Solapur University, Solapur
B.Sc. Part III PHYSICS
(New Syllabus) w.e.f. June2009

The meeting of sub committee for preparing the syllabus of B.Sc III in physics was held on 28th August , 13th and 14th October 2008. The titles of papers and **the syllabus for B.Sc. Part III Physics** is enclosed herewith :

Paper V: Mathematical Physics & Statistical Physics and Nuclear Physics

Section I: Mathematical Physics & Statistical Physics
Section II: Nuclear Physics

Paper VI: Solid state Physics and Materials Science

Section I: Solid state Physics
Section II: Materials Science

Paper VII: Classical & Quantum Mechanics and Spectroscopy & Astrophysics

Section I: Classical & Quantum Mechanics
Section II: Spectroscopy & Astrophysics

Paper VIII: Electrodynamics & Electromagnetic Waves and Electronics & Computer Programming

Section I: Electrodynamics & Electromagnetic Waves
Section II: Electronics & Computer Programming

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Paper V: Mathematical Physics & Statistical Physics and Nuclear Physics

Section I: Mathematical Physics & Statistical Physics

1.Vector analysis: Scalar and vector triple products, Del operator, Gradient of a Scalar point function, divergence , Curl of a vector point function and their physical significance,

Line integral, Surface integral and volume integral, Gauss divergence theorem, Stoke's theorem, Green's theorem. (10)

2.Orthogonal Curvilinear Coordinates; Introduction to Cartesian, Spherical polar and Cylindrical Coordinate systems, Concept of orthogonal curvilinear coordinates, Gradient, Divergence, Curl and Laplacian in orthogonal curvilinear coordinate system, extension of these in Cartesian, Spherical polar and Cylindrical coordinate systems. (7)

3.Basic Concepts in Statistical Physics : Micro and Macro states, Micro canonical and Canonical Ensembles, Phase Space,

Accessible microstates, a priory probability, thermodynamic probability, Probability distribution, Entropy and Probability. (6)

4.Maxwell Boltzman Statistics: M.B. distribution law, Evaluation of constants α and β, molecular speeds, partition function in canonical ensemble, thermodynamic function in terms of partition function. (8)

5.Quantum Statistics I : Bose Einstein statistics, B.E. law, Derivation of Planck's radiation formula,

Deduction of Wein's formula, Rayleigh's formula, Wein's displacement law and Stefan's law from Planck's formula. (8)

6.Quantum Statistics II: Fermi Dirac distribution law, application to free electrons in metals, electron energy distribution, Fermi energy. Electronic specific heat of metals, comparison of M.B., F.D. and B.E. statistics, (6)

References:

1. Theory and problems of vector analysis –
   Schaum outline series – MurrayR., Spiegel
2 Mathematical methods for physics- George Arfken
3. Thermodynamics and statistical physics- Sharma , Sarakar
4. Statistical mechanics – B.B.Laud
5. Statistical and thermal physics- S. Loknathan
6. Statistical mechanics –Satya Prakash , J.P. Agrawal
7. Elementary statistical mechanics –Kumar, Gupta
8. An approach to Statistical physics – Debi Prasad Ray

Section II -Nuclear Physics

7.Acclerators:

Need of acclerators, orbital acclerators, cyclotron, limitations of cyclotron, phase stable orbit, synchrocyclotron , betatron. (6)

8.Nuclear detectors:

Geiger-Muller counter, construction and working, dead time, self-quenching mechanism, bubble chamber, scintillation counter. (6)

9.Structure and nuclear properties:

Composition of nucleus, nuclear radius, nuclear spin, magnetic moment, electric quadrupole moment, mass defect, binding energy, binding energy curve, packing fraction, liquid drop model of a nucleus, semi-empirical mass formula. (10)

10.Nuclear reactions:

General scheme of nuclear reaction, Q-value of nuclear reaction, threshold energy, cross section of nuclear reactions(qualitative), stripping reactions, pick-up reactions. (5)

11.Nuclear Energy sources:

Neutron induced reaction, nuclear fission, energy released in fission, chain reaction (Atomic Bomb), Atomic energy in India.

Nuclear reactor, four factor formula for nuclear reactors, types of reactors, reactor materials, nuclear energy programme in India, peaceful uses of nuclear radiations. (10)

12.Elementary particles:

Introduction of elementary particles, types of interactions, classification of elementary particles, properties of particles,

Introduction of quarks, different types of quarks. (3)

References:

1. Nuclear physics –Kaplan
2. Nuclear physics –D.C.Tayal
3. Nuclear physics – S.B. Patel
4. Atomic Physics – J.B.Rajam
5. Nuclear physics – Burcham
6. Basic concepts of Nuclear physics – Cohen
7. Nuclear physics – S.N. Ghoshal (S. Chand & Co.)

Paper VI:Solid state Physics and Material Science

Section I- Solid State Physics

1**.Crystal Structure:** (9)

Crystal lattice, unit cell, miller indices, interplaner spacing, Bravis lattices, seven crystal lattices, packing fraction, some crystal structures cubic, HCP, NaCl.

2. X- ray Diffraction by Crystals: (6)

Reciprocal Lattice and it's properties, Bragg's Law in reciprocal lattice, Powder method of X-ray diffraction for crystal structure.

3. Free electron Theory : (8)

Free electron model, Sommerfield's theory, Fermi-Dirac distribution, energy density of orbital in one dimension.

4. Band theory of solids: (10)

Origin of energy bands, one electron approximation, motion of electron in one dimensional periodic potential(Kroning Penny model), effective mass of electron, difference between metals semiconductors and insulators, Hall effect.

5. Magnetism: (6)

Types of magnetic materials, hysterisis, energy loss in the hysterisis, idea of ferrites.

6. Superconductivity: (6)

Critical temperature, effect of magnetic field, Meissner effect, Type I and Type II superconductors.

Reference Books:

Solid State Physics – S.O. Pillai (wiley easten Ltd)
Solid State Physics - A. J. Dekker
Solid State Physics - Charles Kittel
Solid State Physics - R.L.Singhal

Section II -- Material Science

7. Materials and their Properties : (8)

(a)Classification of materials as - Metals, polymers, ceramics, composites, nanocrystalline materials, non-linear materials, biomaterials.

(b) Properties of materials:-

(i) Mechanical properties:- Stress, strain, elastic strain, plastic strain,

strength, plasticity, ductility, hardness, toughness, malleability, creep, fatigue, stiffness.

(ii) Thermal properties:-Sp. heat, thermal expansion, thermal conductivity.

(iii) Electrical properties:- Resistivity, conductivity, dielectric strength.

(iv) Introduction of magnetic, optical and chemical properties.

8. Single Phase Materials: (10)

Single phase alloys, deformation, elastic deformation, plastic deformation, comparison between elastic deformation and plastic deformation, mechanics of plastic deformations, deformation by slip, solution hardening, Critical Resolved Shear Stress (CRSS), plastic deformation in poly-crystalline materials, work hardening (or strain hardening), annealing of cold worked metals, comparison between recovery & recrystallization, variation of mechanical properties in annealing, mechanical working of metals,

cold working of metals.

9. Polymer Materials: (8)

Introduction, Polymers, polymerisation mechanism, addition polymerisation, condensation polymerisation, degree of polymerisation, classification of polymers, structure of polymers, fabrication process, properties of the polymers, applications.

10. Ceramics: (5)

Introduction, classification of ceramics, structure of ceramics, ceramic processing, properties of ceramics, applications.

11. Nanophase Materials: (6)

Introduction to nanophase materials, synthesis, characterization and properties of nanophase materials, applications of nanophase materials.

12. Phase diagrams: (8)

Introduction to phase diagrams and co-ordinates of phase diagrams, Gibb's Phase-rule, Phase diagrams for (i) Al_2O_3– Cr_2O_3 (ii) Pb-Sn (iii) Ag-Pt (iv)MgO - Al_2O_3 , Applications of Phase diagrams.

References:

1. Materials science – V. Rajendran & A. Marikani (TMHl).
2. Elements of material Science & engineering.- I.H.Van Vlack (4^{th} Edition.).
3. Material Science and Engineering by Raghavan.
4. Material Science and Metallurgy V.D. Kodgire.

Paper VII :- Classical Mechanics & Quantum Mechanics and Spectroscopy & Astrophysics

Section I - Classical Mechanics & Quantum Mechanics

1. Mechanics of a particle and system of particles:-Mechanics of a particle using vector algebra and vector calculus, conservation theorems, for linear and angular momentum and energy. Mechanics of a System of particles, Concept of centre of mass, conservation theorems for linear and angular momentum and energy. (5)

2. Langrangian Formulation :-Constraints, degrees of freedom, Generalised coordinates, Principle of Virtual work, D'Alembert's Principle, Langrange's equations from D'Alembert's Principle, Applications of Langrange's equation to i) a Particle in space (Cartesian Coordinates) ii)Atwood's Machine and iii) a bead sliding on uniformly rotating wire (10)

3. Moving Coordinate systems : Moving origin of coordinates, pseudo forces, Rotating coordinate systems, Coriolis Force, effect of Coriolis force in nature, effect of Coriolis force on freely falling body. (7)

4.Quantum Mechanics: Heisenberg's Uncertainty Principle (Statement),its similarity with concept of matter waves , time dependent and time independent Schrodinger Wave equations. Physical significance of ψ , Eigen Values and Eigen Functions, Probability current density (Qualitative idea only.) (5)

5.Application of Schrodinger's time independent wave equation:

1.Particle in a Box (One and three dimensional cases) its eigen Values and eigen functions.

2.Step potential, Potential Barrier, Potential Well.

Statement and boundary conditions, Schrodinger's equations in different regions, discussion of results. (only Qualitative treatment for all the three cases.) Linear Harmonics Oscillator – Eigen Values and Eigen functions. Zero point Energy. (10)

6. Operators: Operator's in Quantum Mechanics, their Expectation values and properties. Angular Momemtum Operator, and Commutation properties for its components ,(Lx, Ly , Lz) Commutation for L^2 and Lz operators and their Eigen values, Schrodinger's equation for **Hydrogen atom.** Separation of radial and angular parts.Significance of n, l, m_l and m_s quantum numbers. (8)

References :

1.Classical Mechanics by Goldstien

2.Introduction to Classical Mechanics by R.G. Takawale and P.S. Puranik

3.Classical Mechanics by Gupta Kumar Sharma

4. Classical Mechanics by J.C.Upadhye
5.Perspectives of Modern Physics- Arther Beiser
6.Quantom Mechanics by J. Powell and B. Creassman
7.Introduction to Quantum Mechanics by Pauling and Wilson
8.Elements of Quantum Mechanics by Kamal Singh and S.P. Singh.

Section II : Spectroscopy & Astrophysics

7.Atomic Spectra: Review of Quantum numbers, electronic configuration of alkali metals, Doublet fine structure of Alkali metals, optical spectral series, spectral notations, spectrum of Sodium, Selection rules , intensity rules, Electron-spin interation. (7)

8. Effects of Magnetic and Electric fields on Atomic Spectra: Anomalous Zeeman effect and its explanation from vector atom model of a one electron system in a weak magnetic field, Lande g factor.The Paschen Back effect, Paschen Back effect in principal series doublet,
Selection rules for Paschen Back effect.The Stark effect of hydrogen, weak field Stark effect in Hydrogen, strong field Stark effect in Hydrogen, second order Stark effect in Hydrogen. (6)

9.Molecular Spectra The Molecular bond, electron sharing, the H_2^+ molecular ion, the hydrogen molecule, rotational energy levels, rotational spectra, vibrational energy levels, vibrational spectra, vibration-rotation spectra.Electronic spectra of diatomic molecules, intensity of vibrational electronic spectra, Franck-Condon principle. (9)

10. Raman effect :Raman effect, characteristic properties of Raman lines, difference between Raman spectra and infra red spectra, classical theory of Raman effect. (3)

11. Cosmology : The Big-Bang Theory of Universe, the steady state cosmology, the oscillating cosmology,
the Hubble lawand cosmological tests, (3)

12. Milky –way galaxy and Solar System:The Milky-way galaxy, inter-stellar medium, interstellar molecules, stellar evolution, stellar energy of nuclear origin, fusion of light nuclei,

Origin of solar system, Condensation theory, arguments for and against the theory, early history of planets, planetary properties of Mars, evidence of geological activities, prospects for life on Mars, surface of the Sun, Sunspots, the Sunspot cycle. (15)

References:

1.Atomic Spectra – H.E. White
2.Molecular Spectroscopy - Banwell
3.Molecular Spectroscopy - Hertzberg
4. Modern Physics – Arthur Beiser

5.Fundamentals and Frontiers of Astronomy- Jastrow and Thompson
6. Astronomy- Franck Bash

Paper VIII: Electrodynamics & Electromagnetic Waves and Electronics & Computer Programming

Section I : Electrodynamics & Electromagnetic Waves

1.Electrostatics and Charged particle dynamics:

Poisson's and Laplace's equations and their applications to spherical systems, Motion of charged particles in i) constant electric (E) and magnetic (B) fields, ii) crossed uniform electric and magnetic fields. (8)

2. Time varying fields:

E.M.F., electromagnetic induction – Faraday's law (integral and differential forms) , Lenz's law, Mutual and self inductance, applications to transformer, solenoid, straight conductor. (7)

3. Maxwell's equations:

Biot-Savart's law, Ampere's law, derivation of m.B = o and m x B =J, displacement current, Maxwell's correction to Ampere's law, Maxwell's equations for time-dependent electric and magnetic fields in vacuum and material medium. (10)

4. Electromagnetic waves:

Wave equations for electric (E) and magnetic (B) fields in vacuum, plane wave solutions, orthogonality of E, B and propagation vector (k), plane e.m. waves in vacuum, dielectrics and conductors, attenuation of waves in metals (skin depth), Poynting's vector, conservation of energy and momentum in e.m. fields. (10)

5. Reflection and Refraction of E.M.waves:

Boundary conditions for e.m. field vectors, reflection and refraction of e.m. waves at a boundary of two dielectrics (normal incidence only), total internal reflection. (7)

6. Radiation from Electric Dipole:

Electric dipole, power radiated by a dipole and its radtion reaction. (3)

References:

1.Introduction to Electrodynamics (third edition) – David. J. Griffith's.
2.Classical Electrodynamics – S. P. Puri
3.Classical Electrodynamics – J. D. Jackson.
4.Electrodynamics – B.B. Laud.

Section II: Electronics & Computer Programming

7. Operational Amplifier:-Differential amplifier and its types, Comparison between normal amplifier and differential amplifier, Common mode and differential mode gains, CMRR, OP-AMP using block diagram, Characteristics of OP-AMP, OP-AMP parameters, OP-AMP as inverting amplifier, non inverting amplifier,.adder, subtractor, differentiator, integrator., comparator,Schmitt's trigger . (9)

8. Timer :-

Block diagram of IC 555, it's Pin connections, Operating modes monostable and astable , Applications of timer IC 555 as linear ramp generator and square wave generator, voltage to frequency converter. (5)

9. Power Electronics

SCR construction, Characteristics, turn on methods of SCR, Applications of SCR to control the speed of DC motor, Four layer PNPN diode, Diac and Triac Characteristics, and their applications. (8)

10. Computer Fundamentals:- Introduction toComputer Hardware and Software, Computer languages:- Lower level language, Assembly language, Higher level language.Operating system, functions of operating system. Introduction to MS DOS and Windows (4)

11. Introduction of C++ :-

History of C++, Character set and Keywords of C++, Standard I/O streams.Identifiers, constants and variables , Data types. Operators in C++ : Arithmetic operators, increment and decrement operator, relational operators, logical operators, Hierarchy of operators, assignment operator, conditional operators. (6)

12. Programming in C++ : Algorithm, flow chart, structure of C++ program, comment in C++, Control statements:- if … Else, switch….. case, for statement, while and do…while statements,Simple programs using above statements. (10)

Refernces:

1.Electronic principles – Malvino & Leech
2.Basic Electronic – Grob
3.Electronic Circuits and devices – Allan Mottershed
4.Linear Op – Amp – Ramakanth Gaikwad
5.Electronic principles – V.K.Mehta
6.Mastering C++ - Venugopal & Ravishankar

7.Programming in C++ - Balguruswamy.
8.Fundamentals of Computers – P.K.Sinha

Practicals

Group I : (General Physics, Heat and Sound)

1. Resonance Pendulum
2. S.T. of a Soap film
3. S.T. by Fergusson's modified method
4. Y and η using Flat spiral spring
5. Y by Koenig's method
6. Y by vibration of a bar
7. Stefan's fourth power law
8. Thermal conductivity by Lee's method
9. Velocity of sound using C.R.O. and microphone
10. Y by Cornu's method

Group II : (optics)

1. Cardinal points by turn table
2. Cardinal points by Newton's method
3. Wedge shaped film – Measurement of thickness
4. Diffraction due to cylindrical obstacle
5. Diffraction at straight edge
6. Lloyd's single mirror
7. Diameter of Lycopodium powder
8. R.P. of a prism
9. μ by total internal reflection
10. Elliptically and circularly polarized light

Group III : (Electricity and magnetism)

1. Self inductance by Owen's bridge
2. Self inductance by Rayleigh's method
3. Earth Inductor- B_H , B_V and ϴ
4. Hysterisis by magnetometer method
5. High resistance by leakage
6. Absolute capacity of a condenser
7. Calibration of a bridge wire using Carey Foster Bridge
8. e/m by Thomson method
9. Series resonance and parallel resonant circuits
10. Resistivity by four probe method

Group IV : (Electronics)

1. Astable multi vibrator using IC555
2. OP-AMP as inverting amplifier
3. OP-AMP as comparator –Schmitt's trigger
4. OP-AMP as adder and subtractor
5. . SCR characteristics
6. RS and JK flip flops
7. Band gap energy / temp. sensor using semiconductor diode
8. FET as VVR
9. SCR firing by UJT
10. Study of monostable operation of IC 555

Group V : (Skill testing and computer programming) / Project Work

V(A) Skill testing

1. Study of divergence of Laser beam
2. Polar graph using photo cell
3. Study of Lissajeous figures using C.R.O.
4. Measurement of Phase shift of RC network using C.R.O.
5. Resistance of B.G. by half deflection method
6. Assembling the given electronic circuit using breadboard
7. Diode as Clipper
8. Testing of electronic components.
9. Radius of capillary bore using mercury thread
10. Comparison of capacities by measuring throws separately

V(B) Computer programming

1. Creating a document using MS WORD
2. Plotting of graphs using MS Excel
3. Creating a presentation using Power point
4. Creating E-Mail ID as sending E-Mail with file attachment
5. Searching information of physics topics through search engine.
6. C++ program – To find larger between two numbers using if….else
7. C++ program– To find smallest of three numbers using nested if
   or multiple if
8. C++ program –To find sum of first 10 natural numbers using do-while loop
9. C++ program – To generate Fibonacci series
10. C++ program – To find area of a circle using function defination

Group VI : (Assessment of annual work of a student)

1. Certified Laboratory Journal
2. Seminar Report
3. Tour Report

Scheme of Practical examination for B.Sc. Part III (New Syllabus)

1. Practical examination will be conducted for three days per batch.
2. The examination will be conducted for three days in two sessions per day and each session will be of three hours duration.
3. Every candidate should perform one experiment each from Group I to IV .
4. Every candidate should perform **either** two experiments from Group V [one each from V.(A) and V.(B)] **or** a Project
5. Study tour up to seven days any where in India is compulsory.
6. The distribution of marks for practical examination is as given below

Group I to IV:- 32 marks each expt.		**= 128 marks**
Group V :-[16marks x 2)] / Project		**= 32 marks**
Group VI :-		**= 40 marks**
1. Certified Laboratory Journal	**= 20**	
2. Seminar Report	**=10**	
3. Tour Report	**=10**	
	--------	**40 marks**
	Total	**= 200 marks**