BANGALORE UNIVERSITY
Syllabus, Scheme of Instruction & Examination for
B.Sc., Physics Semester Scheme (from 2014- 15)

Serial Number	Paper Number	Teaching hours per week	Examination duration	Maximum marks		Maximum total marks
				Final exam	IA	
01	PHY 101	4	3 hours	70	30	100
02	PHY 102	3	3 hours	35	15	50
03	PHY 201	4	3 hours	70	30	100
04	PHY 202	3	3 hours	35	15	50
05	PHY 301	4	3 hours	70	30	100
06	PHY 302	3	3 hours	35	15	50
07	PHY 401	4	3 hours	70	30	100
08	PHY 402	3	3 hours	35	15	50
09	PHY501	3	3 hours	70	30	100
10	PHY502	3	3 hours	35	15	50
11	PHY503	3	3 hours	70	30	100
12	PHY504	3	3 hours	35	15	50
13	PHY601	3	3 hours	70	30	100
14	PHY602	3	3hours	35	15	50
15	PHY603	3	3 hours	70	30	100
16	PHY604	3	3hours	35	15	50
				Grand total		1200

Note-I:

- The paper number is a three digit number with ' **0** ' in the middle
- The digit to the left of ' **0** ' indicates the semester number
- Odd number to the right of ' **0** ' indicates a theory paper
- Even number to the right of ' **0** ' indicates a practical paper

Note-II:

The marks distribution for the final practical examination is as follows:

1. Writing formula, Explanation, Figure/circuit diagram 05 Marks
2. Setting up of the experiment & entering the observations in the tabular column. 20 Marks
3. Calculation / Graph, Results with units 05 Marks
4. Class Records (to be valued at the time of practical examination) 05 Marks

Total for the practical examination – 35 marks

Note-III:

A minimum of **EIGHT** (8) experiments must be performed in each practical paper

Syllabus for I Sem BSc, (Physics)
PHY-101: Mechanics, Oscillations and Properties of matter

Unit -1

Motion & Friction

Newton's laws of motion with illustrations (review); Enumeration of II law - Motion in a resistive medium; Examples of drag force, concept of terminal velocity; role of static and dynamic friction; Motion along inclined plane with and without frictional force; Use of free body diagrams

6 hours

Frames of reference

Inertial and Non inertial frames of reference; Galilean relativity; Postulates of special theory of relativity; Lorentz transformation equation (no derivation) ; mass energy equivalence; length contraction and time dilation

7 hours

Unit -2

Planetary & Satellite motion

Motion along a curve - radial and transverse components of acceleration; Newton's law of gravitation, Kepler's laws (statements only); Escape velocity and orbital velocity; Launching of artificial Satellite; Geostationary and geosynchronous satellites

5 hours

Work & Energy

Work done by a constant and variable force; Work energy theorem; Work and potential energy; examples of potential energy; Work done by gravitational force; Work done by a spring force; Conservative and non conservative force; Conservation of energy

4 hours

Surface tension

Molecular interpretation of surface tension; Surface energy; Angle of contact and wetting; Pressure difference across a curved surface; Interfacial tension; Drop weight method with necessary theory; Factors affecting surface tension

4 hours

Unit - 3

System of particles

Centre of mass of rigid bodies; Newton's law for a system of particles; Linear momentum for a particle and a system of particles; Conservation of linear momentum; System with varying mass; Rocket motion; Elastic and inelastic collisions (oblique)

5 hours

Moment of inertia

Review of rotational motion of Rigid bodies; Kinetic energy of rotation-Moment of Inertia of a body; Theorem of Moment of Inertia-Parallel and perpendicular axes theorem with proofs (2-D case); Calculation of moment of inertia of a disk, annular ring, solid sphere and rectangular bar; Conservation of angular momentum with illustrations

8 hours

Unit - 4

Oscillation

SHM; Simple and compound pendulum; damped oscillations; forced oscillations - concept of resonance; coupled oscillators

5 hours

Elasticity

Review of elastic properties; Relationship between three elastic constants; Poisson's ratio; Work done in stretching a wire; Bending of beams; Bending moment, Theory of single cantilever, Couple per unit twist, Torsional oscillations

8 hours

References

1. Fundamentals of Physics- RResnik, and D Halliday, Wiley 2001
2. Physics-Classical and Modern, FJKeller, EGettys and JJSkove, McGraw Hill Second Edition
3. Classical Mechanics-KNSreenivasaRao, Universities Press- Orient Longman
4. Concepts of Physics Vol (1)-HC Verma, Bharathi Bhavan Publishers, 2004 Edition
5. University Physics- FWSears, MW Zemansky & HDYoung, Narosa Publications- Delhi
6. Mechanics- JCUpadhaya, Ramprasad & Co, Agra
7. Mechanics- Berkeley Physics Course Vol(1)- Mittal, Knight & Rudermann, TMH Delhi, 1981
8. Mechanics- EMPurcell, McGraw Hill
9. Oscillations and Waves – DPKhandelwal, Himalaya Publishing House
10. Elements of Properties of matter - DSMathur, Shamlal Charitable Trust, Delhi, 1996
11. Properties of Matter - Brijlal & Subramanyam, SChand & Co, 1982
12. Newtonian Mechanics- APFrench, Nelson & Sons UK, 1971
13. Mechanics & Thermodynamics, GBasavaraju & Dipan Ghosh, TMH Publishing Limited, New Delhi
14. A treatise on general properties of matter, Sengupta and Chatterjee, (Fifth edition -2001) New Central Book Agency, Calcutta
15. Waves & Oscillations, PKMittal & Jai Dev Anand, Hari Anand Publications (1994)

PHY-102: Practical Physics – I

List of Experiments

1. Atwood machine – with photogate
2. Torsional pendulum – to determine C and Rigidity modulus
3. Spring mass- (a) static case to determine 'k'
   (b) dynamic case to determine 'k'
   (c) 'k' as a function of L of spring
4. Bar pendulum – effective length and T
5. Rigid pendulum – T and decay of amplitude
6. Coupled oscillator – string coupled with change of tension
7. Simple pendulum - dependence of T on amplitude
8. Rolling dumb bell - on parallel inclined rails
9. Verification of parallel and perpendicular axis theorem
10. Searle's double bar
11. Work done by variable force
12. Cantilever of negligible mass to find Young's modulus
13. q- by Stretching
14. Fly wheel
15. Verification of principle of conservation of energy
16. Determination of coefficients of static, kinetic and rolling frictions
17. q by uniform bending
18. q by single cantilever

Note: A minimum of EIGHT (8) experiments must be performed

Referenc

1. BSaraf etc, - Physics through experiments, Vikas Publications
2. DPKhandelwal – A Laboratory Manual of Physics for Undergraduate Classes, Vani Publications
3. Advanced Practical Physics for Students – Worsnop & Flint, Methuen & Co, London
4. An Advanced Course in Practical Physics , D Chattopadhyay, PC Rakshit, B Saha, New Central Book Agency (P) Limited, Kolkata, Sixth Revised Edition, 2002
5. BSC, Practical Physics, CLArora, SChand & Co, New Delhi, 2007 Revised Edition

Syllabus for II Sem BSc (Physics)
PHY-201: Thermal physics and Statistical mechanics

Unit - 1

Kinetic Theory of Gases

Basic assumptions of kinetic theory; Derivation of $pV = \frac{1}{3}mnc^2$ - deduction of perfect gas equation; Maxwell's law of distribution of velocity *(without derivation)* ; Calculation of most probable velocity, mean velocity and root mean square velocity; Derivation of expression for mean free path; Degrees of freedom and principle of equipartition of energy; Derivation of $U = \frac{3}{2}RT$, Specific heats of an ideal gas, atomicity of gases

7 hours

Transport Phenomena

Viscosity and thermal conduction in gases *(with derivation)* ; Relation between coefficient of viscosity and coefficient of thermal conductivity of a gas

2 hours

Real Gases

Derivation of van der Waal's equation of state; Andrews experiments on Carbon dioxide; Derivation of the critical constants; Comparison of van der Waal's isotherms with Andrew's isotherms

4 hours

Unit – 2

Basic Concepts and the Zeroth law of thermodynamics

Macroscopic and microscopic descriptions of a system; Thermal Equilibrium - Zeroth Law of Thermodynamics; Concept of temperature; Thermodynamic equilibrium; Thermodynamic coordinates - extensive and intensive; Equations of state; Various processes - PVT indicator diagrams

3 hours

First Law of Thermodynamics

The first law of Thermodynamics; Sign convention for heat and work; Work done in an isothermal process for an ideal gas; Internal energy as a state function; Application of the first law for (i) Cyclic Process (ii) Adiabatic Process (iii) Isochoric Process (iv) Isobaric Process and (v) Isothermal Process

3 hours

Second Law of Thermodynamics

Reversible and irreversible processes; Carnot Cycle and its efficiency (with derivation); Second law of thermodynamics (Kelvin's & Clausius' statements and their equivalence); Carnot Engine; Practical internal combustion engines - Otto and Diesel Cycles (qualitative treatment); Carnot theorem; The thermodynamic temperature scale; Refrigerator- Coefficient of performance

3 hours

Entropy

The concept of entropy; Entropy of an ideal gas; Entropy - reversible process, Entropy - irreversible process; Entropy and the second law; Clausius inequality; Principle of increase of entropy; Entropy change in (i) adiabatic process (ii) free expansion (iii) cyclic process (iv) isobaric process; TdS diagram of a Carnot cycle; Entropy and disorder

4 hours

Unit - 3

Thermodynamic potentials

Internal Energy; Enthalpy; Helmholtz free energy; Gibbs free energy and their significance; Maxwell's thermodynamic relations and their significance; TdS relations; Energy equations and Heat Capacity equations; Third law of thermodynamics (Nernst Heat theorem)

4 hours

Phase transitions of the first order

Melting, vaporization and sublimation; Condition of equilibrium of phases in terms of Gibbs potential; Clausius-Clapeyron equation - elevation of boiling point, depression of freezing point; Equilibrium between phases - triple point

3 hours

Classical Equilibrium Statistical Mechanics

Specification of the state of the system; Phase space; Microstates and macrostates; Thermodynamic probability and its calculation; Basic postulates; Entropy and thermodynamic probability; Calculation of temperature from statistical mechanics

6 hours

Unit - 4

Low Temperature Physics

Methods of producing low temperatures: (i) Joule Thomson (Joule Kelvin / Throttling / Porous plug) experiment, Joule Thomson Coefficient, inversion temperature (ii) Adiabatic demagnetization - working and theory

4 hours

Liquefaction of gases

Cascade process; Regenerative cooling coupled with Joule Thomson cooling; Adiabatic expansion with Joule Thomson cooling (qualitative)

3 hours

Black Body Radiation

Block body radiation and its spectral energy distribution; Kirchhoff s law, Stefan-Boltzmann's law, Wien¯s displacement law, Rayleigh-Jeans law, Derivation of Planck'¯s law, Radiation pressure (qualitative), Solar constant and its determination; Estimation of the surface temperature of the sun

6 hours

References

1. Fundamentals of Physics- RResnik, D Halliday and KS Krane, Asian Books Private Limited, New Delhi, 1994
2. Heat and Thermodynamics- M M Zemansky,(International Edition) McGraw Hill New Delhi, 1981
3. Heat & Thermodynamics, MWZemansky & RHDittman, McGraw Hill Book company, Fifth Print 1986
4. Heat and Thermodynamics- Brij Lal and N Subramanyam, SChand & Co, New Delhi -1985
5. Concepts of Physics Vol (1) and (2)- HC Verma, Bharathi Bhavan Publications, New Delhi, 1996
6. Heat and Thermodynamics - DS Mathur, SChand & Co, New Delhi, 5th Edition(2004)
7. Heat, Thermodynamics & Stastical Mechanics, BrijLal & Subramanyam, SChand & Company
8. Thermodynamics & Statistical Physics, Sharma & Sarkar, Himalaya Publishing House, Third Edition(1991)
9. Thermodynamics, Kinetic theory & Statistical Thermodynamics, FWSears & GLSalinger, Narosa Publishing House (Third Edition)
10. Mechanics & Thermodynamics, GBasavaraju & Dipan Ghosh, TMH Publishing Limited, New Delhi, 1984
11. Fundamentals of Classical Thermodynamics, Gordon J V Wylen & Richard E Sonntag, Wiley Eastern Limited
12. Thermal Physics, S C Garg, R M Bansal & C K Ghosh, TMH Publishing Company, New Delhi
13. Statistical Physics, Thermodynamics & Kinetic theory, V S Bhatia, SChand & Co, (5th Edition-1993)
14. Perspectives of Modern Physics, Arthur Beiser, McGraw hillo Book Company, Fourth Edition, 1987
15. Thermal Physics, BKAgarwal, Lokbharathi Publications, Allahabad, Third Edition 1993
16. Elements of Statistical Mechanics, Kamal Singh & SPSingh, SChand & Co, (IInd Edition, 1992)

17. Theory & Problems of Thermodynamics, Michael M Abbott & Hendrick C Van Ness, Schaum's Outline Series, McGraw Hill International Book Company, Singapore
18. University Physics-Sears & MW Zemansky
19. Fundamentals of Statistical and Thermal Physics -F Reif
20. Mechanics and Thermodynamics, C Basavaraju and D Ghosh
21. Thermal Physics- *C* Kittel
22. Thermal Physics - Chakraborthy

PHY-202: Practical Physics – II

List of Experiments

1. Specific heat by Newton's law of cooling
2. Specific heat of water using a thermistor
3. Thermal conductivity of a bad conductor by Lee's and Charlton's method
4. Thermal conductivity of rubber
5. Determination of thermal conductivity of a good conductor by Angstrom method / Searle's method
6. Thermal behavior of a torch filament
7. γ- by measuring velocity of sound- using CRO
8. Verification of Newton's law of cooling and Stefan's law of radiation
9. Determination of Stefan's constant by emissivity method
10. Calibration of thermocouple for Temperature measurement
11. Verification of Clausius-Clapeyron equation using pressure cooker
12. Determination of Solar constant
13. Monte Carlo experiment & error analysis
14. Verification of Maxwell's distribution of velocity
15. Maxwellian distribution of velocities for electron using EZ81vacuum diode
16. Dice experiment – to study statistical nature of results

Note: A minimum of EIGHT (8) experiments must be performed

References:

1. BSaraf etc, - Physics through experiments, Vikas Publications
2. DPKhandelwal – A Laboratory Manual of Physics for Undergraduate Classes, Vani Publications
3. Advanced Practical Physics for Students – Worsnop & Flint, Methuen & Co, London
4. An Advanced Course in Practical Physics , D Chattopadhyay, PC Rakshit, B Saha, New Central Book Agency (P) Limited, Kolkata, Sixth Revised Edition, 2002
5. BSC, Practical Physics, CLArora, SChand & Co, New Delhi, 2007 Revised Edition

Syllabus for III Sem BSc (Physics)
PHY-301: Electricity and Magnetism

Unit - 1

Electric field and potential Review:
Electrostatic field and intensity; Electrostatic potential; Relation between field and potential

1 hour

Electric dipole, potential and intensity at any point due to a dipole

2 hours

Network theorems
Superposition theorem; Thevenin's theorem; Norton's theorem; Maximum power transfer theorem (for dc circuits - with problems)

5 hours

Magnetic fields and forces

Motion of charged particles in a magnetic field; Magnetic force on a current carrying conductor; Force and torque on a current loop, Concept of dead beat; Theory of a BG, Determination of high resistance by leakage

5 hours

Unit - 2

Source of magnetic field
Magnetic field due to moving charge, Biot and Savart's law; Magnetic field due to a straight current carrying conductor; Force between parallel conductors; Definition of ampere; Magnetic field of a circular loop; Theory of HTG; Field on the axis of a solenoid, Ampere's law, Application of Ampere's law to straight wire, solenoid and toroid

10 hours

Electromagnetic induction
Faraday's laws; Lenz's law; Expression for induced emf; motional emf; eddy currents and applications

3 hours

Unit - 3

Transient currents
Self inductance; Magnetic field energy stored in an inductor; Growth and decay of current in RC, LR, LCR circuits; Damped, under-damped and over-damped conditions

5 hours

Scalar and vector fields
Gradient of a scalar function; Relation between field and potential; Divergence and curl product rules; Line, surface and volume integrals; Fundamental theorem of divergence and curl (statements only)

3 hours

Electromagnetic waves
Maxwell's equations (derivation and significance) ; Electromagnetic waves - Derivation of wave equation, Velocity of em waves, Relation between refractive index and permittivity, Plane em waves, Energy and momentum, Significance of Poynting vector

5 hours

Unit - 4

Alternating current
Alternating current circuits, Resistance, Reactance and Impedance; LCR series and parallel circuits (vector method), Resonance, Power in ac circuits, Representation of sinusoids by complex numbers, ac bridge - Maxwell bridge

6 hours

Thermoelectricity
Seebeck effect; Thermoelectric series; Neutral temperature; Laws of thermoelectricity; Peltier effect, Demonstration of Peltier effect, Peltier coefficient; Thomson effect, Demonstration of Thomson effect, Thomson coefficient; Theory of thermoelectric circuits using thermodynamics; Thermoelectric diagrams and uses; Applications of thermoelectricity - Boy's radio micrometer, thermopile and thermoelectric pyrometer

7 hours

References

1. Electricity and magnetism by Brij Lal and N Subrahmanyam, Rathan Prakashan Mandir, Nineteenth Edition, 1993
2. Principles of Electronics by VK Mehta and Rohit Mehta, SChand & Company, Eleventh Edition, 2008
3. Feynman Lecture series, VolII, RPFeynnman et al, Narosa Publishing House, New Delhi
4. Electricity & Magnetism, NSKhare & SSSrivastava, AtmaRam & Sons, New Delhi
5. Electricity & Magnetism, DLSehgal, KLChopra, NKSehgal, SChand & Co, Sixth Edition, (1988)
6. Electricity & Electronics, DCTayal, Himalaya Publishing House, Sixth Edition(1988)
7. Basic Electronics & Linear Circuits, NN Bhargava, DC Kulshrestha & SC Gupta, TMH Publishing Company Limited, 28th Reprint,1999
8. Fundamentals of Physics by Halliday, Resnick and Walker, Asian Books Private Limited, New Delhi, 5th Edition,1994
9. Introduction to Electrodynamics by DJ Griffiths
10. Electromagnetism by BB Laud
11. Electrical Networks, Theraja
12. Electrical Networks, Malvino

PHY - 302: Practical Physics – III

List of Experiments

1. To find L and C by equal voltage method
2. Energy consumption in an electrical circuit - to find power factor
3. Resonance in LCR series circuit
4. Resonance in LCR parallel circuit
5. Mirror galvanometer- figure of merit
6. High resistance by leakage using BG
7. Thermoelectric circuit - find Seebeck coefficients
8. Study of thermo emf as a heat pump
9. Black box - identify & measure R, L and C
10. Verification of Thevenin's theorem
11. Verification of Superposition theorem
12. Verification of maximum power transfer theorem
13. Maxwell's impedance bridge
14. Desauty's bridge
15. Anderson's bridge

Note: A minimum of EIGHT (8) experiments must be performed

References:

1. Physics through experiments, BSaraf etc,Vikas Publications
2. Advanced practical physics, Chauhan & Singh, Pragathi Publications
3. Practical Physics, DChattopadhyaya et al, Central Publications
4. An Advanced Course in Practical Physics , D Chattopadhyay, PC Rakshit, B Saha, New Central Book Agency (P) Limited, Kolkata, Sixth Revised Edition, 2002
5. Practical Physics, TCTayal

Syllabus for IV Sem BSc (physics)

PHY- 401: Physical Optics, Lasers and Fibre optics

Unit - 1

Wave Theory

Huygens' wave theory of light; Huygens' Principle; Construction Huygens' wave front; Laws of reflection and refraction using spherical wave front at a plane surface

3 hours

Interference – a Review:

Coherent sources and their production; Conditions for observing interference; Conditions for constructive and destructive interference

1 hour

Coherent sources by wavefront division

Biprism-theory and working, experiment to determine wavelength; Effect of thin film in the path of one of the beams; Calculation of thickness of the film

5 hours

Coherent sources by amplitude division:

Interference at thin films - reflected and transmitted light Colours of thin films; Theory and experiment of air wedge; Theory and experiment of Newton's rings

4 hours

Unit - 2

Diffraction - Fresnel diffraction

Division of wavefront into Fresnel's half period zones; Theory of rectilinear propagation using these ideas; Construction and working of Zone plate; Comparison of Zone plate with lens; Theory of diffraction at a straight edge

7 hours

Fraunhoffer diffraction

Theory of single slit diffraction; Theory of grating - normal and oblique incidence - Experimental determination of wavelength; Discussion of Dispersive power; Resolution, Rayleigh's criterion; Expression for resolving power of grating and telescope; Comparison of prism and grating spectra

6 hours

Unit - 3

Lasers

Introduction; Spontaneous and stimulated emission; Einstein's coefficients and optical amplification; Population inversion; Main components of a laser; Lasing action; Ruby Laser - construction and working - energy level diagram; He-Ne Laser - construction and working - energy level diagram; Fiber Laser - Master Oscillator power amplifier; Solid State Laser - construction and working; Applications of Lasers - Holography, bloodless surgery (principles only)

7 hours

Polarization

Review of plane polarized light and method of production; Double refraction at crystals; Huygens' explanation of double refraction; Theory of retarding plates - Quarter wave plates and Half wave plates; Production and detection of linearly , elliptically and circularly polarized light; Optical activity - Fresnel's explanation Laurent's half shade polarimeter

6 hours

Unit - 4

Optical Fibres

Optical fiber-principle, description and classification; Why glass fibers? Coherent bundle; Numerical aperture of fiber; Attenuation in optical fibers - limit Multimode optical fibers; Ray dispersion in multi-mode step index fibers; Dispersion due to material; Dispersion and maximum bit rates; Fiber optic sensors

8 hours

Modes in fibres

Introduction; Modes in fibers Symmetric step index planar waveguide TE modes; Propagation constants; Field distribution; Physical understanding of modes; TM modes of a symmetric step index planar wave guide

5 hours

References

1. Introduction to Modern Optics, Tata McGraw Hill Publications (2009)
2. Fundamentals of Physics by Halliday, Resnick and Walker, Asian Books Private Limited, New Delhi, 5th Edition, 1994
3. A K Ghatak and K Thyagarajan, Contemporary Optics, Macmillan
4. Jenkins and White, Optics, McGraw Hill
5. Optics, BrijLal and Subramaniam, SChand & Company, 22nd Edition, 1994
6. Principles of Optics, B K Mathur, Gopal Printing Press, Kanpur, 6th Edition,1996
7. An Introductions to LASERS-Theory & Applications, MNAvadhanulu, SChand & Co, (2001)
8. Introduction to Fibre Optics, Ajoy Ghatak & K Thyagarajan, Cambridge University Press, First Edition Reprint,2002
9. Optical Fibre Communications, Gerd Keiser, McGraw Hill, 3rd Edition, 2000
10. Fibre Optic Communication, DCAgarwal, Wheeler Publications, Second Edition Reprint,1996
11. Optics, Klein and Furtak, Wiley Publications
12. B B Laud, Lasers, Wiley Eastern

PHY-402: Practical Physics – IV

List of Experiments

1. Verification of Brewster's law
2. Refractive index of a liquid by parallax method
3. Biprism – determination of wavelength of light
4. Air wedge – determination of thickness of object
5. Newton's rings – determination of radius of curvature of lens surface
6. Diffraction grating in minimum deviation position
7. Diffraction grating in normal incidence position
8. Resolving power of telescope
9. Diffraction at straight edge
10. Polarimeter – determination of specific rotation of a solution
11. Diffraction of LASER at a wire
12. Measurement of numerical aperture of an optical fibre
13. Fraunhoffer diffraction of LASER at single slit
14. Diffraction of LASER at graduations of a metal scale

Note: A minimum of EIGHT (8) experiments must be performed

References:

1. An Advanced Course in Practical Physics , D Chattopadhyay, PC Rakshit, B Saha, New Central Book Agency (P) Limited, Kolkata, Sixth Revised Edition, 2002
2. Practical Physics, Experiments with He-Ne laser, RSSirohi
3. Advanced Practical Physics, Wirsnop & Flint
4. BSc, Practical Physics, CLArora, SChand & Company, New Delhi, Revised Edition, 2007

General References:

1. College Physics, Raymond A Serway & Jerry S Faughn, Thomson Brooks / Cole (sixth Edition)
2. Scientia Physics, Avinash Sharma, CBS Publishers & Distributors, New Delhi(First Edition 2000)
3. Principles of Physics, Frederick J Bueche & David A Jerde, McGraw Hill Inc (Sixth Edition)
4. University Physics, Hugh D Young & Roger A Fredman, Addision Wesley Longman Inc, (Ninth Edition) , Pinnacle Distributors, NewDelhi
5. Understanding Physics, Karen Cummings, Priscilla Laws, Edward Redish & Patrick Cooney, Wiley India, 2006 Reprint
6. College Physics, Serway

Syllabus for V Sem. B.Sc. (Physics)
PHY 501: Quantum Statistical Physics, Quantum Mechanics-I and II

Unit-1: Statistical Physics

Maxwell – Boltzmann distribution function (with derivation) **1 hour**

Bose-Einstein Statistics

B-E distribution law (with derivation), Bose-Einstein condensation properties of liquid He (qualitative description). Radiation as photon gas. Bose's derivation of Planck's law, Rayleigh-Jeans law, Wein's law, Thermodynamic functions of photon gas. Specific Heat capacity of metals. **9 hours**

Fermi – Dirac Statistics

Fermi-Dirac distribution function (with derivation), Fermi sphere and Fermi energy, Fermi gas, Electronic heat capacity in metals.

Comparison of Maxwell – Boltzmann, Bose – Einstein and Fermi – Dirac distribution functions. **5 hours**

Unit-2: Quantum Mechanics-I

Introduction to quantum mechanics : Planck's quantum theory, failure of classical physics to explain the phenomena such as stability of atom, atomic spectra, black body radiation, photo electric effect, Compton effect and specific heat of solids . Explanation of the above effects on the basis of quantum mechanics. **5 hours**

De Broglie's hypothesis of matter waves, Thomson's experiment, Davisson and Germer's experiment – normal incidence method, concepts of packets for quantum particle, group velocity and phase velocity, relation between particle velocity and group velocity. Heisenberg's uncertainty principle - different forms, Gamma ray microscope experiment, applications. **10 hours**

Unit-3: Quantum mechanics-II

The concept of wave function, physical significance of wave function. Development of time dependent and time independent Schrodinger's wave equation. Max Born's interpretation of the wave function. Normalization and expectation values, Quantum mechanical operators, Eigen values and Eigen functions. Applications of Schrodinger's equation – free particle, particle in one dimensional box- derivation of Eigen values and Eigen function – extension to three dimensional box; Development of Schrodinger's equation for One dimensional Linear harmonic oscillator, Rigid rotator, Hydrogen atom – mention of Eigen function and Eigen value for ground state. **15 hours**

References :

1. Quantum Mechanics, ***B.H. Bransden and C.J. Joachain***, 2nd Edition, Pearson Education (2004)
2. Introduction to Quantum Mechanics, ***David J. Griffiths***, 2nd Edition, Pearson Education ,(2005)
3. Modern Quantum Mechanics, ***J.J. Sakurai***, Pearson Education, (2000)
4. Principles of Quantum Mechanics, ***Ghatak and Lokanathan***, Macmillan, (2004)
5. Statistical Mechanics, An Introduction, **Evelyn Guha**, Narosa (2008)
6. Statistical Mechanics, ***R.K.Pathria***, 2nd edition, Pergamon Press (1972)
7. Statistical and Thermal physics, ***F.Reif***, McGraw Hill International(1985)
8. Statistical Mechanics, ***K.Huang***, Wiley Eastern Limited, New Delhi (1975)

PHY-502: Practical Physics V (A)

1. Analysis of X-ray diffraction pattern obtained by powder method to determine properties of crystals.
2. Determination of Fermi energy of a metal.
3. Determination of thermal conductivity of a metal by Forbe's method.
4. Measurement of heat capacity of metals.
5. Characteristics of a photo cell-determination of stopping potential.
6. Determination of Planck's constant.
7. Characteristics and spectral response (selenium photocell)
8. Hysteresis loop for iron and finding energy loss per cycle
9. Applications of CRO in the (a) study of Lissajous figures (b) calculation of rms voltage (c) calculation of frequency of AC.
10. Regulated power supply (using zener diode).
11. Determination of transistor h-parameters.
12. Frequency response of a CE amplifier.
13. Transistor as a switch and active device.
14. Construction of RFO or AFO - using transistor
15. Emitter follower

Note: A minimum of EIGHT experiments must be performed.

References :

1. Worsnop and Flint , Advanced practical physics for students, Asia Pub.(1979)
2. Singh and Chauhan, Advanced practical physics, 2 vols., Pragati prakashan, (1976)
3. Misra and Misra, Physics Lab. Manual, South Asian publishers (2000)
4. Gupta and Kumar, Practcal physics, Pragati prakashan, (1976)
5. Ramalingom & Raghuopalan : A Lab. Course in Electronics
6. Bharagav et al : Electronics, TTI

PHY- 503: Astrophysics, Solid State Physics and Semiconductor Physics

Unit-1: Astrophysics

Parallax and distance: Helio-centric parallax, Definition of parsec (pc), Astronomical unit (AU), light year (ly) and their relations.

Luminosity of stars: Apparent brightness, Apparent magnitude - scale of Hipparchus. Absolute magnitude - distance - modulus relationship. Distinction between visual and bolometric magnitudes, Radius of a star. **3 hours**

Stellar classification: Pickering classification and Yerke's luminosity classification. H-R diagram, Main sequence stars and their general characteristics.

Gravitational potential energy or self energy of a star based on the linear density model, Statement and explanation of Virial theorem.

Surface or effective temperature and color of a star : Wien's displacement law. Expressions for - average temperature, core temperature, hydrostatic equilibrium, core pressure of a star based on the linear density model of a star. Photon diffusion time (qualitative), Mass – Luminosity relationship and expression for lifetime of a star. **7 hours**

Evolution of stars: Stages of star formation (GMC – Protostar- T-Tauri) and main sequence evolution, White dwarfs, Pulsars, Neutron stars and Black holes, Variable stars, Supernova explosion- its types, Chandrasekhar limit. Event horizon, singularity and Schwarzchild's radius (qualitative) **5 hours**

Unit-2: Solid State Physics

Crystal systems and X-rays: Crystal systems-Bravais lattice; Miller indices– Spacing between lattice planes of cubic crystals, Continuous and characteristic X-ray spectra; Moseley's law, Scattering of X-rays - Compton effect, Bragg's law. **4 hours**

Free electron theory of metals : Electrical conductivity- classical theory (Drude-Lorentz model) ; Thermal conductivity; Wiedemann - Franz's law; Density of states for free electrons; Fermi-Dirac distribution function and Fermi energy; Expression for Fermi energy and Kinetic energy at absolute zero. Hall Effect in metals **5 hours**

Band theory of solids: Elementary ideas regarding formation of energy bands; Bloch theorem; One dimensional Kroning-Penney model; Effective mass; Energy gap. **4 hours**

Superconductivity : Introduction – Experimental facts – Zero resistivity – The critical field – The critical current density – Meissner effect ,Type I and type II superconductors– BCS Theory (qualitative). **2 hours**

Unit-3: Semiconductor Physics

Semiconductors: Distinction between metals, semiconductors and insulators based on band theory. Intrinsic semiconductors - concept of holes – effective mass - expression for carrier concentration and electrical conductivity – extrinsic semiconductors – impurity states in energy band diagram and the Fermi level.

Semiconductor devices: Formation of P-N junction, depletion region, Biased P-N junction, variation of width of the depletion region, drift and diffusion current –expression for diode current. **6 hours**

Special Diodes: Zener diode – characteristics and its use as a voltage regulator.
Photo diodes, Solar cells and LED (principle, working and applications). **4 hours**

Transistors: Transistor action, Characteristics (CE mode), Biasing, Load line analysis - Transistor as an amplifier(CE mode). h-parameters **5 hours**

References

1. Astronomy : Fundamentals and Frontiers – **Jastrow & Thompson**
2. Chandrashekhar and his limit – **G. Venkataraman**
3. An introduction to Astrophysics – **Baidyanath Basu**
4. Astrophysics Concepts, ***M. Herwit***: John Wiley, 1990.
5. Astrophysics. ***Krishnaswamy*** (ed)
6. Introduction to solid State Physics, ***Charles Kittel***, VII edition, 1996.
7. Solid State Physics- **A J Dekker**, MacMillan India Ltd, (2000)
8. Elementary Solid State Physic, **J P Srivastava**,PHI,(2008)
9. Essential of crystallography**, M A Wahab**, Narosa Publications (2009)
10. Solid State Physics-**F W Ashcroft and A D Mermin**-Saunders College (1976)
11. Solid State Physics-**S O Pillai**-New Age Int. Publishers (2001)

PHY –504: Practical Physics V (B)

1. Parallax Method – Distance of objects using trigonometric parallax.
2. HR Diagram & the physical properties of stars.
3. Analysis of stellar spectra.
4. Determination of temperature of a star (artificial) using filters.
5. Analysis of sunspot photographs & solar rotation period.
6. Mass luminosity curve – Estimation of mass of a star.
7. Mass of binary stars.
8. Resistivity of a material by four probe method.
9. Semiconductor temperature sensor.
10. Temperature coefficient of resistance and energy gap of thermistor.
11. LED characteristics and spectral response.
12. LDR characteristics – dark resistance – saturation resistance.
13. Solar cell characteristics – Open circuit voltage – short circuit current – efficiency.
14. Study of Hall effect in a metal.
15. Characteristics of LASER diode.
16. Spectral response of a photodiode and its I – V characteristics.

Note: A minimum of EIGHT experiments must be performed.

References :

1. IGNOU : Practical Physics Manual
2. Saraf : Experiment in Physics
3. S.P. Singh : Advanced Practical Physics
4. Melissons : Experiments in Modern Physics
5. Misra and Misra, Physics Lab. Manual, South Asian publishers, 2000
6. Gupta and Kumar, Practcal physics, Pragati prakashan, 1976
7. Ramalingom & Raghuopalan : A Lab. Course in Electronics
8. Bharagav et al : Electronics, TTI

Syllabus for VI Sem. B.Sc. (Physics)
PHY- 601: Atomic and Molecular Physics, Nuclear Physics and Material Science

Unit-1: Atomic and Molecular Physics

Vector Model of the Atom

Review of Bohr's theory of hydrogen atom, Sommerfeld's modification of the Bohr atomic model (qualitative). Spatial quantization and spinning electron. Different quantum numbers associated with the vector atom model, Spectral terms and their notations, Selection rules, Coupling schemes(*l*-s and j-j coupling in multi electron systems), Pauli's Exclusion Principle, Expression for maximum number of electrons in an orbit. Spectra of alkali elements (sodium D-line), Larmor precession, Bohr magneton, Stern-Gerlach Experiment**.** Zeeman Effect-Experimental study, theory of normal and anomalous Zeeman effect based on quantum theory. **10 hours**

Molecular Physics: Pure rotational motion, Spectrum and selection rules; Vibrational motion, vibrational spectrum and selection rules; Rotation-Vibration spectrum; Scattering of light-Tyndall scattering, Rayleigh scattering and Raman scattering. Experimental study of Raman effect, Quantum theory of Raman effect - Applications. **5 hours**

Unit-2: Nuclear Physics

Alpha particle scattering: Rutherford's theory of alpha scattering (assuming the path to be hyperbolic).

Alpha decay: Gamow's theory of alpha decay, Q-value of alpha decay, Exact energy of alpha particle emitted, characteristics of alpha spectrum. Geiger- Nuttal law.

Beta decay : Types of beta decay (electron, positron decay and electron capture). Characteristics of beta spectrum and Pauli's neutrino hypothesis. **8 hours**

Detectors : Variation of ionization current with applied voltage in a gas counter, GM Counter. **2 hours**

Particle accelerators: Cyclotron, Electron Synchrotron. **2 hours**

Nuclear reactions: Types of Nuclear reactions. Conservation laws. Expression for Q value of a nuclear reaction - Endoergic and Exoergic reactions, threshold energy. **3 hours**

Unit-3: Material Science

Nanomaterials - Synthesis techniques(Top down & bottom up)- Electron confinement-Size effect-Surface to volume ratio; distinction between nanomaterials and bulk materials in terms of energy band. Distinct properties of nano materials. Classification of Nanosystems - quantum dots, nanowires and nanofilms. Multilayered materials- Graphene, Fullerene, Carbon Nano Tube (CNT), Mention of applications of nanomaterials. **5 hours**

Dielectrics : Static dielectric constant, polarizability (electronic, ionic and orientation), calculation of Lorentz field (derivation), Clausius-Mosotti equation (derivation), dielectric breakdown, electrostriction (qualitative), electrets. Piezo electric effect, cause, examples and applications. **5 hours**

Liquid Crystals : Classification-Thermotropic and lyotropic. Properties - anisotropy in dielectric constant, electrical conductivity, magnetic susceptibility, refractive index and elasticity. Applications: construction and operation of twisted nematic display and thermography. **5 hours**

References

1. Concepts of Modern Physics, **Beiser** 3rd edition, Student edition, New Delhi (1981).
2. Introduction to Atomic Physics – **H.E. White**
3. Introduction to Modern Physics – **H.S. Mani, G.K. Mehta**-West Press (1989).
4. Principles of Modern Physics, **A.P. French**, John Wiley, London (1958).
5. Modern Physics - **S.N. Ghosal**, Part 1 and 2 S. Chand and Company (1996).
6. Physics of the Atom, **Wehr et. al**. McGraw Hill
7. Atomic and Nuclear Physics, **S. N. Ghoshal**: Vol. II. (2000).
8. Alpha, beta and gamma spectroscopy, **K. Seighbahn**: Vol. I and II, John Wiley (1967)
9. N. Rudraiah (Ed) : Modelling of Nano and smart materials
10. Introduction to solid State Physics, ***Charles Kittel***, VII edition(1996).
11. Solid State Physics- **A. J. Dekker**, MacMillan India Ltd. (2000).
12. Elementary Solid State Physics, **J. P. Srivastava**,PHI (2008).
13. Modern physics, **Murugeshan et al**.
14. Nano materials, **K. P. Bandopadhyay**.
15. Nanocrystals, **C. N. Rao, P. John Thomas**.
16. Nanotubes and wires, **C. N. Rao, A. Govindaraj**.

PHY- 602: Practical Physics VI (A)

1. Study of hydrogen spectrum.
2. Sommerfeld's fine structure constant determination.
3. Determination of e/m by Thomson's method.
4. Characteristics of GM counter.
5. Verification of inverse square law using GM counter (with a radioactive source).
6. Determination of mass absorption coefficient of gamma rays.
7. Determination of half-life of K^{40}.
8. Millikan's Oil drop experiment
9. Determination of phase transition temperature of liquid crystal and Identification of mesophases.
10. Analysis of band spectrum of PN molecule.
11. Analysis of rotational spectrum of nitrogen.
12. Analysis of rotational vibrational spectrum of a diatomic molecule (HBr).
13. Absorption spectrum of $KMnO_4$.
14. Determination of dielectric constant.
15. Determination of dipole moment of organic liquid

Note: A minimum of EIGHT(8) experiments must be performed.

References:

1. IGNOU : Practical Physics Manual
2. Saraf : Experiment in Physics
3. S.P. Singh : Advanced Practical Physics
4. Melissons : Experiments in Modern Physics
5. Misra and Misra, Physics Lab. Manual, South Asian publishers, 2000
6. Gupta and Kumar, Practcal physics, Pragati prakashan, 1976

PHY-603: Atmospheric Physics, Electronics and Computational Physics

Unit-1: Atmospheric Physics and Earth's Atmosphere

Origin and composition of atmosphere:
Fixed and variable gases, Mechanism of production and destruction of atmospheric constituents, Different layers of atmosphere. **2 hours**

Temperature structure of the atmosphere:
Vertical profile and horizontal distribution, Pressure (over land and ocean), Variation of pressure with altitude, hydrostatic equation, Relative and Absolute humidity, Density (over land and ocean), wind (speed and direction). **3 hours**

Sun's Radiation
Spectrum of radiation (EM spectrum, Visible range, diffuse radiation), Black body radiation (Planck's law, emission curves from Sun and Earth atmosphere), Absorption of solar radiation by earth's atmosphere (absorption and emission of radiation by molecules, absorptivity, emissivity, Kirchoff's law, reflectivity and transmittivity), Beer's law (derivation), Global energy balance for earth – atmosphere system, Green house effect. **4 hours**

Atmospheric motions
Atmosphere dynamics – Eulerian and Lagrangian approaches;
Accelerated rotational frames of reference – Centripetal and Coriolis force, Gravity and pressure gradient forces (with derivation); Applications of Coriolis force – Formation of trade winds, cyclones, erosion of river banks. **6 hours**

Unit–2: Electronics

Integrated circuits
Monolithic IC - description of discrete IC - Techniques of manufacturing thin film and thick film IC. **2 hours**

Operational amplifiers
Ideal OP amplifier characteristics. The basic op-amp circuits, Inverting amplifier, Non-inverting amplifier; Applications of op-amp – summer, integrator, differentiator. **3 hours**

Oscillators
Feedback concepts - oscillator circuits - Feedback amplifier - oscillator operation – Barkhausen Criterion - phase and frequency considerations- phase shift oscillator and Wien bridge oscillator (using op amp). **3 hours**

Digital Electronics
Logic states; Voltage range of high and low logic states; Number codes; Hexadecimal representation; BCD; signed numbers; Arithmetic 1's and 2's complement; Gray code.
Logic gates and truth tables; OR gate, AND gate; Inverter (the NOT function); NAND and NOR; exclusive OR; exclusive NOR. **5 hours**

Combination logic: Adders (full and half adder) & Subtractors (full and half).
2 hours

Unit–3: Computational Methods in Physics (using C-program)

Basics of C Language:
Program structure in C, Constants and Variables, Input and output statements, Arithmetic and conditional operations, conditional structure, Looping structures, one dimensional Arrays, programs to solve linear and quadratic equations. **3 hours**

Algorithms: modeling and simulation in physics: Errors in numerical calculations. **1 hours**

Roots of an equation : Newton-Raphson method and Bisection method. Application using Bisection method for LCR transient circuit (to determine R for given values of L and C for a pre-specified rate of dissipation of energy), program in C. **3 hours**

Numerical Integration: Simpson's 1/3 rule, Simpson's 3/8 rule, Applications - calculation of time period of a simple pendulum, rms current of ac, work done by variable force. **2 hours**

Numerical Differentiation: Newton – Forward and Backward formulae. Application: Problem on heat current: $H = -kA\frac{dT}{dx}$ **2 hours**

Ordinary Differential equation: Euler's method, Runge – Kutta II and IV order methods. Applications: Freely falling body in a resistive medium with resistance proportional to velocity, Projectile motion, LCR transient circuit, solution to Schrödinger wave equation for Harmonic potential (plotting wave function only). **4 hours**

References

1. Basics of Atmospheric Science by **A Chandrashekar**, PHI Publications (2010).
2. Weather, climate and atmosphere by **Siddartha**.
3. Atmospheric Science by **John M Wallace and Peter V Hobbs**, Elsevier Publications (2006).
4. Introduction to Atmospheric Science by **Turberick and Lutzens**, Elsevier Publications
5. Computational Physics, An Introduction by **R C Verma, Ahluwalia, Sharma**
6. A first Course in Computational Physics by **Paul L. DeVries, Javier E. Hasbun**
7. Numerical Methods for Engineers by **Steven C. Chapra, Raymond P Canale**
8. C-Programming Language, ***Balaguruswamy E,*** Tata McGraw Hill (1999).
9. C-Programming Language, ***Xavier C***, New Age International (2000).
10. Computer Programming in C**, V RajaRaman,** PHI Learning Pvt. Ltd. (2004).

PHY-604: Practical Physics VI (B)

1. Low pass filter using Op-amp
2. High pass filter using Op-amp
3. Band pass filter using Op-amp
4. Op-amp inverting and non-inverting amplifier.
5. Op-amp-summer, integrator, differentiator.
6. Phase shift oscillator using op –amp
7. Wien-bridge Oscillator using op – amp
8. Digital Half-adder & Full-adder circuits.
9. Temperature of atmospheric air - by using Thermograph (Bimetallic type)- Plotting the graph of temperature Vs time.
10. Relative humidity using hair hygrometer
11. Estimation of relative humidity using wet and dry bulb thermometer
12. Wind speed and direction by Hand held anemometer and wind wane
13. Estimation of height from the given pressure data

Execution of computer programs using C for the following problems.

14. (a) Determination of R in LCR transient circuit using Bisection method
    (b) Freely falling body in a resistive medium using Euler method / Runge – Kutta method
15. (a) Cooling of a body due to radiation – Stefan – Boltzmann Law using Euler method
    (b) rms current of ac using Simpson's rule
16. (a) Problem on heat flow using Newton Forward formula
    (b) Projectile motion with resistance using Euler method/Runge – Kutta method
17. (a) Work done by a variable force using Simpson's rule
    (b) LCR transient circuit – analysis – using Euler method
18. Schrödinger wave equation – Harmonic potential – Wave function plot only

Note : A Minimum of EIGHT experiments must be performed

References

1. IGNOU : Practical Physics Manual
2. Saraf : Experiment in Physics
3. S.P. Singh : Advanced Practical Physics
4. Melissons : Experiments in Modern Physics
5. Misra and Misra, Physics Lab. Manual, South Asian publishers, 2000
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10. A first Course in Computational Physics by **Paul L. DeVries, Javier E. Hasbun**
11. Numerical Methods for Engineers by **Steven C. Chapra, Raymond P Canale**