S.P. Mandali's

Ramnarain Ruia Autonomous College

Syllabus for M.Sc.

Program: P.G.

Course: Physics (Electronics I)

(Credit Based Semester and Grading System with effect from the academic year 2019–2020)

Course Structure & Distribution of Credits

M. Sc. in Physics Program 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 ~~a~~ 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 24 (twenty four) credits per semester and total 96 (ninety six) credits in four semesters. The course structure is as follows,

Theory Courses

	Paper-1	Paper-2	Paper-3	Paper-4
Semester-I	Mathematical Methods	Classical Mechanics	Quantum Mechanics I	Solid State Physics
Semester-II	Advanced Electronics	Electrodynamics	Quantum Mechanics-II	Solid State Devices
Semester-III	Statistical Mechanics	Nuclear Physics	Microcontroller & interfacing Course -1	Embedded & RTOs Course -2
Semester-IV	Experimental Physics	Atomic and Molecular Physics	Advanced Microprocessor & ARM – 7 Course -3	VHDL & Communication Interface Course -4

Practical Lab Courses

Semester-I	Lab Course -1	Lab Course -2
Semester-II	Lab Course -3	Lab Course -4
Semester-III	Project -1	Elective Lab Course-1
Semester-IV	Project -2	Elective Lab Course-2

The elective theory courses offered by College will be:

1. Microcontrollers and Interfacing
2. Embedded systems and RTOS

Semester I

M.Sc. in Physics Program for Semester-I consists of four theory courses and two Practical Lab courses. The details are as follows:

Theory Courses (4): 16 hours per week (One lecture of one hour duration)

Theory Paper	Subject	Lectures(Hrs.)	Credits
RPSPHY101	Mathematical Methods	60	04
RPSPHY102	Classical Mechanics	60	04
RPSPHY103	Quantum Mechanics-I	60	04
RPSPHY104	Solid State Physics	60	04
TOTAL		**240**	**16**

Practical lab courses (2): 16 hours per week

Practical Lab Course	Practical Lab Sessions (Hrs)	Credits
RPSPHYP101	**120**	**04**
RPSPHYP102	**120**	**04**

Semester II

M.Sc. in Physics Program for Semester-II consists of four theory courses and two Practical Lab courses. The details are as follows:

Theory Courses (4): 16 hours per week (One lecture of one hour duration)

Theory Paper	Subject	Lectures(Hrs.)	Credits
RPSPHY201	Advanced Electronics	60	04
RPSPHY202	Electrodynamics	60	04
RPSPHY203	Quantum Mechanics-II	60	04
RPSPHY204	Solid State Devices	60	04
TOTAL		**240**	**16**

Practical lab courses (2): 16 hours per week

Practical Lab Course	Practical Lab Sessions (Hrs)	Credits
RPSPHYP201	**120**	**04**
RPSPHYP202	**120**	**04**

Semester III

M.Sc. in Physics Program for Semester-III consists of four theory courses, one Practical Lab course and one Project course. The details are as follows:

Theory Courses (4): 16 hours per week (One lecture of one hour duration)

Theory Paper	Subject	Lectures(Hrs.)	Credits
RPSPHY301	Statistical Mechanics	60	04
RPSPHY302	Nuclear Physics	60	04
RPSPHY303	Microcontrollers and Interfacing	60	04
RPSPHY304	Embedded Systems and RTOS	60	04
	TOTAL	**240**	**16**

Project (1): 8 hours per week

Project	Course	Total Project Period (Hrs)	Credits
RPSPHYP301	Project -1	**120**	**04**

Practical lab course (1): 8 hours per week

Practical Lab Course	Course	Practical Sessions(Hrs)	Credits
RPSPHYP302	**Advanced Physics Lab-1**	**120**	**04**

Semester IV

M.Sc. in Physics Program for Semester-IV consists of four theory courses, one Practical Lab course and one Project course. The details are as follows:

Theory Courses (4): 16 hours per week (One lecture of one hour duration)

Theory Paper	Subject	Lectures(Hrs.)	Credits
RPSPHY401	Experimental Physics	60	04
RPSPHY402	Atomic and Molecular Physics	60	04
RPSPHYP403	Advanced Microprocessor and ARM 7	60	04
RPSPHYP404	VHDL and Communication Interface	60	04
	TOTAL	**240**	**16**

Project (2): 8 hours per week

Project	Course	Total Project Period (Hrs)	Credits
RPSPHYP401	Project -2	**120**	**04**

Practical lab course (1): 8 hours per week

Practical Lab Course	Course	Practical Sessions(Hrs)	Credits
RPSPHYP402	**Advanced Physics Lab-2**	**120**	**04**

The candidate shall be awarded the degree of *Master of Science in Physics* **(M. Sc. In Physics)** after completing the course and meeting all the evaluation criteria.

No.	Courses Chosen	Name appearing in the Statement of Marks	Name appearing in the Degree Certificate
1	RPSPHYP301, RPSPHYP302, RPSPHYP401, RPSPHYP402	M.Sc. in Physics (Electronics-I)	M.Sc. in Physics

2. Scheme of Examination and Passing:

1. This course will have 40% Term Work (TW) / Internal Assessment (IA) and 60% External Assessment (written examination of 2.5 Hours duration for each course paper and practical examination of 4 Hours duration for each practical). All external examinations will be held at the end of each semester and will be conducted by the University as per the existing norms.
2. Term Work / Internal Assessment - IA (40%) and theory examination (60%)- shall have separate heads of passing. For Theory courses, internal assessment shall carry
   40 marks and Semester-end examination shall carry 60 marks for each Theory Course.
3. To pass, a student has to obtain minimum grade point E or above separately in the IA and the external examination.
4. The University (external) examination for all Theory and Practical courses shall be conducted at the end of each Semester and the evaluation of Project course and Project Dissertation will be conducted at the end of the each Semester.
5. The candidates shall appear for external examination of 4 theory courses each carrying 60 marks of 2.5 hours duration and 2 practical courses(1 Practical Course and 1 Project Course in M.Sc. Part II) each carrying 100 marks at the end of each semester.
6. 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.
7. The candidate shall submit a Project Report / Dissertation for the Project Course at the end of each semester as per the guidelines given on above page.

3. Standard of Passing for University Examinations:

As per ordinances and regulations prescribed by the University for semester based credit and grading system.

4. Standard point scale for grading:

Marks	Grade Points	Grade	Performance
80.00 and Above	10	O	Outstanding
70 to 79.99	9	A+	Excellent

60 to 69.99	8	A	Very Good
55 to 59.99	7	B+	Good
50 to 54.99	6	B	Above Average
45 to 49.99	5	C	Average
40 to 44.99	4	D	Pass
Less Than 40	1	F	Fail

5. **Grade Point Average (GPA) calculation:**

1. GPA is calculated at the end of each semester after grades have been processed and after any grades have been updated or changed. Individual assignments / quizzes / surprise tests / unit tests / tutorials / practicals / project / seminars etc. as prescribed by University are all based on the same criteria as given above. The teacher should convert his marking into the Quality-Points and Letter-Grade.
2. Performance of a student in a semester is indicated by a number called Semester Grade Point Average (SGPA). It is the weighted average of the grade points obtained in all the subjects registered by the student during the semester

$$SGPA = \frac{\sum_{i=1} C_i P_i}{\sum_{i=1} C_i}$$

C_i = The number of credits earned in the i^{th} course of a semester.

P_i = Grade point earned in the i^{th} course

i = 1,2, … . n represents number of courses for which the student is registered.

3. The Final grade will be decided on the basis of Cumulative Grade Point Average (CGPA) which is weighted average of the grade points obtained in all the semesters registered by the learner.

$$CGPA = \frac{\sum_{j=1} C_j P_j}{\sum_{j=1} C_j}$$

C_j = The number of credits earned in the j^{th} course up to the semester for which the CGPA is calculated

P_j = Grade point earned in the j^{th} course*

j = 1,2, ... n represents number of courses for which the student is registered up to the semester for which the CGPA is calculated

*: A letter Grade lower than E in a subject shall not be taken into consideration for the calculation of CGPA

The CGPA is rounded up to the two decimal places.

Course Title: M.Sc. Physics (Electronics – I)

Academic year 2019-20

Learning Objectives:

Upon completion of this course, students would acquire the following knowledge & skills:

(1) The ability to apply the principles of physics to solve new and unfamiliar problems
(2) The ability to analyze and interpret quantitative results in the areas of physics
(3) The ability to use contemporary experimental apparatus and analysis tools to acquire, analyze and interpret scientific data
(4) The ability to communicate scientific results effectively in presentations or posters
(5) A comprehensive, quantitative and conceptual understanding of the core areas of physics, including mechanics, optics, thermodynamics, electrostatics, electrodynamics at a level attuned with graduate programs in physics at peer institutions.

M.Sc. Physics Theory Courses

SEMESTER I		
Course Code	**Title**	**Credits**
RPSPHY101	**Mathematical Methods**	**04**
Unit I	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 lectures**
Unit II	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 lectures**

Unit III	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 lectures**
Unit IV	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**
	Learning Outcomes: On successful completion of this course students will be able to: a) Understand the basic concepts of mathematical physics and their applications in physical situations b) Demonstrate quantitative problem solving skill in all the topics covered	

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
1. A.C. Bajpai, L.R. Mustoe and D. Walker, Advanced Engineering Mathematics, John

Wiley
2. E. Butkov, Mathematical Methods, Addison-Wesley
3. J. Mathews and R.L. Walker, Mathematical Methods of physics
4. P. Dennery and A. Krzywicki , Mathematics for physicists
5. T. Das and S.K. Sharma, Mathematical methods in Classical and Quantum Mechanics
6. R.V. Churchill and J.W. Brown, Complex variables and applications, V Ed. McGraw. Hill
7. A. W.Joshi, Matrices and Tensors in Physics, Wiley India

SEMESTER I		
Course Code	**Title**	**Credits**
PSPH102	**Classical Mechanics**	**04**
Unit I	Review of Newton's laws, 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 non-holonomic systems, Advantages of a variational principle formulation,	**15 lectures**
Unit II	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 lectures**
Unit III	Small Oscillations: Formulation of the problem, The eigenvalue equation and the principal axis transformation, Frequencies of free vibration and	**15 lectures**

	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.	
Unit IV	Canonical Transformations, Examples of canonical transformations, The symplectic approach to canonical transformations, Poissson 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 lectures**
	Learning Outcomes (1) Understand the concepts of Classical mechanics & to apply them to problems (2) Comprehend the basic concepts of mechanics & its applications in physical situation (3) Learn about situations in different problems (4) Demonstrate tentative problem solving skills in all above areas	

Main Text: Classical Mechanics, H. Goldstein, Poole and Safco, 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)

SEMESTER I		
Course Code	**Title**	**Credits**
PSPH103	**Quantum Mechanics – I**	**04**
Unit I	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. 2. 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 lectures**
Unit II	1. **Wave packet:** Gaussian wave packet, Fourier transform. 2. **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 lectures**

Unit III	**Schrodinger equation solutions: Three dimensional problems:** 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, radial equation for a spherically symmetric central potential, hydrogen atom, eigenvalues and radial eigenfunctions, degeneracy, probability distribution.	**15 lectures**
Unit IV	**Angular Momentum:** 1. Ladder operators, eigenvalues and eigenfunctions of L^2 and L_z using spherical harmonics, angular momentum and rotations. 2. Total angular momentum J; LS coupling; eigenvalues of J^2 and Jz. 3. Addition of angular momentum, coupled and uncoupled representation of eigenfunctions, Clebsch Gordan coefficient for $j_1 = j_2 = ½$ and $j_1 = 1$ and $j_2 = ½$. 4. Angular momentum matrices, Pauli spin matrices, spin eigenfunctions, free particle wave function including spin, addition of two spins.	**15 lectures**
	Learning Outcomes: On successful completion of this course students will be able to: (1) Understand the postulates of quantum mechanics and to understand its importance in explaining significant phenomena in Physics (2) Demonstrate quantitative problem solving skills in all the topics covered	

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).

SEMESTER I		
Course Code	**Title**	**Credits**
PSPH104	**Solid State Physics**	**04**
Unit I	***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, Temperature Dependence of the Reflection Lines, Experimental Techniques (Laue Method, Rotating Crystal Method, Powder Method) Scattering from Surfaces, Elastic Scattering by amorphous solids.	**15 lectures**
Unit II	*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, Surface vibrations, Inelastic Neutron scattering. Anharmonic Crystal Interaction. Thermal	**15 lectures**

	conductivity – Lattice Thermal Resistivity, Umklapp Process, Imperfections	
Unit III	***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**
Unit IV	***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 lectures**
	Learning Outcomes: On successful completion of this course, students will be able to: a. Understand the concepts of Solid State mechanics & Devices, how to apply them to problems b. Comprehend the basic concepts Solid State Physics & its applications in physical situation c. Demonstrate cautious problem solving skills in all above areas	

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)

M.Sc. (Physics) Practical Lab Course

Semester –I

Semester – I Lab-1

Course number: RPSPHYP101 (120 hours, 4 credits) Group A

	Experiment		Reference Books
1	Michelson Interferometer		Advanced Practical Physics -Worsnop and Flint
2	Analysis of sodium spectrum	a	Atomic spectra- H.E. White
		b	Experiments in modern physics – Mellissinos
3	h/e by vacuum photocell	a	Advance practical physics - Worsnop and Flint
		b	Experiments in modern Physics – Mellissinos
4	Study of He-Ne laser- Measurement of divergence and wavelength	a	A course of experiments with Laser - Sirohi
		b	Elementary experiments with Laser- G. White
5	Susceptibility measurement by Quincke's method /Guoy's balance method		Advance practical physics - Worsnop and Flint
6	Absorption spectrum of specific liquids		Advance practical physics - Worsnop and Flint
7	Coupled Oscillations		HBCSE Selection camp 2007 Manual

Group B:

Experiment	References
1 , Diac - Triac phase control circuit	a) Solid state devices- W.D. Cooper b) Electronic text lab manual - P.B. Zbar
2. Delayed linear sweep using 1C 555	a) Electronic Principles - A. P. Malvino
3. Regulated power supply using 1C LM 317 voltage regulator IC	a) Opeational amplifiers and linear Integrated circuits - Coughlin & Driscoll
	b) Practical analysis of electronic circuits through experimentation - L.MacDonald
4. Regulated dual power supply using IC LM 317 & 1C LM 337 voltage regulator ICs	a) Opeational amplifiers and linear Integrated circuits - Coughlin & Driscoll
	b) Practical analysis of electronic circuits through experimentation - L.MacDona ld
5. Constant current supply using IC 741 and LM317	Integrated Circuits - K. R. Botkar
6. Active filter circuits (second order)	a) Op-amps and linear integrated circuit technology- R.Gayakwad
	b) Operational amplifiers and linear integrated circuits - Coughlin &. Driscoll
7. Study of 4 digit multiplex display system	Digital Electronics - Roger Tokheim

Note: Minimum number of experiments to be performed and reported in the journal = 06 with minimum 3 experiments from each Group. i.e. Group A: 03 and Group B: 03

Semester –I Lab-2

Course number: PSPHP102 (120 hours, 4 credits) Group A

Experiment		References
1.	Carrier lifetime by pulsed reverse method	Semiconductor electronics by Gibson
2.	Resistivity by four probe method	Semiconductor measurements by Runyan
3.	Temperature dependence of avalanche and Zener breakdown diodes	a) Solid state devices - W.D. Cooper b) Electronic text lab manual - PB Zbar c) Electronic devices & circuits - Millman and Halkias
4.	DC Hall effect	a) Manual of experimental physics - E.V.Smith b) Semiconductor Measurements - Runyan c) Semiconductors and solid state physics - Mackelvy d) Handbook of semiconductors – Hunter
5.	Determination of particle size of lycopodium particles by laser diffraction method	a) A course of experiments with Laser - Sirohi b) Elementary experiments with Laser - G. White
6.	Magneto resistance of Bi specimen	Semiconductor measurements by Runyan
7.	Microwave oscillator characteristics	a) Physics of Semiconductor Devices by S.M.Sze

Group B:

Experiment		References
1.	Temperature on-off controller using IC	a) Op-amps and linear integrated circuit technology by Gayakwad
2.	Waveform Generator using ICs	a) Operational amplifiers and linear integrated circuits-— Coughlin & Driscoll b) Op-amps and linear integrated circuit technology : R. Gayakwad c) Opertional amplifiers : experimental manual C.B. Clayton
3.	Instrumentation amplifier and its applications	a) Operational amplifiers and linear integrated circuits - Coughlin &. Driscoll b) Integrated Circuits - K. R. Botkar
4.	Study of 8 bit DAC	a) Op-amps and linear integrated circuit technology — R. Gayakwad b) Digital principles and applications by Malvino and Leach
5.	16 channel digital multiplexer	a) Digital principles and applications by Malvino and Leach b) Digital circuit practice by RP Jain
6.	Study of elementary digital voltmeter	Digital Electronics by Roger Tokheim (5th Ed, page 371)

Note: Minimum number of experiments to be performed and reported in the journal = 06 with minimum 3 experiments from each Group. i.e. Group A: 03 and Group B: 03

Additional references:

1. Digital theory and experimentation using integrated circuits - Morris E. Levine (Prentice Hall)
2. Practical analysis of electronic circuits through experimentation - Lome Macronaid (Technical Education Press)
3. Logic design projects using standard integrated circuits - John F. Waker (John Wiley & sons)
4. Practical applications circuits handbook - Anne Fischer Lent & Stan Miastkowski (Academic Press)
5. Digital logic design, a text lab manual - Anala Pandit (Nandu printers and publishers Pvt. Ltd.)

Note:

1. Journal should be certified by the laboratory in-charge only if the student performs satisfactorily the minimum number of experiments as stipulated above. Such students, who do not have certified journals, will not be allowed to appear for the practical examinations.

2. Total marks for the practical examinations = 200

SEMESTER II		
Course Code	**Title**	**Credits**
RPSPHY201	**Advanced Electronics**	**04**
Unit I	***Microprocessors and Microcontrollers:*** 1. **Microprocessors:** Counters and Time Delays, Stack and Sub-routines RSG: Microprocessor Architecture, Programming and Applications with the 8085 : R. S. Gaonkar , 5th Edition, Penram International 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. AVD: Ch.1 3. **8051 Microcontrollers:** Introduction, MCS–51 Architecture, Registers in MCS-51, 8051 Pin Description, Connections,8051 Parallel I/O Ports and Memory Organization. AVD: Ch. 2, 3 4. **8051 Instruction set and Programming:** MCS-51 Addressing Modes and Instruction set. 8051 Instructions and Simple programs using Stack Pointer. AVD: Ch.4	**15 lectures**
Unit II	***Analog and Data Acquisition Systems:*** 1. **Power Supplies**: Linear Power supply, Switch Mode Power supply, Uninterrupted	**15 lectures**

	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.	
Unit III	***Data Transmissions, Instrumentations Circuits& Designs:*** 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. 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.	**15 lectures**

Unit IV	***Instrumentation Circuits and Designs:*** Microprocessors/ Microcontrollers based D C motor speed controller. Microprocessors /Microcontrollers based temperature controller. Electronic weighing single pan balance using strain gauge/ load cell. Optical analog communication system using fiber link. Electronic intensity meter using optical sensor. IR remote controlled ON/OFF switch.	**15 lectures**
	Learning Outcomes: On successful completion of this course students will be able to: a) Understand the basics of Microprocessors & microcontroller with their programming b) Understand the basic concepts of analog & data acquisition system c) Understand the basic concepts of Data Transmissions, Instrumentations Circuits& Designs d) Understand the basic concepts of Instrumentation Circuits and Designs e) Demonstrate quantitative problem solving skill in all the topics covered	

Reference Books:

1. Microprocessor Architecture, Programming and Applications with the 8085 R. S. Gaonkar, 4th Edition. Penram International.
2. The 8051 Microcontroller and Embedded Systems, Dr. Rajiv Kapadia, Jaico Publishing House.
3. The 8051 Microcontroller & Embedded Systems by M.A. Mazidi, J.G. Mazidi and R.D. Mckinlay
4. The 8051 Microcontroller: K.J. Ayala: Penram International
5. Programming & customizing the 8051 Microcontroller : Myke Predko, TMH
6. Power Electronics and its applications, Alok Jain, 2nd Edition, Penram

International India.
7. Op-Amps and Linear Integrated Circuits - R. A. Gayakwad , 3rd Edition Prentice Hall India.
8. Operational Amplifiers and Linear Integrated Circuits, Robert F. Coughlin and Frederic F. Driscoll, 6th Edition, Pearson Education Asia.
9. Optical Fiber Communications, Keiser, G. McGraw Hill, Int. Student Ed.
10. Electronic Communication Systems; 4th. Ed. Kennedy and Davis, (Tata-McGraw. Hill, 2004.
11. Electronic Instrumentation, H.S. Kalsi, Tata-McGraw. Hill, 1999

SEMESTER II		
Course Code	**Title**	**Credits**
RPSPHY202	**Electrodynamics**	**04**
Unit 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**
Unit 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**
Unit 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	**15 lectures**
Unit IV	Relativistic covariant Lagrangian formalism: Covariant Lagrangian formalism for relativistic point charges, The energy-momentum tensor, Conservation laws.	**15 lectures**

	Learning Outcomes: On successful completion of this course students will be able to: a) Understand the laws of electrodynamics and be able to perform calculations using them b) Demonstrate quantitative problem solving skill in all the topics covered	

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

SEMESTER II		
Course Code	**Title**	**Credits**
RPSPHY203	**Quantum Mechanics – II**	**04**
Unit I	***Perturbation Theory:*** Time independent perturbation theory: First order and second order corrections to the energy eigenvalues and eigenfunctions. Degenerate perturbation Theory: first order correction to energy. Time dependent perturbation theory: Harmonic perturbation, Fermi's Golden Rule, sudden and adiabatic approximations, applications.	**15 lectures**

Unit II	***Approximation Methods*** 1. Variation Method: Basic principle, applications to simple potential problems, He- atom. 2. WKB Approximation: WKB approximation, turning points, connection formulas, Quantization conditions, applications.	**15 lectures**
Unit III	***scatteringTheory*** 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 lectures**
Unit IV	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 lectures**
	Learning Outcomes: On successful completion of this course students will be able to: (1) Understand the postulates of quantum mechanics and to understand its importance in explaining significant phenomena in Physics (2) Demonstrate quantitative problem solving skills in all the topics covered	

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).

J.J. Sakurai Modern Quantum Mechanics, Addison-Wessley (1994).

SEMESTER II		
Course Code	**Title**	**Credits**
RPSPHY204	**Solid State Devices**	**04**
Unit 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 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 lectures**

Unit II	***Semiconductor DevicesI:*** 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 lectures**
Unit III	***Semiconductor DevicesII:*** 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	***Semiconductor Devices III:*** Metal-semiconductor field effect transistor (MESFET)- Device structure, Principles of operation, Current voltage (I-V) characteristics, High frequency performance.	**15 lectures**

	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.	
	Learning Outcomes: On successful completion of this course, students will be able to: a. Understand the basic laws of Solid State Physics and be able to perform calculations using them b. Comprehend the basic concepts Solid State Physics & its applications in physical situation c. Demonstrate cautious problem solving skills in all above areas	

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, 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.
5. S.M. Sze; Physics of Semiconductor Devices, 2nd edition, Wiley Eastern Ltd., New Delhi, 1985.

M.Sc. (Physics) Practical Lab Course Semester –II

Semester –II Lab-1

Course number: RPSPHYP201 (120 hours, 4 credits) Group A

Experiment	References
1. Zeeman Effect using Fabry-Perot etalon /Lummer — Gehrecke plate	a). Advance practical physics - Worsnop and Flint b). Experiments in modern physics - Mellissinos
2. Characteristics of a Geiger Muller counter and measurement of dead time	a). Experiments in modern physics:Mellissions b). Manual of experimental physics --EV-Smith c). Experimental physics for students - Whittle &. Yarwood
3. Ultrasonic Interferometry-Velocity measurements in different Fluids	Medical Electronics-Khandpur
4.Measurement of Refractive Index of Liquids using Laser	Sirohi-A course of experiments with He-Ne Laser; Wiley Eastern Ltd
5.I-V/ C-V measurement on semiconductor specimen	Semiconductor measurements - Runyan
6.Double slit- Fraunhofer diffraction (missing order etc.)	Advance practical physics - Worsnop and Flint
7.Determination of Young's modulus of metal rod by interference method	Advance practical physics - Worsnop and Flint (page 338)

Group B

Experiment	Reference
1.Adder-subtractor circuits using ICs	a) Digital Principles and applications-Malvino and Leach b) Digital circuit practice-R.P.Jain
2.Study of Presettable counters-74190 and 74193	a) Digital circuit practice-Jain & Anand b) Digital Principles and applications-Malvino and Leach c) Experiments in digital practice-Jain & Anand
3.TTL characteristics of Totempole, Open collector and tristate devices	a) Digital circuit practice-Jain & Anand b) Digital Principles and applications-Malvino and Leach
4.Pulse width modulation for speed control of dc toy motor	Electronic Instrumentation - H. S. Kalsi
5. Study of sample and hold circuit	Integrated Circuits - K. R. Botkar
6. Switching Voltage Regulator	

Note: Minimum number of experiments to be performed and reported in the journal = 06 with minimum 3 experiments from each Group. i.e. Group A: 03 and Goup B: 03

Semester –II Lab-2

Course number: RPSPHYP202 (120 hours, 4 credits)

Group A

Experiment	References
1. Carrier mobility by conductivity	Semiconductor electronics - Gibson
2. Measurement of dielectric constant, Curie temperature and verification of Curie— Weiss law for ferroelectric material	a) Electronic instrumentation & measurement : W. D. Cooper b) Introduction to solid state physics - C. Kittel c) Solid state physics — A. J. Dekkar
3. Barrier capacitance of a junction diode	Electronic engineering - Millman Halkias
4. Linear Voltage Differential Transformer	Electronic Instrumentation - W.D. Cooper
5.Faraday Effect-Magneto Optic Effect: a) To Calibrate Electromagnet b) To determine Verdet's constant for KCI & KI solutions.	a) Manual of experimental physics: E.V. Smith b) . Experimental physics for students: Whittle & Yarwood
6. Energy Band gap by four probe method	Semiconductor measurements — Runyan
7. Measurement of dielectric constant(Capacitance)	

Group B

Experiment	References
1. Shift registers	a) Experiments in digital principles-D.P. Leach b) Digital principles and applications - Malvino and Leach
2. Study of 8085 microprocessor Kit and execution of simple Programmes	a) Microprocessor Architecture, Programming and Applications with the 8085 - R. S. Gaonkar b) Microprocessor fundamentals- Schaum Series- Tokheim c) 8085 Kit User manual
3. Waveform generation using 8085	a) Microprocessor Architecture, Programming and Applications with the 8085 - R. S. Gaonkar b) Microprocessor fundamentals- Schaum Series- Tokheim
4. SID& SOD using 8085	a) Microprocessor Architecture, Programming and Applications with the 8085 - R. S. Gaonkar b) Microprocessor fundamentals- Schaum Series- Tokheim c) 8085 Kit User manual
5. Ambient Light control power switch	a) Electronic Instrumentation H. S. Kalsi b) Helfrick & Cooper, PHI
6. Interfacing TTL with buzzers, relays, motors and solenoids	Digital Electronics by Roger Tokheim

Note: Minimum number of experiments to be performed and reported in the journal = 06 with minimum 3 experiments from each Group. i.e. Group A: 03 and Goup B: 03

Additional references:

1. Digital theory and experimentation using integrated circuits - Morris E. Levine (Prentice Hall)
2. Practical analysis of electronic circuits through experimentation - Lome Macronaid (Technical Education Press)
3. Logic design projects using standard integrated circuits - John F. Waker (John Wiley & sons)
4. Practical applications circuits handbook - Anne Fischer Lent & Stan Miastkowski (Academic Press)

5. Digital logic design, a text lab manual - Anala Pandit (Nandu printers and publishers Pvt. Ltd.)

Note:

1. Journal should be certified by the laboratory in-charge only if the student performs satisfactorily the minimum number of experiments as stipulated above. Such students, who do not have certified journals, will not be allowed to appear for the practical examinations.
2. Total marks for the practical examinations = 200

SEMESTER III		
Course Code	**Title**	**Credits**
RPSPHY301	**Statistical Mechanics**	**04**
Unit 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 - Phase space 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	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	The Grand Canonical Ensemble - Equilibrium between a system and a particle-energy	**15 lectures**

	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.	
Unit 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**
	Learning Outcomes: On successful completion of this course, students will be able to: a. Understand the concepts of Classical statistical mechanics how to apply them to problems b. Comprehend the basic concepts of Quantum statistical mechanics & its applications in physical situation c. Learn about situations of different systems d. Demonstrate cautious problem solving skills in all above areas	

Main Reference:

Statistical Mechanics - R. K. Pathria & Paul D. Beale (Third Edition), Elsevier 2011 – Chap. 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

SEMESTER III		
Course Code	**Title**	**Credits**
PSPH302	**Nuclear Physics**	**04**
Unit 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 force as an 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	(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,	**15 lectures**

	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	
Unit III	(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 based on above mentioned topics	**15 lectures**
Unit 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,	**15 lectures**

	Qualitative introduction to CP violation and TCP theorem. *Tutorials should include 4 problem solving session based on above mentioned topics	
	Learning Outcomes: On successful completion of this course, students will be able to: a. Understand the concepts of Nuclear Physics how to apply them to problems b. Comprehend the basic concepts of dacays& its applications in physical situation c. Demonstrate cautious problem solving skills in all above areas	

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, David Griffith, 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, Prentice Hall
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, Addison 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

SEMESTER III		
Course Code	**Title**	**Credits**
RPSPHY303	**Microcontrollers and Interfacing**	**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. Ref. MMM: - The 8051 Microcontroller & Embedded Systems by M.A. Mazidi, J.G. Mazidi and R.D. Mckinlay, Second Edition, Pearson Ref. AVD: -The 8051 Microcontroller	**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 16C61/71Timers, PIC 16C71 Analog-to-Digital Converter. Ref. AVD: - Microcontrollers by Ajay V. Deshmukh, Tata-Mcgraw Hill Publication	**15 lectures**

Unit III	**PIC 16F8XX Flash Microcontrollers:** Introduction, Pin Diagram, STATUS Register, Power Control R AVD – Ch 10: 10.1, 10.2, 10.3, 10.4, 10.5, 10.6, 10.7, 10.10 Capture/Compare/PWM (CCP) Modules in PIC 16F877, Analog-to-Digital Converter AVD – Ch 11: 11.1, 11.2, 11.5 Ref. AVD: - Microcontrollers by Ajay V. Deshmukh, Tata-Mcgraw Hill Publication	**15 lectures**
Unit IV	**Interfacing microcontroller/PIC microcontroller and Industrial Applications of microcontrollers:** Light Emitting Diodes (LEDs); Push Buttons, Relays and Latch Connections; Keyboard Interfacing; Interfacing 7-Segment Displays; LCD Interfacing; ADC and DAC Interfacing with 89C51 Microcontrollers. Introduction and Measurement Applications (For DC motor interfacing and PWM refer Sec 17.3 of MMM) Ref: AVD: -Microcontrollers by Ajay V. Deshmukh, Tata-Mcgraw Hill Publication Ref. MMM:- The 8051 Microcontroller & Embedded Systems by M.A. Mazidi, J.G. Mazidi and R.D. Mckinlay, Second Edition, Pearson	**15 lectures**
	Learning Outcomes: On successful completion of this course students will	

	be able to: a) Understand the assembly language programming of Microprocessors & microcontrollers b) Understand the assembly language programming of PIC microcontrollers c) Understand the basic concepts of Instrumentation Circuits and Designs d) Demonstrate quantitative problem solving skill in all the topics covered	

Additional Reference books:

1. The 8051 Microcontroller & Embedded Systems-Dr. Rajiv Kapadia (Jaico Pub.House)
2. 8051 Micro-controller, K.J.Ayala., Penram International.
3. Design with PIC microcontrollers by John B. Peatman, Pearson Education Asia.
4. Programming & customizing the 8051 microcontroller By Myke Predko, TMH.

SEMESTER III		
Course Code	**Title**	**Credits**
PSPH304	**Programming using C++,VC++, Embedded Systems and RTOS**	**04**
Unit I	**Programming Using C++:** Introduction to Computers and programming , Introduction to C++, Expressions and interactivity , Making decisions, Looping , Functions , Arrays , Sorting arrays , Pointers TG – Ch 1: 1.3 to 1.7 , Ch 2: 2.1 to 2.14, Ch 3: 3.1 to 3.11, Ch 4: 41 to 4.15, Ch 5: 5.1 to 5.13, Ch 6: 6.1 to 6.14, Ch 7: 7.1 to 7.9 , Ch 8: 8.3 , Ch 9: 9.1 to 9.7 Ref. TG: - Starting out with C++ from Control	**15 lectures**

	structures through objects, by Tony Gaddis, Sixth edition, Penram International Publications, India	
Unit II	**Introduction to classes:** More about classes, Inheritance, polymorphism, virtual functions. TG – Ch 13: 13.1 to 13.11, Ch 14: 14.1 to 14.5, Ch 15: 15.1 to 15.6 **Introduction to VC++:** YK – Ch 1, 2, 3 **Reference:** TG: - Starting out with C++ from Control structures through objects, by Tony Gaddis, Sixth edition Penram International Publications, India YK: - Introduction to Visual C++ by Yashwant Kanetkar	**15 lectures**
Unit III	**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 Attributed of**	**15 lectures**

	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 RK - Ch 1: 1.10.2, 1.10.3, 1.10.4, 1.10.5, 1.10.6, 1.10.7 Ref. SKV:- Introduction to embedded systems, by Shibu K. V. ,Sixth Reprint 2012, Tata McGraw Hill Ref. RK:- “Embedded Systems” Architecture, Programming and Design, by Raj Kamal, Second Edition, The McGraw-Hill Companies	
Unit IV	**Real –Time Operating System based Embedded System Design:** Operating system Basics, Types of Operating Systems, Tasks, Process and Threads, Multi-processing and Multitasking, Task Scheduling, Threads, Processes and Scheduling: Putting them altogether, task Communication, task Synchronizations, Device Drivers, How to choose an RTOS. *SKV: Ch – 10: 10.1, 10.2, 10.3, 10.4, 10.5, 10.6,*	**15 lectures**

	10.7, 10.8, 10.9. 10.10 Ref: SKV :- Introduction to embedded systems, by Shibu K. V. ,Sixth Reprint 2012, Tata Mcgraw Hill **Additional references:** 1. Object Oriented Programming with C++, By E. Balagurusamy, 2nd ed. TMH. 2. OOPS with C++ from the Foundation, By N. R. Parsa, Dream Tech Press India Ltd.	
	Learning Outcomes: On successful completion of this course students will be able to: a) Understand the basic concepts of Embedded systems and Designs b) Understand the basic concepts of RTOs and Designs c) Understand the assembly language programming d) Demonstrate quantitative problem solving skill in all the topics covered	

Additional references:

1. Object Oriented Programming with C++, By E. Balagurusamy, 2nd ed. TMH.
2. OOPS with C++ from the Foundation, By N. R. Parsa, Dream Tech Press India Ltd.

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

Students have to perform at least 10 experiments from Group A and Group B:
Group A:

I <u>Interfacing 8031/8051 based experiments</u>:

1. Interfacing 8 bit DAC with 8031/51 to generate waveforms: square, sawtooth, 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.

II Microcontroller 8031/8051 based experiments:

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.

III 16F84 or 16FXXX) PIC Micro-controller based experiments (Using assembly language only):

1. Interfacing LED's: flashing LED's, to display bit pattern, 8-bit counter.
2. Interfacing Push Buttons: to increment and decrement the count value at the output by recognizing of push buttons, etc
3. Interfacing Relay: to drive an ac bulb through a relay; the relay should be tripped on recognizing of a push button.
4. Interfacing buzzer: the buzzer should be activated for two different frequencies, depending on recognizing of corresponding push buttons.

IV C++ and Visual C++ experiments:

1. C++ Program (Conversion from decimal system to binary, octal, hexadecimal system).
2. C++ Program (Program on mean, variance, standard deviation for a set of numbers.

3. C++ Program (Sorting of data in ascending or descending order).
4. C++ experiment (Programs on class, traffic lights)
5. C++ experiment (Programs on inheritance, over loading)
6. Visual C++

experiment V

Computation

1. Least squares fit / curve-fitting
2. Interpolation

Note:
Journal should be certified by the laboratory in-charge only if the student performs satisfactorily the minimum number of experiments as stipulated above. Such students, who do not have certified journals, will not be allowed to appear for the practical examinations.

Semesters III
Project evaluation guidelines

Every student will have to complete one project each in Semester III and Semester IV with four credits (100 marks) each. Students can take one long project (especially for SSP/SSE/Material Sc/Nanotechnology/Nuclear etc) or two short project (especially for EI /EII). However for one long project students have to submit two separate project reports / dissertation consisting of the problem definition, literature survey and current status, objectives, methodology and some preliminary experimental work in Semester III and actual experimental work, results and analysis in semester IV with four credits each. Those who have opted for two separate projects will also have to submit two separate project reports at each examination. The project can be a theoretical or experimental project, related to advanced topic, electronic circuits, models, industrial project, training in a research institute, training of handling a sophisticated equipments etc.

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 what other group members have done. 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. In case a student takes training in a research institute/training of handling sophisticate equipment, he/she should mention in a report what training he/she has got, which instruments he/she handled and their principle and operation etc.

Each project will be of 100 marks with 50% by internal and 50% by external evaluation.

There 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

MSc Physics (Theory Sem IV)

SEMESTER IV		
Course Code	**Title**	**Credits**
RPSPHY401	**Experimental Physics**	**04**

Unit I	**Data Analysis for Physical Sciences:** Population and Sample, Data distributions Probability, Probability Distribution, Distribution of Real Data, The normal distribution, The normal distribution, From area under a normal curve to an interval, Distribution of sample means, The central limit theorem, The t distribution, The log- normal distribution, Assessing the normality of data, Population mean and continuous distributions, Population mean and expectation value, The binomial distribution The Poisson distribution, Experimental Error, Measurement, error and uncertainty, The process of measurement, True value and error, Precision and accuracy, Random and systematic errors, Random errors, Uncertainty in measurement. Main Reference: Data Analysis for Physical Sciences (Featuring Excel®) Les Kirkup, 2nd Edition, Cambridge University Press (2012), Chapters 1-6 and 9 Additional Reference: Statistical Methods in Practice for scientists ad Technologists, Richard Boddy and Gordon Smith, John Wiley & Sons (2009) Internal tests will be of solving problems using Excel.	**15 lectures**
Unit II	**Vacuum Techniques:** Fundamental processes at low pressures, Mean Free Path, Time to form monolayer, Number density, Materials used at low pressurs, vapour	**15 lectures**

	pressure Impingement rate, Flow of gases, Laminar and turbulent flow, Production of low pressures; High Vacuum Pumps and systems, Ultra High Vacuum Pumps and System, Measurement of pressure, Leak detections **References:** I. Vacuum Technology, A. Roth, North Holland Amsterdam II. Ultra High Vacuum Techniques, D. K. Avasthi, A. Tripathi, A. C. Gupta, Allied Publishers Pvt. Ltd (2002) III. Vacuum Science and Technology, V. V. Rao, T. B. Ghosh, K. L. Chopra, Allied Publishers Pvt. Ltd (2001)	
Unit III	Nuclear Detectors: Gamma ray spectrometer using NaI scintillation detector, High Purity Germanium detector, Multi-wire Proportional counter Accelerators: Cockroft Walten Generator, Van de Graf Generator, Sloan and Lawrence type Linear Accelerator, Proton Linear Accelerator, Cyclotron and Synchrotron. **References** 1. Nuclear Radiation Detection- William James Price , McGraw Hill 2. Techniques for Nuclear and Particle Physics Experiments, W.R. Leo, Springer-Verlag 3. Radiation Detection and Measurement, Glenn F. Knoll, John Wiley and sons, Inc. 4. Particle Accelerators, Livingston, M. S.; Blewett, J. 5. Introduction to Nuclear Physics, HA Enge, pp 345-353	**15 lectures**

	6. Electricity & Magnetism and Atomic Physics Vol. II, J. Yarwood 7. Principles of Particle Accelerators, E. Persico, E. Ferrari, S.E. Segre 8. Fundamentals of Molecular Spectroscopy, C. N. Banwell, Tata-McGraw Hill 9. Radiation detection & Measurement-Glenn F. Knoll 10. Techniques for Nuclear & Particle Physics Experiment- William Leo	
Unit IV	**Characterization techniques for materials analysis:** Spectroscopy: XRD,XRF, XPS, EDAX , Raman, UV Visible spectroscopy, FTIR spectroscopy. Microscopy: SEM, TEM, AFM **References:** 1. An Introduction to Materials Characterization, Khangaonkar P. R., Penram International Publishing 2. Rutherford Backscattering Spectrometry, W. K. Chu, J. W. Mayer, M. A. 3. Nicolet, Academic Press 4. A Guide to Materials Characterization and Chemical Analysis, John P. Sibilia, Wiley-VCH; 2 edition 5. Fundamentals of Surface and Thin Film Analysis, L.C. Feldman and J.W. 6. Mayer North Holland amsterdam 7. Elements of X-ray diffraction, Cullity, B. D Addison-Wesley Publishing Company, Inc. 8. Nano: The Essentials: T.Pradeep, TMH Publications.	**15 lectures**
	Learning Outcomes: On successful completion of this course students will	

	be able to: a) Understand the basic concepts of Data Analysis for physical sciences b) Understand the basic concepts Vacuum techniques c) Understand the Characterization techniques for materials analysis d) Demonstrate quantitative problem solving skill in all the topics covered	

SEMESTER IV		
Course Code	**Title**	**Credits**
RPSPHY402	**Atomic & Molecular Physics**	**04**
Unit I	**Review*** of one-electron eigenfunctions and energy levels of bound states, Probability density, Virial theorem. Fine structure of hydrogenic atoms, Lamb shift. Hyperfine structure and isotope shift. (ER 8-6) 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	The central field, Thomas-Fermi potential, the gross structure of alkalis (GW). The Hartree theory, ground state of multi-electron atoms and the periodic table (ER), The L-S coupling	**15 lectures**

	approximation, allowed terms in LS coupling, fine structure in LS coupling, relative intensities in LS coupling, j-j coupling approximation and other types of coupling (GW)	
Unit 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 life times of excited state, line shapes and line widths. X-ray spectra. (BJ)	**15 lectures**
Unit 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)	**15 lectures**

	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 but not examined in these.)	
	Learning Outcomes: On successful completion of this course students will be able to: a) Understand the basic concepts of Atomic and Molecular Physics b) Understand the basic problem solving techniques on basis of various laws c) Demonstrate quantitative problem solving skill in all the topics covered	

Reference:

1. Robert Eisberg and Robert Resnick, Quantum physics of Atoms, Molecules, Solids, Nuclei and Particles, John Wiley & Sons, 2nded, (ER)
2. B.H. Bransden and G. J. Joachain, Physics of atoms and molecules, Pearson Education 2nded, 2004 (BJ)
3. G. K. Woodgate, Elementary Atomic Structure, Oxford university press, 2nded, (GW).
4. G. Aruldhas, Molecular structure and spectroscopy, Prentice Hall of India 2nded, 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)

SEMESTER IV		
Course Code	**Title**	**Credits**
RPSPHY403	**<u>Microprocessors and ARM 7</u>**	**04**
Unit I	8085 Interrupts**: The 8085 Interrupt, 8085 Vectored Interrupts, Restart as Software Instructions, Additional I/O Concepts and Processes.** RSG - Ch 12: 12.1, 12.2, 12.3, 12.4 **Programmable Peripheral and Interface Devices**: The 8255A Programmable Peripheral Interface, Interfacing Keyboard and Seven Segment Display, the 8259A Programmable Interrupt Controller, Direct Memory Access (DMA) and 8237 DMA Controller, the 8279 Programmable Keyboard/Display Interface RSG - Ch 15: 15.1, 15.2, 15.5, 15.6 & Ch 14: only 14.3 **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 RSG - Ch 16: 16.1, 16.2, 16.3, Ref. RSG: - Microprocessor Architecture, Programming and Applications with the 8085 by Ramesh S. Gaonkar, Fifth Edition Penram	**15 lectures**

	International Publication (India) Pvt Ltd	
Unit II	**8086 microprocessor:** 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. AB - Ch 1: 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9. **8086 Instruction set and assembler directives:** Machine Language Instructions Formats, Addressing modes of 8086, Instruction set of 8086. AB - Ch 2: 2.1, 2.2, 2.3. **The Art of Assembly Language Programming with 8086:** A few machine level programs, Machine coding the programs, Programming with an assembler (only using Debug), Assembly language example programs. AB - Ch 3: 3.1, 3.2, 3.3.4 & 3.4 **Special architectural features and related programming:** Introduction to Stack, Stack structure of 8086, Interrupts and Interrupt Service Routines, Interrupt cycle of 8086, Non-maskable interrupt, Maskable interrupt (INTR). AB - Ch 4: 4.1, 4.2, 4.3, 4.4, 4.5, 4.6	**15 lectures**

	Ref. AB: - Advanced Microprocessors and Peripherals by a K Ray and K M Bhurchandi Second Edition Tata McGraw–Hill Publishing Company Ltd. (Note: Also refer Intel's 8086 Data Sheet)	
Unit III	**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 **Ref. SF: -** ARM System-on-Chip Architecture, by Steve Furber, Second Edition, Pearson	**15 lectures**
Unit IV	**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 **The ARM Instruction Set**: Introduction, Exceptions, Condition execution, Branch and Branch with Link (B, BL), Branch, Branch with Link and eXchange (BX,BLX), Software	**15 lectures**

	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. SF – Ch 7: 7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.7, 7.8, 7.9, 7.10, 7.11 **Ref. SF:** - ARM System-on-Chip Architecture, by Steve Furber, Second Edition, Pearson **Additional Ref:** 1 Microprocessors and interfacing, programming and hardware, By Douglas V. Hall (TMH) 2 8086 Microprocessor: Programming and Interfacing K.J.Ayala,	

	Penram International	
	Learning Outcomes: On successful completion of this course students will be able to: a) Understand the Assembly language programming in microprocessors and microcontrollers b) Understand the basic of architecture of microprocessors and microcontrollers c) Demonstrate quantitative problem solving skill in all the topics covered	

Additional Ref:

1 Microprocessors and interfacing, programming and hardware, By Douglas V. Hall (TMH)

2 8086 Microprocessor: Programming and Interfacing K.J.Ayala, Penram International

SEMESTER IV		
Course Code	**Title**	**Credits**
PSPH404	**VHDL and Communication Interface**	**04**
Unit I	**VHDL-I:** **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** **Sequential Processing**: Process Statement, Sensitivity List, Process Example, Signal Assignment	**15 lectures**

	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** **Ref. DLP: - VHDL programming by example by Douglas L. Perry, Fourth edition, Tata McGraw- Hill**	
Unit II	**VHDL-II:** **Data Types**: Object Types, Signal, Variables, Constants, Data Types, Scalar Types, Composite Types, Incomplete Types, File Types, File Type Caveats, Subtypes. **DLP -Ch 4** **Subprograms and Packages**: Subprograms Function, Conversion Functions, Resolution Functions, Procedures, Packages, Package Declaration, Deferred Constants, Subprogram, Declaration, Package Body. **DLP -Ch 5** **Predefined Attributes**: Value Kind Attributes, Value Type Attributes, Value Array Attributes, Value Block Attributes, Function Kind Attributes, Function Type Attributes, Function Array, Attributes, Function Signal Attributes, Attributes 'EVENT and, LAST-VALUE Attribute 'LAST- EVEN Attribute, 'ACTIVE and 'LAST-ACTIVE Signal Kind Attributes, Attribute 'DELAYED, Attribute 'STABLE, Attribute 'QUIET, Attribute TRANSACTION, Type Kind Attributes, Range Kind Attributes. **DLP -Ch 6** **Configurations**: Default Configurations, Component Configurations, Lower-Level Configurations, Entity-Architecture Pair Configuration, Port Maps, Mapping Library Entities, Generics inConfigurations, Generic Value Specification in Architecture, Generic Specifications in Configurations, Board-Socket-Chip	**15 lectures**

	Analogy, Block Configurations, Architecture configurations. **DLP -Ch 7** **Ref. DLP: - VHDL programming by example by Douglas L. Perry, Fourth edition, Tata McGraw- Hill**	
Unit III	**Understanding USB and USB Protocols** **USB Basics**: Uses and limits, Evolution of an interface, Bus components, Division of Labor, Developing a Device. **JA – Ch 1** **Inside USB Transfers**: Transfer Basics, Elements of a Transfer, USB 2.0 Transactions, Ensuring Successful Transfers, Super-Speed Transactions. **JA – Ch 2** **A Transfer Type** for Every Purpose: Control transfers, Bulk Transfers, Interrupt Transfers, Isochronous Transfers, More about time-critical transfers. **JA – Ch 3** **Enumeration**: How the Host learns about devices: The Process, Descriptors. **JA – Ch 4** **Control Transfers**: Structured Requests for Critical Data: Elements of a Control Transfer, Standard Requests, Other Requests. **JA – Ch 5** Chip Choices: Components of USB device. **JA – Ch 6: Pages 137 - 141** **How the Host Communicates**: Device Drivers, Inside the Layers, Writing Drivers, Using GUIDs. **JA – Ch 8** **Ref. JA: - The Developers Guide "USB Complete", by Jan Axelson, Fourth Edition, Penram International Publishing (India) Pvt Ltd**	**15 lectures**
Unit IV	**Communication Interface** **On board Communication Interface:** Inter Integrated Circuit (I2C), Serial Peripheral Interface (SPI), Universal Asynchronous Receiver Transmitter (UART), Wire Interface, Parallel Interface, **External Communication Interfaces**: RS-232 &	**15 lectures**

	RS-485, USB, IEEE 1394 (Firewire), Infrared (IrDA), Bluetooth, Wi-Fi, Zig-Bee, GPRS. **SKV: Ch – 2: 2.4** **Detailed studies of I2C Bus refer:** **I2C Bus Specification Version 2.1 by Philips (Pages 4-18 and 27-30)** (Download from www.nxp.com) • The I2C-Bus Benefits designers and manufacturers (Art 2: 2.1, 2.2) • Introduction to the I2C-Bus Specification (Art 3) • The I2C-Bus Concept (Art 4) • General Characteristics (Art 5) • Bit Transfer (Art 6) • Transferring Data (Art 7) Byte format 7.1, Acknowledge 7.2 • Arbitration and Clock Generation (Art 8) Synchronization (8.1), Arbitration (8.2), Use of the clock synchronizing mechanism as a handshake (8.3) • Formats with 7-Bit Addresses (Art 9) • 7-Bit Addressing (Art 10) • 10-Bit Addressing (Art 14) Definition of bits in the first two bytes (14.1), Formats with 10-bit addresses (14.2) **Detailed study of Bluetooth: Overview, Radio Specifications, FHSS** **WS: Ch- 15: 15.1, 15.2 upto Page 512**	
	Learning Outcomes: On successful completion of this course students will be able to: a) Understand the Assembly language programming in VHDL b) Understand the basic of Communication Interface c) Demonstrate quantitative problem solving skill in all the topics covered.	

Ref: SKV :- Introduction to embedded systems, by Shibu K. V. ,Sixth Reprint 2012, Tata Mcgraw Hill

WS:- Wireless Communications and Networks, by William Stallings, 2nd edition Pearson

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

Students have to perform a minimum of 10 experiments from Group A and group B

Group A:

I.: <u>8085/8086 Microprocessor based experiments</u>:

1. Study of 8085 interrupts (Vector Interrupt 7.5).
2. Study of PPI 8255 as Handshake I/O (mode 1): interfacing switches and LED's.
3. 8086 assembly language programming:
4. 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 INT 20, displaying a string of characters using INT 20)

<u>Please note</u>: Assembly language programming of 8086 may be done by operating PC in real mode by using 'Debug' program. Separate 8086 study kit not needed.

II. <u>ARM7 based experiments</u>:

1. Simple data manipulation programs (addition, subtraction, multiplication, division etc).
2. Study of IN and OUT port of ARM7 by Interfacing switches, LEDs etc.
3. Study of Timer.
4. Interfacing DAC/ADC using I2C Protocols.

III. <u>Basic VHDL experiments</u>:

a. Write VHDL programs to realize: logic gates, half adder and full adder
b. Write VHDL programs to realize the following combinational designs: 2 to 4 decoder, 8 to 3 encoder without priority, 4 to 1 multiplexer, 1 to 4 de- multiplexer

c. Write VHDL programs to realize the following: SR – Flip Flop, JK – Flip Flop,
T – Flip Flop

d. Write a VHDL program to realize a 2/3/4-bit ALU (2-arithmetic, 2-logical operations)

IV: <u>VHDL Interfacing based experiments</u>:

1. Interfacing stepper motor: write VHDL code to control direction, speed and number of steps.
2. Interfacing dc motor: write VHDL code to control direction and speed using PWM.
3. Interfacing relays: write VHDL code to control ac bulbs (at least two) using relays.

V. Computation

a. Computer program for file handling.

References:

1. Advanced Microprocessors and Peripherals by a K Ray and K M Bhurchandi Second Edition Tata McGraw–Hill Publishing Company Ltd.
2. ARM System-on-Chip Architecture, by Steve Furber, Second Edition, Pearson
3. VHDL programming by example by Douglas L. Perry, Fourth edition, Tata McGraw-Hill
4. Manual of VHDL kit.

Note:

Journal should be certified by the laboratory in-charge only if the student performs satisfactorily the minimum number of experiments as stipulated above. Such students, who do not have certified journals, will not be allowed to appear for the practical examinations

Semesters IV

Project evaluation guidelines

Every student will have to complete one project each in Semester III and Semester IV with four credits (100 marks) each. Students can take one long project (especially for SSP/SSE/Material Sc/Nanotechnology/Nuclear etc) or two short project (especially for EI /EII). However for one long project students have to submit two separate project reports / dissertation consisting of the problem definition, literature survey and current status, objectives, methodology and some preliminary experimental work in Semester III and actual experimental work, results and analysis in semester IV with four credits each. Those who have opted for two separate projects will also have to submit two separate project reports at each examination. The project can be a theoretical or experimental project, related to advanced topic, electronic circuits, models, industrial project, training in a research institute, training of handling a sophisticated equipments etc.

Maximum three students can do a joint project. Each one of them will submit a separate project report with details/part only he/she has done. However he/she can in brief (in a page one or two) mention in Introduction section what other group members have done. 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. In case a student takes training in a research institute/training of handling sophisticate equipment, he/she should mention in a report what training he/she has got, which instruments he/she handled and their principle and operation etc.

Each project will be of 100 marks with 50% by internal and 50% by external evaluation.

There 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: (each semester)

Criteria	Maximum Marks
Literature Survey	05
Objectives/Plan of the project	05
Experimental/Theoretical methodology/Working condition of project or Model	10
Significance and originality of the study/Society application and Inclusion of recent References	05
Depth of knowledge in the subject / Results and Discussions	10
Presentation	15
Maximum marks by External examiner	**50**
Maximum marks by internal examiner/guide	**50**
Total marks	**100**

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(case studies/ seminars/presentation)	10

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 5 questions each of 12 marks. On each unit there will be one question &last question will be based on all the 4 units.
2. All questions shall be compulsory with internal choice within the questions.

Questions	Options	Marks	Questions on
Q.1)A)	Any 1 out of 2	8	Unit I
Q.1)B)	Any 1 out of 2	4	
Q.2)A)	Any 1 out of 2	8	Unit II
Q.2)B)	Any 1 out of 2	4	
Q.3)A)	Any 1 out of 2	8	Unit III
Q.3)B)	Any 1 out of 2	4	
Q.4)A)	Any 1 out of 2	8	Unit IV
Q.4)B)	Any 1 out of 2	4	
Q.5)	Any 4 out of 8	12	All four Units

Practical Examination Pattern:

(A) External (Semester End Practical Examination):

Semester – I : Practical Lab Course			
PSPHP101	**Group A / B**	Long	60M
	Group A / B	Short	20M
		Journal	10M
		Viva	10M
		Total	**100M**
PSPHP102	**Group A / B**	Long	60M
	Group A / B	Short	20M
		Journal	10M
		Viva	10M
		Total	**100M**

Semester – II : Practical Lab Course			
PSPHP201	**Group A / B**	Long	60M
	Group A / B	Short	20M
		Journal	10M
		Viva	10M
		Total	**100M**
PSPHP202	**Group A / B**	Long	60M
	Group A / B	Short	20M
		Journal	10M
		Viva	10M
		Total	**100M**

Semester – III : Practical Lab Course			
PSPHP301		**Project -External**	50M
		Project -Internal	50M
		Total	**100M**
PSPHP302	**Group – A**	**Experiment**	40M
		Viva	10M
	Group – B	**Experiment**	40M
		Viva	10M
		Total	**100M**
Semester – IV : Practical Lab Course			
PSPHP401		**Project -External**	50M
		Project -Internal	50M
		Total	**100M**
PSPHP402	**Group – A**	**Experiment**	40M
		Viva	10M
	Group – B	**Experiment**	40M
		Viva	10M
		Total	**100M**

PRACTICAL BOOK/JOURNAL

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 / Incharge 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.

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