School of Physical Sciences
Solapur University, Solapur
Course Structure (w.e.f. June 2014-15)
M.Sc- Physics (Applied Electronics)

Semester - I

PHAE-I - Mathematical Techniques(C)	- 70+30=100
PHAE - II -Condensed Matter Physics(C)	- 70+30=100
PHAE - III - Analog & Digital Electronics(C)	- 70+30=100
PHAE - IV - Classical Mechanics (C)	- 70+30=100
Practical - I	-70+30=100
Practical - II	- 70+30=100

Semester - II

PHAE - V - Statistical Mechanics (C)	- 70+30=100
PHAE - VI - Quantum Mechanics (C)	- 70+30=100
PHAE - VII -Electrodynamics (C)	- 70+30=100
PHAE - VIII - Microprocessors & Microcontrollers	- 70+30=100
Practical - III	- 70+30=100
Practical - IV	- 70+30=100

The practical's examination at Sem. I & Sem. II shall be of 4 laboratory practical's of 35 marks each.
(C) Indicates common courses of the school.
30 marks are for internal evaluation.

M.SC-I, SEME. I, PHYSICS (APP. ELEC. / MAT. SCIENCE)

Paper – I - PH (AE/MS): MATHEMATICAL TECHNIQUES (C)

(Revised syllabus w. e. f. June 2014-2015)

Unit I: Calculus of Residues (10)

COMPLEX VARIABLE AND REPRESENTATIONS: Algebraic Operations, Argand Diagram: Vector Representation, Complex Conjugate, Euler's Formula, De Moiver's Theorem, The n^{th} Root or Power of a complex number.
ANALYTICAL FUNCTIONS OF A COMPLEX VARIABLE : The Derivative of f(Z) and Analyticity, Harmonic Functions, Contour Integrals, Cauchy's Integral Theorem, Cauchy's Integral Formula,
Zeros, Isolated Singular points, Evaluation of Residues, Cauchy's Residue theorem.

Unit II : Operator and Matrix Analysis (10)

Vector Space and its dimensionality, Vector Spaces and Matrices, Linear independence; Bases; Dimensionality, linear dependence, Inner product Hilbert space, linear operators.
Matrix operations, properties of matrices, Inverse, Orthogonal and unitary matrices; Independent elements of a matrix Diaglonization; Complete orthogonal sets of functions, special square matrices, Eigen values and eigenvectors; Eigen value problem.

Unit III: Ordinary Differential Equations (10)

First-Order homogeneous and non homogeneous equations with variable coefficients. The superposition principle, Second-order homogeneous equations with constant coefficient. Second-order non homogeneous equations with constant coefficients.

Unit IV : Fourier Series, Integral Transforms and Laplace transform (18)

Fourier Series: Fourier's theorem; Cosine, Sine and complex Fourier series, Applications to saw footh and square waves and full wave rectifier. FS of arbitary period; Half wave expansions; Partial sums Fourier integral and transforms; cosine since complex forms, Parsevals relation, Application to Gaussian distribution, box and exponential functions; FT of delta function.
Laplace transforms: Laplace transforms of common functions, First and second shifting theorems; inverse LT by partial fractions; LT of derivative and integral of a function.

Reference Books:

1. Introduction to Mathematical Physics by C. Harpcr, Prcnticc - Hall of India Ltd. N.Delhi 1993,(Chapters 2,4,6,9)
2. Mathematical Physics by A.G. Ghatak, I.C.Goyal and S.J.Chua, McMillan India Ltd. New Delhi 1995 (Chapters 4,7,9,10)
3. Matrices and Tensors for Physicists,by A W Joshi
4. Advanced Engineering Mathematics, by E Keryszig
5. Mathematical Method for Physicits and Engineers, by K F Reily, M P Hobson and S J Bence
6. Mathematics for Physicists by Mary L B
7. Mathematical Methods for Physics, by G Arfken

M.SC-I, SEME. I, PHYSICS (APP. ELEC. / MAT. SCIENCE)

Paper – II - PH (AE/MS): CONDENSED MATTER PHYSICS (C)

(Revised syllabus w. e. f. June 2014-2015)

Unit I: Crystal Structure (12)

Basic Structures; symmetry properties, packing fractions, directions and position-orientation of planes in crystal, concept of reciprocal lattice, concept of brillouin zones, closed packed structure, and structures of some binary/ternary compounds. Elementary concepts of polycrystalline, nanocrystalline and amorphous materials. Elementary concepts of defects in solids. X-ray scattering from solids including Laue conditions and line intensities.

Unit II : Energy bands and Semiconductors (14)

Energy bands: Electron in periodic potential, Bloch function, solution of wave equation of electron in periodic potential, reduced, periodic and extended zone schemes. Construction of Fermi surfaces in brillouin zones for two - dimensional lattices, Introduction to methods for calculations of energy bands and their features. **Semiconductors:** Direct and indirect band gap semiconductors effective mass, intrinsic carrier concentration, impurity conductivity thermal ionization Revision on p-n junction and rectification, metal- semiconductor contacts, schotky barrier.

Unit III : Dielectric properties of Solids (10)

electronic, ionic, orientational, polarzabilities, static dielectric constant for gases, internal field in solids, dielectric constant of solids, dielectric relaxation in alternating fields, dielectric losses, complex dielectric constant.

Unit IV: Superconductivity (12)

Basic concepts, Meissner effect, heat capacity, energy gap, London equation, coherence length Josephson effect (flux quantization), type I and II superconductors, BCS theory, Introduction to high Tc Superconductors.

Reference Books:

1) Introduction to Solid State Physics 4 th Ed. C.Kittel,
2) Solid State Physics by A.J.Dekker
3) Solid State Physics by N.W.Ashoroff & N.D.Mermin
4) Solid State Physics S.O.Pillai
5) Solid state Physics by R.L.Singhal

M.SC-I, SEME. I, PHYSICS (APP. ELEC. / MAT. SCIENCE)

Paper – III - PH (AE/MS): ANALOG & DIGITAL ELECTRONICS (C)

(Revised syllabus w. e. f. June 2014-2015)

Unit I: Operational Amplifiers (12)

Differential amplifier Circuit Configurations, Dual Input Balanced Output Differential amplifier , DC analysis, AC analysis, Inverting and Non Inverting Inputs, Constant Current Bias Circuit.

Block diagram of a typical Op-Amp, Open loop configuration, Inverting and Non-inverting amplifiers, Op-amp with negative feedback, Voltage Series Feed back, Effect of feed back on closed loop gain, Input resistance, Output resistance, Bandwidth and Output offset voltage, Voltage follower.

Practical Op-amp, Input Offset Voltage, Input bias current- input offset current, total output offset voltage, CMRR frequency response.

Unit II: Applications of Op amps (12)

DC and AC amplifier, Summing, Scaling and Averaging Amplifiers, Instrumentation amplifier, Integrator and Differentiator.

Oscillator: Principles , Oscillator types, Frequency stability, Response , Phase Shift oscillator ,Wein Bridge Oscillator, LC Tunable Oscillator , Multivibrators, Monostable and Astable, Comparators, Square Wave and Triangle wave generators.

Voltage regulations: Fixed regulators, Adjustable voltage regulators, Switching regulators.

Unit III: Combinational & Sequential Logic Circuits (12)

Combinational logic:

The transistor as a switch, OR AND NOT gates- NOR And NAND gates Boolean algebra- Demorgans theorems- exclusive OR gate, Decoder/ Demultiplexer Date selector/ multiplexer - Encoder.

Sequential Logic:

Flip- Flops: RS Flip- Flop, JK Flip- Flop, JK master slave Flip-Flops Flip-Flop, D Flip- Flop, Shift registers Synchronous and Asynchronous counters.

Unit IV: Microprocessors (12)

Architecture of 8085, Signals and timing diagram of 8085, Demultiplexing Address and Data bus, Instruction Set, Addressing modes, Assembly Language Programming of 8085 (Sum of an array, Minimum and Maximum of an array, Multiplication & Division of 4 & 8 bit numbers) .

Reference Books:

1) OP Amp amplifiers by Ramakant Gaikwad

2) Integrated Circuits by K.R.Botkar

3) Modern Digital Electronics by R.P.Jain

4) Digital Principle and Application by Malvino & Leeach

5) Digital Fundamentals by Floyd

6)8085 Microprocessor by Ramesh Gaonkar

M.SC-I, SEME. I, PHYSICS (APP. ELEC. / MAT. SCIENCE)
Paper – IV - PH (AE/MS): CLASSICAL MECHANICS(C)
(Revised syllabus w. e. f. June 2014-2015)

Unit I : Mechanics of Particles and Rigid Bodies (12)

Mechanics of Particle and system of Particles using vector algebra and vector calculus, Conversion laws, work-energy theorem, open systems (with variable mass), Gyroscopic forces; dissipative systems, Jacobi integral, gauge invariance, integrals of motion; symmetries of space and time with conservation laws; invariance under Galilean transformations.

Unit II : Lagrangian Formulation and Motion Under Central Force (10)

Constrainsts, Generalised co-ordinates, D Alemaberts Principle, Lagranges equations of motion, Central Force, definition and characteristics, Reduction of Two-bod problem into equivalent One-body problem, General analysis of orbits, Keplers laws and equations, Artificial satellites, Rutherford Scattering.

Unit III : Variational Principle (14)

Introduction to Calculus of variation, Variational technique for many independent variables, Eulers Lagrange differential equation, Hamilton's principle, Deduction f Lagrange's equation of motion from Hamilton's principle.

Hamilton, Generalized momentum, Constant of motion, Hamilton's canonicl equations of motion, Deduction of canonical equations from Variations principle.

Applications of Hamilton's equations of motion, Principle of least action, Proof of principles of least action, Problems.

Unit IV: Canonical Transformations and Hamilton's - Jacobi Theory (12)

Canonical Transformations, Condition for Transformation to be Canonical, Illustration of Canonical Transformation, Poisson's Brackets, Properties of Poisson's Brackets, Hamilton's Canonical equations in terms of Poisson's Brackets.

Hamilton's - Jacobi Theory, Solution of harmonic oscillator problems by HJ Method, Problems.

Texts and Reference Books:

1. Classical Mechanics, By Gupta, Kumar and Sharma (Pragati Prakashan2000).
2. Introduction to Classical Mechanics, by R.G. Takwale and P S Puranik (Tata McGraw Hill 1999).
3. Classical Mechanics, by H Goldstein (Addison Wesley 1980).
4. Classical Mechanics, by N C Rana and P S Joag (Tata McGraw Hill 1991).
5. Mechanics, by A Sommerfeld (Academic Press 1952)

M.SC-I, SEME. II, PHYSICS (APP. ELEC. / MAT. SCIENCE)

Paper – V - PH (AE/MS): STATISTICAL MECHANICS (C)

(Revised syllabus w. e. f. June 2014-2015)

Unit I: Foundations of statistical Mechanics and Classical Statistical Mechanics (12)

Thermodynamics, Laws of thermodynamics, Contact between statistics and thermodynamics, the classical ideal gas, entropy of mixing and Gibbs and paradox.

Classical statistical mechanics: Phase space, statistical ensembles, Liouville's theorem, Micro canonical ensemble-condition for equilibrium, canonical ensemble-partition function, energy fluctuations, Grand canonical ensemble-partition function, density and number fluctuations.

Unit II: Quantum Statistical Mechanics (12)

Phase space and quantum states, density matrix, Liouvilles theorem, ensembles, various statistics in quantum mechanics-

Maxwell- Boltzmann, Fermi-Dirac and Bose-Einstein statistics, Ideal Bose gas, Fermi gas, Bose- Einstein condensation.

Unit III: Phase transitions and critical phenomena (10)

Phase transition, condition for phase equilibrium, first order phase transition, Clausius-Clayperon equation, second order phase transition, Critical indices, Properties of matter near the critical point. The law of corresponding states.

Unit IV: Fluctuations (14)

Thermodynamic fluctuations, spatial correlations in a fluid, Einstein - Smoluchowski theory of Brownian motion, Langevin theory of Brownian motion, The fluctuation-deposition theorem, The Fokker-Plank equation.

Reference Books:

1) Introduction to Statistical Mechanics by B.B.Laud

2) Statistical Mechanics by S.K.Sinha

3) Statistical Mechanics by I.D. Landau & F.M.Lifshitz

M.SC-I, SEME. II, PHYSICS (APP. ELEC. / MAT. SCIENCE)

Paper – VI - PH (AE/MS): QUANTUM MECHANICS (C)

(Revised syllabus w. e. f. June 2014-2015)

Unit I : Introductory Quantum Mechanics (12)

Waves and quanta: Wave and particle nature of radiation, Wave equation, Interpretation and properties of wave function; Heisenberg uncertainty principle. Operators, postulates of quantum mechanics, some important theorems, Eigen functions of the position operator and Dirac delta function. (AKC, pp 1-32)

Unit II: Wave Mechanics of simple systems (16)

One dimensional Box, Normalization and orthogonality, Discussion of the factors influencing colour. One dimensional harmonic oscillator, Normalization and Characteristics of eigen functions of harmonic oscillator, Hydrogen - like atoms, Total wave function of hydrogen- like atom, Prob. Density of 1s atomic orbital, shape of atomic orbital, physical interpretation of hydrogenic orbital, space quantization, electronic spin, Vibration and vibrational spectra of diatomic molecules. [AKC,pp:33-91]

Unit III : Many electron atoms (08)

Wave function of many electron systems, Helium atom, Many electron atoms, Hartree and Hartree Fock self consistent field methods. [AKC, pp: 120-130)

Unit IV: Molecular Orbitals (12)

The Born- Oppenheimer approximation, Molecular orbital theory, Hydrogen molecule ion, Hydrogen Molecule - Molecular Orbital -Valance Band methods. [AKC, pp: 151-180]

Text Books:

1. Introductory Quantum Chemisty (3rd Ed^{n}), A. K. Chandra (Tata McGraw Hill).
2. Quantum Chemistry (4th Edition) - Ira N. Levine (Prentice Hall) of India Pvt. Ltd. New Delhi. 1995.
3. A textbook of Quantum Mechanics - P M Mathews, K Venkatesan. (Tata McGraw Hill).

M.SC-I, SEME. II, PHYSICS (APP. ELEC. / MAT. SCIENCE)

Paper – VII - PH (AE/MS): ELECTRODYNAMICS (C)

(Revised syllabus w. e. f. June 2014-2015)

Unit I: Multipole expansions and time varying fields (12)

Multipole expansions for a localized charge distribution in free space, linear quadrapole potential and field, static electric and magnetic fields in material media, boundary conditions, Time dependent fields, Faraday's law for stationary and moving media, Maxwell's displacement current, differential and integral forms of Maxwell's equations, Maxwell's equations for moving medium.

Unit II: Energy, force, momentum relations and electromagnetic wave equations (12)

Energy relations in quasi-stationary current systems, Magnetic interaction between two current loops, Energy stored in electric and magnetic fields, Poynting's theorem, General expression for electromagnetic energy, Electromagnetic wave equations, Electromagnetic plane waves in stationary medium, Reflection and refraction of electromagnetic waves at plane boundaries (Oblique incidence), Electromagnetic waves in conducting medium, Skin effect and skin depth.

Unit III: Inhomogeneous wave equations (12)

Inhomogeneous wave equations, Lorentz's and Coulomb's gauges, Gauge transformations, Wave equations in terms of electromagnetic potentials, D'Alembertian operator, Hertz potential and its use in computation of radiation fields.

Unit IV: Radiation emission (12)

Radiation from an oscillating electric dipole, radiation from a half wave antenna, radiation from a group of moving charges, radiation damping, Thomson cross-section.

Text Book:

1. Introduction to Electrodynamics, (3rd Edition) by David J. Griffith Publication: Prentice-Hall of India, New Delhi.

Reference Books:

2. Introduction to Electrodynamics, by A.Z.Capri and P.V.Panat Narosa Publishing House.
3. Classical electricity & Magnetism, by panofsky and Phillips, Addison Wesley.
4. Foundations of Electromagnetic theory, by Reitz & Milford, World student series Edition.
5. Classical Electrodynamics, by J.D.Jackson, 3rd Edition John Wiley.
6. Electromagnetic theory and Electrodynamics, by Satya Prakash, Kedar Nath and Co.Meerut.
7. Electromagnetics by B.B.Laud, Willey Eastern.
8. Electrodynamics by Kumar Gupta and Singh.

M.SC-II, SEME. I, PHYSICS (APP. ELEC.)

Paper – VIII - PH (AE): MICROPROCESSORS & MIICROCONTROLLERS

(Revised syllabus w. e. f. June 2014-2015)

Unit I : Microprocessors Intel 8086 (12)

Pin configuration, Architecture, EU and BIU, Flag registers, Concept of Segmentation of Memory, Buffered system bus, minimum mode and maximum mode configurations, clock generator 8284, Interrupts of 8086.

Unit II : Instruction set & programming of 8086 (12)

Instruction format, Addressing modes, Physical & Effective memory address , Data transfer, Arithmetic, Logical instructions, Control & branch instructions, Assembly language programming of 8086.

Unit III : Microcontrollers (8051) (12)

Pin configuration, Architecture of 8051, Program status word, Internal registers of 8051, Memory organization, Programming model of 8051, SFRS, Input/ Output ports, Timers/ Counters, Interrupts and Serial communication.

Unit IV : Instruction Set & programming of 8051 (12)

Instruction set, Arithmetic instructions, Logical byte operations, program control instructions, Stack operations, Data pointer & lookup table instructions, Addressing modes, Assembly language programming, Introduction to IDE (Integrated development environment-Keil/ Pinnacle), Port programming, LED Interfacing, Wave generation using 8051.

Reference Books/Text Books:

1. Microprocessors and Digital Systems: Hall .D. V.
2. Microprocessors and Digital Systems 8086/8088: Hall. D V.
3. Microprocessor systems 8086/8088 architecture, programming and design: Luo & Gibson
4. Programming and customizing the 8051 microcontroller: Predko, TMH.
5. 8051 Microcontroller : Ayla
6. Microprocessor Interface Techniques: Zaka Lasen (BPB).