relays: to display bit pattern on LED's, to count the number of "ON" switches and display on LED's, to trip a relay depending on the logic condition of switches, event counter (using LDR and light source).	
3	Study of external interrupts (INT0/INT1) of 8031/51.	
4	Study of internal timer and counter in 8031/51.	
	Microcontroller 8051 Interfacing	
1	Interfacing 8-bit DAC with 8031/51 to generate waveforms: square, saw-tooth, triangular.	
2	Interfacing stepper motor with 8031/51: to control direction, speed and number of steps.	
3	Interface 8-bit ADC (0804) with 8031/51: to convert an analog signal into its binary equivalent.	

Main References:

1. The 8051 Microcontroller and Embedded Systems, Dr. Rajiv Kapadia, Jaico Publishing House.

2. The 8051 Microcontroller & Embedded Systems by M. A. Mazidi, J. G. Mazidi and R.D. McKinlay
3. The 8051 Microcontroller: K. J. Ayala: Penram International
4. Programming & customizing the 8051 Microcontroller: Myke Predko, TMH
5. The 8051 Microcontroller & Embedded Systems by M.A. Mazidi, J.G. Mazidi and R.D. McKinlay, Second Edition, Pearson (MMM)
6. Microcontrollers by Ajay V. Deshmukh, Tata-McGraw Hill Publication (AVD)

Modality of Assessment – DSC / DSE

Theory Examination Pattern:

C) Internal Assessment – 40% - 30 Marks

Sr. No.	Evaluation Type	Marks
1	Internal Class Test	20
2	Class Test/ Project / Assignment / Presentation	10
	Total	**30**

D) External Examination (Semester End) - 60%- 45 Marks

Semester End Theory Examination:

7. Duration – The duration for these examinations shall be of **two hours**.
8. Theory question paper pattern:

Paper Pattern:

Question	Options	Marks	Questions Based on
Q1.	3 questions of 5 M each from 4 Questions OR 7/8 marks questions with option to any one	15	Unit - I
Q2.	3 questions of 5 M each from 4 Questions OR 7/8 marks questions with option to any one	15	Unit - II
Q3.	3 questions of 5 M each from 4 Questions OR 7/8 marks questions with option to any one	15	Unit - III
	TOTAL	**45**	

Practical Examination Pattern:

A) External Examination (Semester End)- 25 Marks

Semester End Theory Examination:

9. Duration – The duration for these examinations shall be of **two hours**.
10. Practical question paper pattern:

Paper Pattern:

Question		Marks
1	Major Experiment	25
	TOTAL	**25**

Overall Examination and Marks Distribution Pattern:

Course	RPSPHY.E511			RPSPHY.E512			RPSPHY.E513			RPSPHY.E514			RPSPHY.E515			RPSPHY.E516			Total
	I	E	T	I	E	T	I	E	T	I	E	T	I	E	T	I	E	T	
Theory	30	45	75	30	45	75	30	45	75	-	50	50	-	100	100	30	45	75	450

Course	RPSPHYP. E511	RPSPHYP. E512	RPSPHYP. E513	RPSPHYP. E514	Total
Practical	25	25	25	25	100

[Grand Total: 550 Marks]

Ramnarain Ruia Autonomous College

(Affiliated to University of Mumbai)

Syllabus for MSc- PART II-SEM-III & IV

Program: M.Sc. (Physics) (Electronics I)

Program Code: RPSPHY

(Credit Based Semester and Grading System with effect from the academic year 2022-23)

Course Code: RPSPHY301

Course Title: Microcontroller 8051, PIC and Embedded System

Academic year 2022-23

Course Code	Title	Credits
RPSPHY301	**Microcontroller 8051, PIC and Embedded System**	04
Unit I	**8051 microcontroller:** (Review of 8051), Timer /Counters, Interrupts, Serial communication. Programming 8051 Timers, Counter Programming Basics of Serial Communication, 8051 Connection to RS232, 8051 Serial Port Programming in assembly. 8051 Interrupts, Programming. Timer interrupts Programming External hardware Interrupts, Programming the Serial Communication Interrupt, Interrupt Priority in 8051/52.	15 lectures
Unit II	**16C61/71 PIC Microcontrollers:** Overview and Features, PIC 16C6X/7X, PIC Reset Actions, PIC Oscillator Connections, PIC Memory Organization, PIC 16C6X/7X Instructions, Addressing Modes, I/O Ports, Interrupts in PIC 16C61/71, PIC 16C61/71 Timers, PIC 16C71 Analog-to-Digital Converter.	15 lectures
Unit III	**PIC 16F8XX Flash Microcontrollers**: Introduction, Pin Diagram, STATUS Register, Power Control Register (PCON), OPTION Register, Program memory, Data memory, I/O Ports Capture/Compare/PWM (CCP) Modules in PIC 16F877, Analog-to- Digital Converter. AVD – Ch. 10: 10.1, 10.2, 10.3, 10.4, 10.5, 10.6, 10.7, 10.10	15 lectures
Unit IV	**Embedded systems** Introduction to Embedded Systems: What is an embedded system, Embedded System v/s General Computing System, Classification of Embedded Systems, Major Application Areas of Embedded Systems, Purpose of Embedded Systems, Smart Running Shoes. SKV – Ch. 1: 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7 A Typical Embedded system: Core of the embedded system SKV–Ch.2:2.1	

	Characteristics and quality Attributes of Embedded Systems: Characteristics of an Embedded System, Quality Attributes of Embedded Systems SKV – Ch. 3: 3.1, 3.2 Embedded Systems-Application and Domain–Specific: Washing Machine, Automatic- Domain, Specific examples of embedded system SKV – Ch. 4: 4.1, 4.2 Design Process and design Examples: Automatic Chocolate Vending machine (ACVM), Smart Card, Digital Camera, Mobile Phone, A Set of Robots	

Main References:

1. The 8051 Microcontroller and Embedded Systems, Dr.Rajiv Kapadia, Jaico Publishing House.
2. The 8051 Microcontroller & Embedded Systems by M.A.Mazidi,J.G.Mazidi and R.D. Mckinlay
3. The 8051 Microcontroller: K.J.Ayala: Penram International.
4. Microcontrollers by Ajay V. Deshmukh, Tata-McGraw Hill Publication (AVD)
5. Introduction to embedded systems by ShibuK.V.,Sixth Reprint 2012,Tata McGraw-Hill (SKV)

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6. Embedded Systems Architecture, Programming and Design, by RajKamal, Second Edition, The McGraw-Hill Companies(RK)

Course Code: RPSPHY302

Course Title: Statistical Mechanics

Academic year 2022-23

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION
CO 1	Understand Statistical Basis of Thermodynamics, in particular ensemble Theory.
CO 2	Developing formalism of Canonical Ensemble, analysis with partition function
CO3	Comprehend concept of statistics of Para-magnetism, thermodynamics of magnetic systems..
CO 4	Developing formalism of Grand Canonical Ensemble
CO 5	Exploring physical significance of statistical quantities-Density and energy fluctuations
CO 6	Formulation of Quantum Statistics- Statistics of the various ensembles
CO7	Demonstrate problem solving skills in all above areas

DETAILED SYLLABUS

Course Code		Title	Credits
RPSPHY302	Unit	Statistical Mechanics	04
Unit I	I	The Statistical Basis of Thermodynamics-The macroscopic and the microscopic states, contact between statistics and thermodynamics, the classical ideal gas, The entropy of mixing and the Gibbs paradox, the enumeration of the microstates. Elements of Ensemble Theory-Phasespace of a classical system, Liouville's theorem and its consequences. The micro-canonical ensemble - Examples Quantum states and the phase space	15 lectures
Unit II	II	The Canonical Ensemble-Equilibrium between a system and a heat reservoir, a system in the canonical ensemble, physical significance of the various statistical quantities in the canonical ensemble, expressions of the partition function, the classical systems, energy fluctuations in the canonical ensemble, correspondence with the microcanonical ensemble, the equipartition theorem and the virial theorem, system of harmonic oscillators, statistics of paramagnetism, thermodynamics of magnetic systems.	15 lectures
Unit III	III	The Grand Canonical Ensemble-Equilibrium between a system and a particle-energy reservoir, a system in the grand canonical ensemble, physical significance of the various statistical quantities, Examples, Density and energy fluctuations in the grand canonical ensemble, correspondence with other ensembles.	15 lectures
Unit IV	IV	Formulation of Quantum Statistics-Quantum-mechanical ensemble theory: the density matrix, Statistics of the various ensembles, Examples, systems composed of indistinguishable particles, the density matrix and the partition function of a system of free particles. **Note:** 50% of time allotted for lectures to be spent in solving problems.	15 lectures

Main Reference:

Statistical Mechanics- R.K. Pathria & Paul D.Beale (ThirdEdition), Elsevier 2011– Chapter 1 to 5

Additional References:

1. Thermodynamics and Statistical Mechanics, Greiner, Neise and Stocker, Springer 1995.
2. Introduction to Statistical Physics, Kerson Huang,Taylor and Francis 2001.
3. Thermal and Statistical Physics, F Reif.
4. Statistical Physics, D Amit and Walecka.
5. Statistical Mechanics, Kerson Huang.
6. Statistical Mechanics, J.K.Bhattacharjee.
7. Non-equilibrium Statistical Mechanics, J.K.Bhattacharjee.
8. Statistical Mechanics, Richard Feynman.
9. Statistical Mechanics, Landau and Lifshitz.
10. Thermodynamics, H.B.Callen

Course Code: RPSPHY303

DSE 3 Title: ARM 7 processor and VHDL

Academic year 2022-23

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION
CO 1	Understand the basic of architecture of ARM7.
CO 2	Understand the basic assembly programming of ARM7.
CO3	Understand the basic programming of the microcontroller with and without the interrupt service request.
CO 4	Acquire knowledge of microcontrollers and their role in I/0 port programming and their interface with peripherals.
CO 5	Understand the basic Architecture of VHDL
CO 6	Understand the basic of VHDL programming with examples.
CO7	Acquire knowledge on how to simulate and implement combinational and sequential circuits using VHDL systems.

DETAILED SYLLABUS

Course Code	Title	Credits
RPSPHY303	**ARM 7 processor and VHDL**	**02**
Unit I	**The ARM Architecture:** The Acorn RISC Machine, Architectural inheritance, The ARM Programmer's model, ARM development tools. SF - Ch 2: 2.1, 2.2, 2.3, 2.4 **ARM Organization and Implementation:** 3–stage Pipeline ARM organization, ARM instruction execution, ARM implementation. SF - Ch 4: 4.1, 4.3, 4.4 **ARM Processor Cores**: ARM7TDMI SF – Ch 9: 9.1 only **ARM Assembly language Programming**: Data processing instructions, Data transfer instructions, Control flow instructions, Writing simple assembly language programs. SF – Ch 3: 3.1, 3.2, 3.3, 3.4	**15 lectures**
Unit II	**The ARM Instruction Set**: Introduction, Exceptions, Condition execution, Branch and Branch with Link (B,BL), Branch, Branch with Link and exchange (BX,BLX), Software Interrupt (SWI), Data processing instructions, Multiply instructions, Count leading zeros (CLZ), Single word and unsigned byte data transfer instructions, Half-word and signed byte data transfer instructions, Multiple register transfer instructions, Swap memory and register instructions (SWP), Status register to general register transfer instructions, General register to Status register transfer instructions SF–Ch 5:5.1,5.2,5.3,5.4,5.5,5.6,5.7,5.8,5.9,5.10,5.11,5.12,5.13,5.14,5.15 **The Thumb Instruction Set**: the Thumb bit in the CPSR, The Thumb programmer's model, Thumb branch instructions, Thumb software interrupt instruction, Thumb data processing instructions, Thumb single register data transfer instructions, Thumb multiple register data transfer instructions, Thumb breakpoint instruction, Thumb implementation, Thumb applications, Example and exercises.	**15 lectures**
III	**VHDL-I:**	**15 lectures**

	Introduction to VHDL: VHDL Terms, Describing Hardware in VHDL, Entity, Architectures, Concurrent Signal Assignment, Event Scheduling, Statement concurrency, Structural Designs, Sequential Behavior, Process Statements, Process Declarative Region, Process Statement Part, Process Execution, Sequential Statements, Architecture Selection, Configuration Statements, Power of Configurations. **DLP -Ch 1** **Behavioral Modeling**: Introduction to Behavioral Modeling, Transport Versus Inertial Delay, Inertial Delay, Transport Delay, Inertial Delay Model, Transport Delay Model, Simulation Deltas, Drivers, Driver Creation, Bad Multiple Driver Model, Generics, Block Statements, Guarded Blocks. **DLP -Ch 2**	
IV	**Sequential Processing**: Process Statement, Sensitivity List, Process Example, Signal Assignment Versus Variable Assignment, Incorrect Mux Example, Correct Mux Example, Sequential Statements, IF Statements, CASE Statements, LOOP statements, NEXT Statement, EXIT Statement, ASSERT Statement, Assertion BNF, WAIT Statements, WAIT ON Signal, WAIT UNTIL Expression, WAIT FOR time_expression, Multiple WAIT Conditions, WAIT Time-Out, Sensitivity List Versus WAIT Statement, Concurrent Assignment Problem, Passive Processes. **DLP -Ch 3**	

References :

1. The 8051 Microcontroller & Embedded Systems by M.A. Mazidi, J.G. Mazidi and R.D. Mckinlay, Second Edition, Pearson(MMM)
2. Microcontrollers by Ajay V. Deshmukh, Tata-Mcgraw Hill Publication (AVD)

M.Sc. (Physics) Practical Lab Course
Semester –III- RPSPHYP301-PROJECT

Semesters III and IV
Project guidelines and evaluation

1. Every student will have to complete one long project for both semesters- Semester III and Semester IV with six credits (150 marks) in each semester, in subject –Electronics, / Solid state electronics,/ solid state Physics,/ Material Science,/ Nanotechnology,/ Nuclear Physics.
2. Students have to submit two separate project reports of one long project for two semesters (III and IV)
3. **In each semester, project will be of 150 marks with 50% by internal evaluation and 50% by external evaluation.**
4. **In Semester III**- student will complete theoretical aspects of the project- consisting of the problem definition, literature survey, current status, objectives, and methodology.
5. **In semester IV**-student will complete experimental part related to Project –actual experimental work, results and analysis.
6. In case of electronic projects, use of readymade electronic kits available in the market should be avoided. The electronics project / models should be demonstrated during presentation of the project.
7. Maximum three students can do a joint project. Each one of them will submit a separate project report with details of the part only he/she has done. However, he/she can in brief (in a page one or two) mention in Introduction section of project report, what other group members have done.
8. **The project report should be file bound/spiral bound/hard bound and should have following format-**

Title Page/Cover page
Certificate endorsed by Project Supervisor and Head of Department
Declaration
Abstract of the project
Table of Contents
List of Figures
List of Tables
Chapters of Content –
Introduction and Objectives of the project
Experimental/Theoretical Methodology/Circuit/Model etc. details
Results and Discussion if any
Conclusions
References

Evaluation of Project by External/Internal examiner will be based on following criteria:

Semester-III - RPSPHYP301- Project-part-A

Assessment Criteria	Maximum marks
Defining the Problem	10
Literature Survey	10
Plan of the project/ Research design	15
Theoretical methodology	15
Significance and originality of the study/Society application	10
Conclusion	05
Presentation	10
Maximum marks by External examiner	**75**
Maximum marks by internal examiner/guide	**75**
Total marks	**150**

Sem-IV – RPSPHYP401Project-part-II

Assessment Criteria	Maximum marks
Introduction to experimental part of the project	10
Experimental procedure details	10
weekly progress of project work	15
results and discussion	20
Conclusion	05
Presentation	15
Maximum marks by External examiner	**75**
Maximum marks by internal examiner/guide	**75**
Total marks	**150**

M.Sc. (Physics) Practical Lab Course

Semester – III

RPSPHYP302 LAB COURSE 7— Digital Electronics

1.	Adder-subtractor circuits using ICs
2.	Study of 8 bit DAC
3.	8/16 channel digital multiplexer

RPSPHYP303 LAB COURSE 8-- Interfacing real world

1.	Temperature on-off controller using IC
2.	Study of IN and OUT port of 8031/51 by Interfacing -Event counter (using LDR and light source).
3.	Interfacing TTL with buzzers, relays, motors and solenoids

RPSPHYP304 DSE 3 LAB COURSE –ARM 7 and VHDL programming

1.	ARM 7 processor - Simple data manipulation programs (addition, subtraction, multiplication, division etc.)
2.	ARM 7 processor - Study of IN and OUT port of ARM7 by Interfacing switches, LEDs etc.
3.	ARM 7 processor -Study of Timer
4.	VHDL program to realize logic gates (AND,OR,NOT,NOR,NAND), half adder / full adder
5.	VHDL program to realize the following combinational designs: 2 to 4 decoder (OR 8 to 3 encoder without priority), 4 to 1 multiplexer (OR 1 to 4 de- multiplexer)
6.	VHDL program to realize the following: SR–Flip Flop / JK–Flip Flop / T – Flip Flop

Note _1:
Number of experiments to be performed and reported in the journal from LAB course7, and LAB courses 8 = 06. (3 from each Lab course)

Note _2:
Number of experiments to be performed from DSE-3 LAB course 5 experiments.

Note _3:

Minimum 9 +3 (DSE LAB course) =12 experiments should be reported in the journal, for appearing at the practical examination.

PRACTICAL BOOK/JOURNAL

The candidate shall prepare and submit for practical examination a certified Journal based on the practical course carried out under the guidance of a faculty member with minimum number of experiments as specified in the syllabus for each group.

The students are required to present a duly certified journal for appearing at the practical examination, failing which they will not be allowed to appear for the examination.

In case of loss of Journal and/ or Report, a Lost Certificate should be obtained from Head/ Coordinator / In-charge of the department on the basis of presenting record of lab readings in rough journal; failing which the student will not be allowed to appear for the practical examination.

MODALITY OF ASSESSMENT

Theory Examination Pattern:

A) Internal Assessment - 40% = 40 Marks.

Sr. No	Evaluation type	Marks
1	One Assignment/Case study/Project	10
2	One class Test (multiple choice questions / objective)	20
3	Active participation in routine class instructional deliveries.	10
	TOTAL	40

B) External examination - 60 %
Semester End Theory Assessment - 60 marks

i. Duration - These examinations shall be of **2- & 1/2-hours** duration.

ii. Paper Pattern:

1. There shall be 4 questions each of 15 marks. On each unit there will be one question.
2. All questions shall be compulsory with internal choice within the questions.

Questions	Options	Marks	Questions on
Q. 1	Any 1 out of 2	8	Unit I
Q.2	Any 1 out of 2	7	
Q.3	Any 1 out of 2	8	Unit II
Q.4	Any 1 out of 2	7	
Q.5	Any 1 out of 2	8	Unit III
Q.6	Any 1 out of 2	7	
Q.7	Any 1 out of 2	8	Unit IV
Q.8	Any 1 out of 2	7	
	TOTAL	60	

Semester III end Practical Examination Pattern:

RPSPHYP301	Project -External	75	
	Project -Internal	75	
	Total marks for Project Examination		**150**
RPSPHYP302	LAB COURSE 7	50	
RPSPHYP303	LAB COURSE 8	50	
RPSPHYP304	DSE 3 LAB course	50	
	Total marks for LAB course Examination		**150**
	Total marks for SEM end Practical examination		**300**

Overall Examination and Marks Distribution Pattern

Course	RPSPHY301			RPSPHY302			RPSPHY303			Total
	Int.	Ext.	Total	I	E	T	I	E	T	
Theory	40	60	**100**	40	60	**100**	40	60	**100**	**300**

Course	RPSPHYP301	RPSPHYP302	Total
Practicals	150	150	300

(GRAND TOTAL MARKS: 600)

Course Code: RPSPHY401

Course Title: Nuclear Physics

Academic year 2022-23

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION
CO 1	Understand all static properties of nuclei
CO 2	Formulate an expression for nuclear size, Deuteron problem and Fermi golden rule.
CO3	Acquire knowledge about the spin orbit interaction and selection rules.
CO 4	Differentiate between elementary particle and properties of neutrino.
CO 5	Compare and study of different nuclear models and nuclear reactions.
CO 6	Understand the basics of Quantum Electrodynamics and Quantum Chromodynamics.
CO7	Demonstrate quantitative problem-solving skills in all the topics covered.

DETAILED SYLLABUS

Course Code		Title	Credits

RPSPHY401	Unit	Nuclear Physics	04
Unit I	I	All static properties of nuclei (charge, mass, binding energy, size, shape, angular momentum, magnetic dipole momentum, electric quadrupole momentum, statistics, parity, isospin), Measurement of Nuclear size and estimation of R_0(mirror nuclei and mesonic atom method) Q-value equation, energy release in fusion and fission reaction. Deuteron Problem and its ground state properties, Estimate the depth and size of (assume)square well potential, Tensor for ceasan example of non-central force, nucleon-nucleon scattering-qualitative discussion on results, Spin-orbit strong interaction between nucleon, double scattering experiment. *Tutorials should include 3 problem solving session based on above mentioned topics	15 lectures
Unit II	II	(11 Lectures + 4 Tutorials) Review of alpha decay, Introduction to Beta decay and its energetic, Fermi theory: derivation of Fermi's Golden rule, Information from Fermi–curie plots, Comparative half- lives, selection rules for Fermi and G-T transitions. Gamma decay: Multipole radiation, Selection rules for gamma ray transitions, Gamma ray interaction with matter, and Charge-particle interaction with matter. *Tutorials should include 4 problem solving session based on above mentioned topics	15 lectures
Unit III	II I	(11 Lectures + 4 Tutorials) 1. Nuclear Models: Shell Model (extreme single particle): Introduction, Assumptions, Evidences, Spin-orbit interactions, Predictions including Schmidt lines, limitations, Collective model-Introduction to Nilsson Model. 2. Nuclear Reactions: Kinematics, scattering and reaction cross sections, Compound nuclear reaction, direct nuclear reaction. *Tutorials should include 4 problem solving session	15 lectures

		based on above mentioned topics	
Unit IV	IV	(11 Lectures + 4 Tutorials) Introduction to the elementary particle Physics, The Eight fold way, the Quark Model, the November revolution and aftermath, The standard Model, Revision of the four forces, cross sections, decays and resonances, Introduction to Quantum Eletrodynamics, Introduction to Quantum Chromodynamics. Weak interactions and Unification Schemes (qualitative description), Revision of Lorentz transformations, Four-vectors, Energy and Momentum. Properties of Neutrino, helicity of Neutrino, Parity, Qualitative discussion on Parity violation in beta decay and Wu's Experiment, Charge conjugation, Time reversal, Qualitative introduction to CP violation and TCP theorem. *Tutorials should include 4 problem solving session based on above mentioned topics	**15 lectures**

Main References:

1. Introductory Nuclear Physics, Kenneth Krane, Wiley India Pvt. Ltd.
2. Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles, Robert Eisberg and Robert Resnick, Wiley(2006)
3. Introduction to Elementary Particles, DavidGriffith, John Wiley and sons.

Other References:

1. Introduction to Nuclear Physics, H.A.Enge, Eddison Wesley
2. Nuclei and Particles, E.Segre, W.A.Benjamin
3. Concepts of Nuclear Physics, B.L.Cohen
4. Subatomic Particles, H.Fraunfelder and E.Henley, PrenticeHall
1. Nuclear Physics: Experimental and Theoretical, H.S.Hans, New Age International
2. Introduction to Nuclear and Particle Physics, A.Das & T.Ferbel, World Scientific
3. Introduction to high energy physics, D.H.Perkins, Addis on Wesley
4. Nuclear and Particle Physics, W.E.Burcham and M.Jones, Addison Wesley
5. Introductory Nuclear Physics, S.M.Wong, Prentice Hall.
6. Nuclear Physics: An Introduction, S.B.Patel, New Age International.
7. Nuclear Physics: S.N.Ghoshal
8. Nuclear Physics: Roy and Nigam

Course Code: RPSPHY402

Course Title: Atomic and Molecular Physics

Academic year 2022-23

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION
CO 1	Understand the different effects and the Exclusion principle.
CO 2	Formulate an expression for Einstein coefficients, dipole approximations with selection rules.
CO3	Acquire knowledge about the Central field and different coupling approximations.
CO 4	Differentiate between energy levels and orbital theories.
CO 5	Compare and study of different electronic spectra and molecule rotations.
CO 6	Explore and understand the basics of Raman, ESR and NMR Spectrometer. .

CO7	Demonstrate quantitative problem solving skills in all the topics covered.

DETAILED SYLLABUS

Course Code		Title	Credits
RPSPHY402	Unit	**Atomic & Molecular Physics**	04
Unit I	I	**Review***of one-electron eigen functions and energy levels of bound states, Probability density, Virial theorem. Fine structure of hydrogen atoms, Lamb shift. Hyper fine structure and isotope shift. (ER8-6) Linear and quadratic Stark effect in spherical polar coordinates. Zeeman effect in strong and weak fields, Paschen-Back effect.(BJ,GW) Schrodinger equation for two electron atoms: Identical particles, The Exclusion Principle. Exchange forces and the helium atom (ER), independent particle model, ground and excited states of two electron atoms.(BJ)	15 lectures
Unit II	II	The central field, Thomas-Fermi potential, the gross structure of alkalis (GW). The Hartree theory, ground	15 lectures

		state of multi-electron atoms and the periodic table (ER), The L-S coupling approximation, allowed terms in L-S coupling, fine structure in L-S coupling, relative intensities in LS coupling, j-j coupling approximation and other types of coupling(GW)	
Unit III	III	Interaction of one electron atoms with electromagnetic radiation: Electromagnetic radiation and its interaction with charged particles, absorption and emission transition rates, dipole approximation. Einstein coefficients, selection rules. Line intensities and lifetimes of excited state, line shapes and line widths. X-ray spectra. (BJ)	**15 lectures**
Unit IV	IV	Born-Oppenheimer approximation - rotational, vibrational and electronic energy levels of diatomic molecules, Linear combination of atomic orbitals (LCAO) and Valence bond (VB) approximations, comparison of valence bond and molecular orbital theories (GA,IL) **A)** Rotation of molecules: rotational energy levels of rigid and non-rigid diatomic molecules, classification of molecules, linear, spherical, symmetric and asymmetric tops. **B)** Vibration of molecules: vibrational energy levels of diatomic molecules, simple harmonic and anharmonic oscillators, diatomic vibrating rotator and vibrational-rotational spectra. **C)** Electronic spectra of diatomic molecules: vibrational and rotational structure of electronic spectra. (GA,IL) Quantum theory of Raman effect, Pure rotational Raman spectra, Vibrational Raman spectra, Polarization of light and the Raman effect, Applications General theory of Nuclear Magnetic Resonance (NMR). NMR spectrometer, Principle of Electron spin resonance ESR. ESR spectrometer.(GA,IL) (*Mathematical details can be found in BJ. The students are expected to be acquainted with them	**15 lectures**

		but not examined in these.)	

Reference:

1. Robert Eisberg and Robert Resnick, Quantum physics of Atoms, Molecules, Solids, Nuclei and Particles, John Wiley & Sons, 2nd ed, (ER)
2. B.H. Bransden and G. J. Joachain, Physics of atoms and molecules, Pearson Education 2nd ed, 2004 (BJ)
3. G. K. Woodgate, Elementary Atomic Structure, Oxford university press, 2nd ed, (GW).
4. G. Aruldhas, Molecular structure and spectroscopy, Prentice Hall of India 2nd ed, 2002 (GA)
5. Ira N. Levine, Quantum Chemistry, Pearson Education, 5th edition, 2003 (IL)

Additional reference:

1. Leighton, Principals of Modern Physics, McGraw hill
2. Igor I. Sobelman, Theory of Atomic Spectra, Alpha Science International Ltd. 2006
3. C. N. Banwell, Fundamentals of molecular spectroscopy, Tata McGraw-Hill, 3rd ed
4. Wolfgang Demtröder, Atoms, molecules & photons, Springer-Verlag 2006
5. SuneSvanberg, Atomic and Molecular Spectroscopy Springer, 3rd ed 2004
6. C.J. Foot, Atomic Physics, Oxford University Press, 2005 (CF)

Course Code: RPSPHYP403

Course Title: Solid State Devices

Academic year 2022-23

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION
CO 1	Understand crystal structures of different intrinsic semiconductors their energy band diagrams, importance of Fermi level in Direct and indirect bandgap semiconductors.
CO 2	Study about P-N junction diodes its fabrication by different processes. Characteristics like I-V and C-V characteristics and evaluate the dependence of reverse saturation current on minority carrier concentration and forward diffusion current on potential barrier.
CO3	Learn about Metal- Semiconductor contacts like Schottky and Ohmic Contacts and its I-V and C-V characteristics

CO 4	Describe the principle and analyze the operation of Bipolar Junction Transistors, MOSFETs, MODFETs, MESFETs and study its I-V and C-V characteristics.
CO 5	Demonstrate cautious problem solving skills in all above areas.
CO 6	Carry out the experiments based on the theory that they have learnt to measure I-V, C-V characteristics on semiconductor specimen, carrier mobility by conductivity, barrier capacitance of a junction diode and Energy band gap.

DETAILED SYLLABUS

Course Code		Title	Credits
RPSPHY403	Unit	**Solid State Devices**	04
Unit I	I	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 carrier surface, Haynes Shockley experiment, High field effects. Hall Effect; Four–point probe resistivity measurement; Carrier life time measurement by light pulse technique.	15 lectures
Unit II	II	**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 breakdown 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 lectures

Unit III	III	**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 hetero-junctions, Hetero-junction bipolar transistors, Quantum well structures.	**15 lectures**
Unit IV	IV	**Semiconductor Devices III:** 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 I_{ds} vs V_{ds} and I_{ds} vs V_g characteristics. Introduction to Integrated circuits.	**15 lectures**

Main References:

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, EnglewoodCliffs,N.J.,1984.

Additional References:

5. Jasprit Singh; Semiconductor Devices: Basic Principles, John Wiley, New York, 2001.
6. Donald A.Neamen; Semiconductor Physics and Devices: Basic Principles, 3rd edition, TataMcGraw-Hill,NewDelhi,2002.
7. M.Shur; Physics of Semiconductor Devices, Prentice Hall of India, New Delhi, 1995.
8. Pallab Bhattacharya; Semiconductor Optoelectronic Devices, Prentice Hall of India, New Delhi,1995.
9. S.M.Sze; Physics of Semiconductor Devices, 2nd edition, Wiley Eastern Ltd., New Delhi,1985.

M.Sc. (Physics) Practical Lab Course
Semester –IV- RPSPHYP401-PROJECT

Sem-IV – RPSPHYP401Project-part-II

Assessment Criteria	Maximum marks
Introduction to experimental part of the project	10
Experimental procedure details	10
weekly progress of project work	15
results and discussion	20
Conclusion	05
Presentation	15
Maximum marks by External examiner	**75**
Maximum marks by internal examiner/guide	**75**
Total marks	**150**

M.Sc. (Physics) Practical Lab Course

Semester – IV

RPSPHYP402 LAB COURSE 9-Semiconductor

1.	Resistivity / Energy band gap by four probe method
2.	DC Hall effect
3.	Carrier lifetime by pulsed reverse method

RPSPHYP403 LAB COURSE -10- Physics

1.	h/e by vacuum photocell
2.	Curie Weiss law
3.	Thermal diffusivity

RPSPHYP404 LAB COURSE -11- Control circuits

1.	Ambient Light control power switch.
2.	Diac-Triac phase control circuit
3.	Delayed linear sweep using 1C 555

Note _1:

Number of experiments to be performed and reported in the journal from LAB course 9, LAB course 10, and LAB course 11 = 09. (3 from each Lab course) Total 9 experiments should be reported in the journal, for appearing at the practical examination.

PRACTICAL BOOK/JOURNAL

The candidate shall prepare and submit for practical examination a certified Journal based on the practical course carried out under the guidance of a faculty member with minimum number of experiments as specified in the syllabus for each group.

The students are required to present a duly certified journal for appearing at the practical examination, failing which they will not be allowed to appear for the examination.

In case of loss of Journal and/ or Report, a Lost Certificate should be obtained from Head/ Coordinator / In-charge of the department on the basis of presenting record of lab readings in rough journal; failing which the student will not be allowed to appear for the practical examination.

MODALITY OF ASSESSMENT

Theory Examination Pattern:

B) Internal Assessment - 40% = 40 Marks.

Sr. No	Evaluation type	Marks

1	One Assignment/Case study/Project	10
2	One class Test (multiple choice questions / objective)	20
3	Active participation in routine class instructional deliveries.	10
	TOTAL	40

B) External examination - 60 %
Semester End Theory Assessment - 60 marks

iii. Duration - These examinations shall be of **2- & 1/2-hours** duration.

iv. Paper Pattern:

3. There shall be 4 questions each of 15 marks. On each unit there will be one question.
4. All questions shall be compulsory with internal choice within the questions.

Questions	Options	Marks	Questions on
Q. 1	Any 1 out of 2	8	Unit I
Q.2	Any 1 out of 2	7	
Q.3	Any 1 out of 2	8	Unit II
Q.4	Any 1 out of 2	7	
Q.5	Any 1 out of 2	8	Unit III
Q.6	Any 1 out of 2	7	
Q.7	Any 1 out of 2	8	Unit IV
Q.8	Any 1 out of 2	7	
	TOTAL	60	

Practical Examination Pattern:

RPSPHYP401	Project -External	75	
	Project -Internal	75	
	Total marks for Project Examination		**150**
RPSPHYP402	LAB COURSE 9	50	
RPSPHYP403	LAB COURSE 10	50	
RPSPHYP404	LAB COURSE 11	50	
	Total marks for LAB course Examination		**150**
	Total marks for SEM end Practical examination		**300**

Overall Examination and Marks Distribution Pattern

Course	RPSPHY401 (Marks)			RPSPHY402 (Marks)			RPSPHY403 (Marks)			Total (Marks)
	Int.	Ext.	Total	I	E	T	I	E	T	
Theory	40	60	**100**	40	60	**100**	40	60	**100**	**300**

LAB Course	RPSPHYP401 (Marks)	RPSPHYP402 (Marks)	RPSPHYP403 (Marks)	RPSPHYP404 (Marks)	Total (Marks)
Practical	**150**	**50**	**50**	**50**	**300**

(GRAND TOTAL MARKS: 600)