UNIVERSITY OF CALICUT
(Abstract)

B.Sc programme in Physics - under Choice based Credit Semester System Modified course structure and syllabus - approved – 2009 admission onwards – implemented - Orders issued.

GENERAL & ACADEMIC BRANCH-IV 'J' SECTION

No. GA IV/J2/4902/10 Dated, Calicut University P.O. 24.05.2011.

Read: 1. U.O.No. GAI/J2/3601/08 Vol.II dated 19.06.2009.
2. U.O.No.GAI/J2/3725/07 dated 04.02.2010.
3. Minutes of the meeting of the Board of Studies in Physics UG held on 24.03.2011, item 1.
4. Orders of the Vice-Chancellor in file of even number.

O R D E R

As per University Order read as first, the Choice based Credit Semester System was implemented in all UG programmes in affiliated colleges of the University with effect from 2009 admission.

Vide paper read as 2nd, the syllabus of B.Sc programme in Physics was implemented from 2009 admission onwards.

The Board of Studies in Physics, vide paper read as (3) resolved to implement the modified course structure and syllabus of B.Sc programme in Physics with effect from 2009 admission without affecting the total credits of 120 and total contact hours (25 hour per week and 450 hours per semester).

The Vice Chancellor considering the exigency, exercising the powers of the Academic Council, approved the minutes subject to ratification by the Academic Council.

Sanction has therefore been accorded for implementing the modified course structure and syllabus of B.Sc programme in Physics without affecting the total credits of 120 and total contact hours of 25 hours per week and 450 hours per semester.

Orders are issued accordingly. Syllabus appended. Syllabus is available in University website also.

Sd/-
DEPUTY REGISTRAR (G & A-IV)
For **REGISTRAR**

To

The Principals of affiliated Colleges offering B.Sc Physics programme.

Copy to:

PS to VC,PA to Registrar, Chairman,
Board of Studies in Physics, CE, EX,DRIII,DR PG/EC
EGI, Enquiry, System Administrator
(with a request to upload in the University Websit
Information Centres,GAI 'F' 'G' sections/GAII,III

Forwarded/By Order

SECTION OFFICER

UNIVERSITY OF CALICUT

Restructuring UG Curriculum

Syllabus

(Revised)

for

BSc. Degree (Physics) Programme

(Core, Complementary and Open Courses)

Framed in the

WORKSHOP ON

RESTRUCTURING OF UNDERGRADUATE COURSES

AND

SYLLABUS FRAMING

Conducted at

St. Joseph's College, Devagiri, Kozhikode

During 18 & 19 February 2009

And

Sree Kerala Varma College, Thrissur

During 18-20 March 2009

B.Sc. DEGREE PROGRAMME (PHYSICS CORE)

COURSE SRTUCTURE

Semester	Course Code	Course Title	Total hours	Hours/ Week	Credits
I	A 01	Common Course I - English	72	4	3
	A 02	Common Course II – English	90	5	3
	A 07	Common Course III – Language other than English	72	4	4
	PH1 B01	Core course I - Methodology of Science and Physics	36	2	2@
	PH1 B02 (P)	Core Course Practical I - Practical I	36	2	*
		1st Complementary Course I - Mathematics	72	4	2
		2nd Complementary Course I	36	2	2
		2nd Complementary Course Practical I	36	2	*
		Total	450	**25**	**16@**
II	A 03	Common Course IV - English	72	4	4
	A 04	Common Course V – English	90	5	4
	A 08	Common Course VI – Language other than English	72	4	4
	PH2 B03	Core Course II - Properties of Matter, Waves and Acoustics	36	2	2
	PH2 B04 (P)	Core Course Practical II - Practical I	36	2	*
		1st Complementary Course II - Mathematics	72	4	2
		2nd Complementary Course II	36	2	2
		2nd Complementary Course Practical II	36	2	*
		Total	450	**25**	**18**
III	A 05	Common Course VI - English	90	5	4
	A 09	Common Course VIII - Language other than English	90	5	4
	PH3 B05	Core Course III - Mechanics	54	3	3
	PH3 B06 (P)	Core Course Practical III – Practical I	36	2	*
		1st Complementary Course III – Mathematics	90	5	4
		2nd Complementary Course III	54	3	2
		2nd Complementary Course Practical III	36	2	*
		Total	450	**25**	**17**
IV	A 06	Common Course IX – English	90	5	4
	A 10	Common Course X - Language other than English	90	5	4
	PH4 B07	Core Course IV - Electrodynamics I	54	3	3
	PH4 B08 (P)	Core Course Practical IV – Practical I	36	2	**5**
		1st Complementary Course IV– Mathematics	90	5	4
		2nd Complementary Course IV	54	3	2
		2nd Complementary Course Practical IV	36	2	4
		Total	450	**25**	**26**
V	PH5 B09	Core Course V - Electrodynamics II	54	3	3
	PH5 B10	Core Course VI - Quantum Mechanics	54	3	3
	PH5 B11	Core Course VII - Physical Optics and Modern Optics	54	3	3

	PH5 B12	Core Course VIII- Electronics (Analogue and Digital)	54	3	3
		Open Course – (*course from other streams*)	54	3	4
	PH5 B13(P)	Core Course Practical V - Practical II	72	4	*
	PH5 B14(P)	Core Course Practical VI - Practical III	72	4	*
	PH5 B15 (PR)	Project	36	**2**	*
		Total	450	**25**	**16**
VI	PH6 B16	Core Course IX - Thermal and Statistical Physics	54	3	3
	PH6 B17	Core Course X - Solid State Physics, Spectroscopy and Laser physics	54	3	3
	PH6 B18	Core Course XI - Nuclear Physics, Particle Physics and Astrophysics	54	3	3
	PH6 B19	Core Course XII – Computational Physics	54	**3**	3
	PH6 B20	Core Course XIII (Elective)	54	3	3
	PH6 B21 (P)	Core Course Practical VII – Practical II	72	**4**	**5**
	PH6 B22 (P)	Core Course Practical VIII – Practical III	72	**4**	**5**
	PH6 B23(Pr)	Project	36	**2**	2
		Total	450	**25**	**27**
Total Credits					**120**

[@] **Only for students of 2009 admission, PH1 B01(Methodology of Science and Physics) carries one (1) credit, instead of 2 given in the syllabus and PH4 B08(P) (core course practical paper I) carries 6 credits, instead of 5 given in the syllabus. Also, the total credits for the I semester will be 15 instead of 16 and that for the IV semester it will be 27 instead of 26 given in the syllabus.**

Note : The teaching hours indicated against all the practicals are actual hours. The effective hours are calculated by considering the strength of the students.

CORE COURSE – XIII (ELECTIVE) :		
1	PH6 B20 (E1)	NANO SCIENCE AND TECHNOLOGY
2	PH6 B20 (E2)	ATMOSPHERIC PHYSICS
3	PH6 B20 (E3)	MATERIALS SCIENCE & THIN FILMS

OPEN COURSES OFFERED BY PHYSICS DEPARMENT (For students from other streams)		
1	PH5 D01(1)	NON CONVENTIONAL ENERGY SOURCES
2	PH5 D01(2)	AMATEUR ASTRONOMY AND ASTROPHYSICS
3	PH5 D01(3)	ELEMENTARY MEDICAL PHYSICS

EVALUATION AND GRADING

Evaluation scheme for course shall contain two parts (1) Internal evaluation and (2) External evaluation. 25% weight shall be given to internal evaluation and the remaining 75% weight shall be for the external evaluation. The details of the evaluation is given in the Regulations for Choice based credit Semester System For Under Graduate Curriculum 2009 of University of Calicut.

Practical:

1. The components of internal evaluation of the practical are

Component	Weightage
1. Class Participation (Attendance)	1
2. Regularity	1
3. Test Paper 1	1
4. Test Paper 2	1
5. Record	1
Total	5

2. The components of external practical examination are

Component	Weightage
1. Principle, Formula and Theory	2
2. Adjustments and observations	6
3. Viva	1
4. Calculation and results	1
Total	10

Project:

1. Project work should be done as an extension of topics in the syllabus.
2. Project can be experimental / theoretical or done in collaboration (association) with a recognised lab or organisation.
3. Project work may be done individually or as group of maximum of six students.
4. A supervisor has to guide a batch of maximum 24 students. For an additional batch another supervisor has to be appointed.However the existing work load should be maintained.

Guidelines for doing project

The project work provides the opportunity to study a topic in depth that has been chosen or which has been suggested by a staff member.The students first carryout a literature survey Which will provide the background information necessary for the investigations during the research phase of the project.
The various steps in project works are the following:-
a) Wide review of a topic.
b) Investigation on an area of Physics in systematic way using appropriate techniques.
c) Systematic recording of the work.
d) Reporting the results with interpretation in written and oral forms.

Use of Log Book
During the Project the students should make regular and detailed entries in to a personal laboratory log book through the period of investigation.
The log book will be a record of progress on project and will be useful in writing the final report.It contains experimental conditions and results,ideas,mathematical expressions,rough work and calculation,computer file names etc.All entries should be dated.
The students are expected to have regular meeting with their supervisor to discuss progress on the project and the supervisor should regularly write brief comments with dated signature.
The log book and report must be submitted at the end of the project.
The assessment is done on the basis of the following.
(1)Performance during the Project[Initiative,motivation,log book keeping and overall work]
(2) Written report[contents and understanding]
(3) Presentation and viva-voce

The components of Evaluvation.
The board suggests both internal and external evaluation.

Component	Weightage
1. Performance	6
2.written report	9*
3. Presentation-Viva	9*

Total	24

The board suggests internal evaluation for item 1 and *both internal & external evaluation for items 2 & 3 (25%-internal & 75% external)

Core Course I

PH1 B01: METHODOLOGY OF SCIENCE AND PHYSICS– 36 hours (Credit - 2)

Part A: Methodology And Perspectives Of Sciences (10Hours)

Unit I – Science and Science Studies

Types of knowledge: Practical, Theoretical, and Scientific knowledge, Information.

What is Science; what is not science; laws of science. Basis for scientific laws and factual truths.

Science as a human activity, scientific temper, empiricism, vocabulary of science, science disciplines.

Revolution in science and Technology.

Unit II – Methods and tools of science

Hypothesis: Theories and laws in science. Observations, Evidences and proofs.

Posing a question; Formulation of hypothesis; Hypothetico-deductive model, Inductive model. Significance of verification (Proving), Corroboration and falsification (disproving), Auxiliary hypothesis, Ad-hoc hypothesis.

Revision of scientific theories and laws, Importance of models, Simulations and virtual testing, Mathematical methods vs. scientific methods. Significance of Peer Review.

Reference Books:

1. Gieryn, T F. Cultural Boundaries of Science., Univ. of Chicago Press, 1999
2. Collins H. and T Pinch., The Golem: What Everyone Should Know About Science., Cambridge Uni. Press, 1993
3. Hewitt, Paul G, Suzanne Lyons, John A. Suchocki & Jennifer Yeh, Conceptual Integrated Science. Addison-Wesley, 2007
4. Newton R G. The Truth of Science: New Delhi, 2nd edition
5. Bass, Joel E and et. al. Methods for Teaching Science as Inquiry, Allyn & Bacon, 2009

Part B: Methodology and Perspectives of Physics (12Hours)

(All topics in this part require qualitative study only, derivations are not required)

What does physics deal with? - brief history of physics during the last century-the inconsistency between experiments and theories-

Birth of new science concepts -Quantum concepts-Black body radiation, Photoelectric effect, X-rays, Compton effect, De Broglie waves, Sections 2.2, 2.3, 2.5, 2.7, 3.1, of Arthur Beisser)

Relativity-Special relativity, Time dilation, Length contraction, Twin paradox (Sections 1.1, 1.2, 1.4, 1.5 of Arthur Beisser)

Laser- Concepts of ordinary and monochromatic light, Coherent and incoherent light, Spontaneous and stimulated emission, Metastable state, pumping and population inversion. (Basic ideas only Section 4.9 of Arthur Beisser)

Design of an experiment , experimentation , Observation, data collection:

Interaction between physics and technology.

References:

1. Concepts of Modern physics- Arthur Beisser
2. A brief history and philosophy of Physics - Alan J. Slavin- http:/ www.trentu. Ca/ academic / history- 895 .html
3. The inspiring History of Physics in the Last One Hundred Years : Retrospect and prospect Prof. Dr-lng . Lu Yongxiang http :// www.twas .org.cn/twas/proLu.asp

Part C – Mathematical Methods in Physics (14 Hours)

Vector Analysis: – Vector Operations - Vector Algebra – Component form – How vectors transform, Applications of vectors in Physics.

Differential Calculus: – The operator ∇ - Gradient, Divergence, Curl – Physical interpretation - Product rules of ∇ - Second derivatives.

Integral Calculus: – Line integral, surface integral and volume integral - Fundamental theorem of Gradients – Gauss's Divergence Theorem (Statement only)– The fundamental theorem of curl – Stoke's theorem(Statement only). Divergence less and curlless fields.

Curvilinear co-ordinates: – Spherical polar coordinates – cylindrical coordinates(Basic ideas).

Matrices: – Basic ideas of matrices – addition, subtraction, scalar multiplication, Trnspose of a matrix, conjugate of a matrix, diagonal matrix - Representation of vectors as column matrix – Determinants – Cramer's rule – Eigen Values and Eigen Vectors - Hermitian Matrix,Unitary Matrix.

References:

1. Introduction to electrodynamics – David J . Griffiths, Prentice Hall India Pvt. Ltd., Chapter – 1
2. Mathematical Physics - Satya Prakash, Sultan Chand &Sons, New Delhi

Semester -2

Core course –II - 36 hours (Credit – 2)

PH2 B03: PROPERTIES OF MATTER, WAVES & ACOUSTICS

Unit-1: Properties of Matter **9 Hours**

Elasticity: Basic ideas, Work Done per Unit Volume, Relations between elastic constants,Poisson's Ratio, Limiting Values of Poisson's Ratio, Twisting Couple on a Cylinder (or a Wire), Torsion pendulum, Determination of Rigidity Modulus, Bending of Beams, Bending Moment, Cantilever Loaded at Free End, Depression of a Beam Supported at the Ends and Loaded at the Centre (weight of the beam neglected), Determination of Y by Bending of a Beam, I form of Girders.

(Sections: 8.1 to 8.18, 8.22 to8.23, 8.26 to 8.27, 8.29 to 8.30, 8.33 to 8.34
Elements of Properties of Matter by D.S. Mathur)

Unit-2 Harmonic Oscillator **14 hours**

Periodic Motion, Simple Harmonic Motion and Harmonic Oscillator, Energy of a Harmonic Oscillator, Examples of Harmonic Oscillator, Anharmonic Oscillator, Composition of Two Simple Harmonic Motions of Equal Periods in a Straight Line, Composition of Two Rectangular Simple Harmonic Motions of Equal Periods: Lissajous Figures, Damping Force, Damped Harmonic Oscillator, Examples of Damped Harmonic Oscillator, Power Dissipation, Quality Factor, Forced Harmonic Oscillator

(Sections: 9.1 to 9.4, 9.7, 9.10 to 9.11, 10.1 to 10.4 to 10.6 of Mechanics by J.C Upadhyaya)

Unit-3 Waves **8 hours**

Wave Motion, General Equation of Wave Motion, Plane Progressive Harmonic Wave, Energy Density for a Plane Progressive Wave, Intensity of a Wave, Transverse Waves in Stretched Strings, Modes of Transverse Vibrations of Strings, Longitudinal Waves in Rods and Gases, Fourier's Theorem, Wave Velocity and Group Velocity

(Sections:11.1 to 11.9 , 11.12 to 11.13 of Mechanics by J.C Upadhyaya)

Unit-4 Acoustics **5 hours**

Intensity of Sound- Decibel and Bel, Loudness of Sound, Noise Pollution, Ultrasonics: Production of Ultrasonic Waves- Piezo Electric Crystal Method, Determination of Velocity of Ultrasonic Waves in a Liquid - Acoustic Grating , Application of Ultrasonic Waves,

Reverberation, Sabine's Formula (Derivation not required), Absorption Coefficient, Acoustics of Buildings

(Sections: 4.10 to 4.13, 5.1 to 5.3, 5.7 to 5.10, 5.12 to 5.15 of Properties of Matter and Acoustics by R.Murugeshan & Kiruthiga Sivaprasath)

Books for Study

1. Elements of Properties of Matter by D.S. Mathur 2008
2. Mechanics by J.C Upadhyaya 2003
3. Properties of Matter and Acoustics by R.Murugeshan & Kiruthiga Sivaprasath 2005

Reference

1. Mechanics -- D.S. Mathur
2. Text book of Sound –Brij Lal& Subramaniam
3. Text book of Sound –Khanna .D.R. & Bedi.R.S.
4. Berkeley Physics course Vol 3 on Waves
5. Elements of Mechanics – K Rama Reddy, S Raghavan & D V N Sarma- Universities Press
6. Introduction to Mechanics – Mahendra K Verma – Universities Press

Semester-3

Core Course – III - 54 hours (Credit – 3)

PH3 B05: MECHANICS

UNIT-1

1. Frames of reference **8 hours**

Laws of Mechanics, Inertial frames of reference, Galilean transformation equations, Hypothesis of Galilean invariance, Conservation of Momentum, Non inertial frames and fictitious forces, Rotating frames of reference, Centrifugal force and Coriolis force, Foucault's pendulum (Section 2.1 to 2.11of Mechanics by J C Upadhyaya)

2. Conservation of Energy **6 hours**

Conservation laws, Conservative forces, Conservation of energy for a particle: Energy function, Potential energy curve, Non conservative forces

(Section 5.1to 5.7, 5.10, 5.11of Mechanics by J C Upadhyaya)

3. Linear and Angular Momentum **9 hours**

Conservation of linear momentum, Centre of mass, ,Centre of mass frame of reference, Collision of two particles ,Deflection of a moving particle by a particle at rest, Rockets, Angular momentum and torque, Motion under central force, Areal velocity, Conservation of angular momentum with examples

(Section 6.1 to 6.4 ,6.6 to 6.9 of Mechanics by J C Upadhyaya)

4. Potentials and Fields **9 hours**

Central force, Inverse square law force, Potential energy of a system of masses, Gravitational field and potential, Escape velocity, Keplar's laws, Newton's deductions from Keplar's laws

(Section 7.1 to 7.4, 7.6to7.9, 7.18, 7.19 of Mechanics by J C Upadhyaya)

UNIT-2

5 Lagrangian formulations of Classical Mechanics **9 hours**

Constraints, Generalized co-ordinates, Principle of virtual work, D'Alembert's principle, Lagrange's equations, Kinetic energy in generalized co-ordinates, Generalized momentum, Cyclic co-ordinates, Conservation laws and symmetry properties-Hamiltonian of a system

UNIT-3

6. Special Theory of Relativity **13 hours**

Electromagnetism and Galilean transformation, Michelson Morley experiment, Ether hypothesis, Postulates of Special Theory of Relativity, Lorentz transformation equations, Velocity transformation, Length contraction, Time dilation, Simultaneity, Mass in relativity, Mass and energy ,Space time diagram, Geometrical interpretation of Lorentz transformation, Principle of covariance, Four-vectors in Mechanics

Text books for study

1. Mechanics by J C Upadhyaya 2003 edition
2. Classical Mechanics by Takwale and Puranik
3. Classical Mechanics by Hans and Puri

4. Classical Mechanics by J C Upadhyaya

Reference books

1. Mechanics by D.S.Mathur
2. Classical Mechanics by Goldstein
3. Berkeley Physics cource Vol 1
4. Feynman Lectures on Physics Vol 1
5. Elements of Mechanics – K Rama Reddy, S Raghavan & D V N Sarma- Universities Press
6. Introduction to Mechanics – Mahendra K Verma – Universities Press

Semester-4

Core Course – IV 54 hours (Credit – 3)

PH4 B07: ELECTRODYNAMICS – I

UNIT I

1. Electrostatics **20 hours**

Electrostatic field – Coulomb's law, Electric field, Continuous charge distributions - Divergence and curl of electrostatic field, Field lines and Gauss law, The divergence of **E**, Applications of Gauss law, Curl of **E** - Electric potential – Comments on potential, Poisson's equation and Laplace's equation, The potential of a localized charge distribution, Electrostatic boundary conditions – Work and energy in electrostatics, The work done in

moving a charge, The energy of point charge distribution, The Energy of a continuous charge distribution, Comments on Electrostatic energy – Conductors, Basic properties of conductors, Induced charges, The Surface charge on a conductor, The force on surface charge, Capacitors.

(Sections 2.1 to 2.5 of Introduction to Electrodynamics by David J Griffiths)

2. Special Techniques for Calculating Potentials **6 hours**

Laplace's equation in One Dimension, Two Dimensions and Three Dimensions, Uniqueness theorems - Method of images, The classic image problem, induced surface charge, force and energy. (Sections 3.1 to 3.2.3 of Introduction to Electrodynamics by David J Griffiths)

UNIT II

3 . Electric fields in matter **8 hours**

Polarization – Dielectrics, Induced dipoles, Alignment of polar molecules, Polarization – The field of a polarized object , Bound charges, Physical interpretation of bound charges, The field inside a dielectric – The electric displacement – Gauss's law in presence of dielectrics, Boundary conditions for **D** – Linear dielectrics, Susceptibility, Permittivity, Dielectric constant, Energy in dielectric systems, Forces on dielectrics, Polarizability and susceptibility.

(Sections 4.1 to 4.4.1, 4.4.3, 4.4.4 of Introduction to Electrodynamics by David J Griffiths)

UNIT III

4 . Magnetostatics **12 hours**

The Lorentz force law – Magnetic fields, Magnetic forces, cyclotron motion, cycloid motion, Currents, Linear, Surface and Volume current density – Biot -Savart law, The magnetic field of steady current – Divergence and curl of **B,** Straight line currents, Applications of Ampere's law, Magnetic field of a toroidal coil, Comparison of magnetostatics and electrostatics – Magnetic vector potential , Vector potential, Magnetostatic boundary conditions.

(Sections 5.1 to 5.4.2 of Introduction to Electrodynamics by David J Griffiths)

5. Magnetostatic fields in matter **8 hours**

Magnetisation – Diamagnets, Paramagnets and Ferromagnets, Torques and forces on magnetic dipoles, Effect of a magnetic field on atomic orbits, Magnetization – Field of a magnetised object, Bound Currents, Physical interpretation, Magnetic field inside matter – Auxiliary field **H**, Ampere's law in magnetised materials, Boundary conditions – Linear and nonlinear media, Magnetic susceptibility and permeability, Ferromagnetism.

(Sections 6.1 to 6.4 of Introduction to Electrodynamics by David J Griffiths)

Textbook for study

Introduction to Electrodynamics by David J Griffiths, 3rd Ed.

Books for reference

1. Electricity and magnetism by Arthur F Kip
2. Physics Vol. II by Resnick and Halliday

Semester-5

Core Course – V 54 hrs (Credit – 3)

PH5 B09: ELECTRODYNAMICS-II

UNIT I (27 hours)

1) Electrodynamics 15 hours

Electromagnetic induction - Faraday's law, induced electric field, inductance, energy in magnetic fields – Maxwell's equations, Electrodynamics before Maxwell, Maxwell's modification of Ampere's law, Maxwell's equations and magnetic charges, Maxwell's equations inside matter, Boundary conditions.

(Sections 7.2 to 7.3 of Introduction to Electrodynamics by David J Griffiths)

2) Electromagnetic waves **12 hours**

Waves in one dimension, The wave equation, sinusoidal waves, boundary conditions : reflection and transmission, Polarization – Electromagnetic waves in vacuum , Wave equation for **E** and **B**, monochromatic plane waves in vacuum, energy and momentum of E.M. waves, Poynting vector - Electromagnetic waves in matter, Propagation through linear media, reflection and transmission at normal incidence.

(Sections 9.1 to 9.3.2 of Introduction to Electrodynamics by David J Griffiths)

UNIT II (27 hours)

3) Transient currents **7 hours**

Growth and decay of current in LR and CR circuits – measurement of high resistance by leakage – growth of charge and discharge of a capacitor through LCR circuit – theory of BG – experiment to determine charge sensitiveness of BG using a standard condenser and HMS.

(Sections 12.1 to 12.6, 10.10 to 10.13 and section 11.14 of Electricity and magnetism by R. Murugeshan)

4) AC circuits **12 hours**

AC through L, C, R, LC, CR, LR and LCR – resonance and resonant circuits – repulsion between coil and conductor – j operators, application to AC circuits – AC bridges – Anderson and Rayleigh bridge.

(Sections 22.1, 22.2, 22.3, 22.6, 22.7, 22.10, 22.11, 22.13, 22.18 to 22.22.1, 22.23 of Electricity and Magnetism by D.N. Vasudeva and sections 11.5 to 11.6 of Electricity and Magnetism by R. Murugeshan)

5) Network theorems **8 hours**

Kirchhoff's laws, Voltage sign and current direction, Solution of simultaneous equations using determinants, Source conversion, Superposition theorem, Ideal equivalent circuits, Thevenin's theorem, Thevenizing a given circuit, Norton's theorem, Maximum power transfer theorem.

(Sections 2.2, 2.3, 2.4, 2.5, 2.6, 2.14, 2.15, 2.16, 2.17, 2.18, 2.19 and 2.30 from Electrical technology by Theraja)

Textbooks for study

1. Introduction to Electrodynamics by David J Griffiths, 3rd ed.
2. Electricity and Magnetism by R.Murugeshan (Third revised edition)
3. Electrical technology by Theraja

Books for reference

1. Electricity and magnetism by Arthur F Kip
2. Physics Vol. II by Resnick and Halliday
3. Electricity and Magnetism by D.N Vasudeva (Twelfth revised edition)
4. Introductory AC Circuit theory – K Mann & G J Russell- Universities Press

Semester-5

Core Course – VI 54 hrs (Credit – 3)

PH5 B10: QUANTUM MECHANICS

UNIT 1 (24 hrs)

1. Particle Properties of Waves. **8 hours**

Electromagnetic waves, black body radiation, ultraviolet catastrophe, Photoelectric effect, nature of light, wave particle duality, Compton Effect & its demonstration. Pair

production, photons & gravity. (Sections 2.1 to 2.4 & 2.7 to 2.9 of Modern Physics- Arthur Beiser)

2. Wave Properties Of Particles 10 hours

De Broglie waves, waves of probability, phase velocity & group velocity, particle diffraction, Davisson And Germer experiment, Electron Microscope, Uncertainty principle I, Uncertainty principle II, Applying the uncertainty principle, Energy & time uncertainty.
(Sections 3.1 to 3.5 & 3.7 to 3.9 of Modern Physics by Arthur Beiser)

3. Atomic Structure 6 hours

The Bohr atom-energy levels and spectra, correspondence principle, nuclear motion, atomic excitation, Frank-Hertz experiment
(Sections 4.4 to 4.8 of Modern Physics by Arthur Beiser)

UNIT 2 (30 hrs)

4. Wave Mechanics 16 hours

Classical mechanics is an approximation of quantum mechanics, wave function, Schrodinger equation-time dependant form, linearity & super position, expectation values, operators, Schrodinger equation-steady state form, eigen values & eigen functions, postulates of quantum mechanics, particle in a box, finite potential well, tunnel effect-scanning tunneling microscope, harmonic oscillator wave function, energy levels, zero point energy.
(Sections 5.1, 5.3 to 5.11 & appendix to chapter 5 of Modern Physics by Arthur Beiser and Section 3.5 of Quantum Mechanics by G Arunldhas]

5. Hydrogen Atom 14 hours

Schrodinger equation for the hydrogen atom, separation of variables, quantum numbers, principal quantum number, orbital quantum number, magnetic quantum number, electron probability density, radiative transitions, selection rules, Zeeman effect, electron spin, exclusion principle, Stern-Gerlach experiment.
(Sections 6.1 to 6.10 & 7.1, 7.2 of Modern Physics by Beiser]

TEXT

Concepts of Modern Physics 6th Edition-By Arthur Beiser

REFERENCE:

1. Modern Physics(II Edn.)-Kenneth Krane
2. Quantum Physics Of Atom, Molecules, Solids, Nuclei & Particles By R.Eisberg & R. Resnick (John Wiley)
3. Quantum Mechanics By G. Aruldhas
4. Berkeley Physics Course: Quantum Physics By Wichmann
5. University Physics – Zemansky
6. Quantum Mechanics – Trilochan Pradhan – Universities Press
7. Advanced Physics Second Edition – Keith Gibbs – Cambridge University Press
8. Introduction to Vector spaces in Physics - K A I L Wijewardena Gamalath – Foundation Books

Semester-5

Core Course – VII - 54 Hours (Credit – 3)

PH5 B11: PHYSICAL OPTICS AND MODERN OPTICS

UNIT I (5 hours)

1. Fermat's Principle, verification of laws of reflection and refraction. **2 hours**

(Sections 2.1-2.6 (Brijlal, Subramaniyam, & Avadhanulu Section 2.1-2.2 Ajoy Ghatak)

2. Matrix methods **3 hours**

Refraction and translation, translation matrix, refraction matrix, system matrix, position of the image plane, magnification, system matrix for thick lens, system matrix for thin lens. (Sections 7.1-7.9 (Brijlal, Subramaniyam, & Avadhanulu)

UNIT II (14 hours)

3. Interference by division of wavefront 7 hours

Superposition of two sinusoidal waves, Interference, coherence ,conditions for interference, the inference patterns, intensity distribution .Fresnel's two mirror arrangement, Fresnel's Biprism, Determination of λ and dλ of Sodium Light (Sections:14.1-14.4,14.6-14.9 (Brijlal, Subramaniyam, & Avadhanulu, Sections 12.1-12.9 Ajoy Ghatak)

4. Interference by division of amplitude 7 hours

Interference by a plane film illuminated by a plane wave, cosine law, non reflecting films (the subsections excluded), interference by a film with two nonparallel reflecting surfaces, colours of thin films, Newton's rings, The Michelson interferometer, white light fringes (Sections 13.1-13.3,13.4,13.813.9-13.11Ajoy Ghatak, Sections 2.1-2.6 (Brijlal, Subramaniyam, & Avadhanulu)

UNIT III (13 hours)

5. Fraunhofer Diffaraction 9 hours

Preliminaries, single slit diffraction pattern, diffraction by circular aperture, limit of resolution, two slit Fraunhofer diffraction pattern, N slit diffraction pattern, plane diffraction grating, resolving power. Sections 16.1-16.7. (Ajoy Ghatak)

6. Fresnel Diffraction 4 hours

Preliminaries, Fresnel half period zones, explanation of rectilinear propagation of light, zone plate, diffraction at straight edge (Sections 17.1-17.4. Ajoy Ghatak)

UNIT IV 7 hours

7. Polarization

Hygiene's explanation of double refraction, positive and negative uniaxial crystals,
quarter and half wave plates, types of polarized light, production and analysis of plane, circularly and elliptically polarized light, optical activity (Sections 20.9,20.17-20.20,20.24 Brijlal, Subramaniyam, & Avadhanulu and Ajoy Ghatak)

UNIT V 4 hours

8. Holography

Principles of holography, Theory of construction and reconstruction, Hologram, Applications of Holography. (Sections 23.1-23.6 Brijlal, Subramaniyam, & Avadhanulu, Sections 18.1-18.4. Ajoy Ghatak)

UNIT VI **6 hours**

9. Fiber Optics

Optical fibre, Numerical aperture, step index fiber, pulse dispersion, graded index fibre, fiber optic communication system, fiber optic sensors. (Sections 24.1-24.3,24.5,24.6-24.7,24.11 Ajoy Ghatak, corresponding sections from Brijlal, Subramaniyam, & Avadhanulu)

UNIT VII **5 hours**

10. Nonlinear Optics

Introduction, wave propagation in an anisotropic crystal, nonlinear polarization, second harmonic generation, phase matching, sum and difference frequency generation, parametric oscillation, self focusing of light.25.1-25.9 (Brijlal, Subramaniyam, & Avadhanulu)

References

1. Optics by Ajoy Ghatak
2. Optics by Subramaniam, Brijlal & Avadhanulu – New edition
3. Optics by Mathur
4. Nonlinear Optics- B.B.Laud
5. Laser Fundamentals- Silfast
6. Wave Optics and its Applications – Rajpal S Sirohi – Orient Longman
7. Optical Communications – M Mukunda Rao – Universities Press

Semester-5

Core Course – VIII 54 hours (Credit – 3)

PH5 B12: ELECTRONICS (ANALOG & DIGITAL)

UNIT I

1. Semiconductor rectifiers and DC Power supplies **4 Hrs.**

Preliminaries of rectification, Bridge rectifier, Efficiency, Nature of rectified output, Ripple factor, different types of filter circuits, voltage multipliers, Zener diode voltage stabilization (sections 6.13-6.15, 6.17 - 6.27 V.K Mehta)

2. Transistors: **12 Hrs.**

Different transistor amplifier configurations:- C-B, C-E, C-C, their characteristics, amplification factors, their relationships, Load line Analysis, Expressions for voltage gain, current gain and power gain of C.E amplifier, cut-off and saturation points, Transistor biasing, Different types of biasing - Base resistor, collector feedback resistor, voltage divider bias method, single stage transistor amplifier circuit, load line analysis, DC and AC equivalent circuits.

Section (8.7 - 8.10, 8.12-8.22, 9.2-9.8, 9.11-9.12, 10.4-10.5, 10.7-10.9)

3. Multistage Transistor amplifiers **5 Hrs.**

R.C coupled amplifier, transformer coupled amplifier, direct coupled amplifier, their frequency response, and gain in decibels, Classification of power amplifiers, class A, class B and class C amplifiers (qualitative idea only).

section (11.1-11.8, 12.6)

4. Feedback Circuits and Oscillators : **7 Hrs.**

Basic principles of feedback, negative feedback and its advantages, positive feed back circuits Oscillatory Circuits-LC, RC oscillators, tuned collector oscillator, Hartley, Colpitt's, phase shift and crystal oscillators - their expressions for frequency.

Sections (13.1-13.5, 14.1 - 14.13, 14.15-14.20)

UNIT II

5. Digital Communication **6 Hrs**

Transmission and reception of radio waves, types of modulation, AM, FM their comparison advantages, demodulation, straight receiver, pulse code modulation (qualitative idea only) (Sections: 16.1-16.10, 16.11-16.18, 16.22)

6. Special Devices and Opamp **9 hrs**

LED, basic idea of LCD, UJT, FET, MOSFET, OP-amp-basic operation, application, inverting, Non-inverting, summing amplifiers, Differentiator integrator.

(7.2-7.4, 19.2-19.14, 19.14, 19.27-19.30, 21.11-21.14, 25.1, 25.16, 25.15-25.17, 25.23-25.26, 25.32, 25.34-25.35, 25.37)

7. Number system **5 Hrs.**

Positional number system, binary number system, Binary - Decimal conversions, Representation of positive integer, negative number representation, Floating point Binary arithmetic, Compliments and its algebra, Other number system, Character representation. (Aditya P Mathur - 2.2 to 2.8).

8. Logic gates and circuits **6 Hrs.**

Fundamental gates, Universal gates, De Morgan's theorem, Exclusive OR gate, Boolean relations, Karnaugh Map, Half adder, Full adder, Flip Flops- RS, D, JK Master Slave, Shift register.

(Sections Malvino - 2.2 to 2.4, 3.1 to 3.5, 5.1 to 5.6, 6.3, 6.4, 7.1, 7.3, 7.5, 7.6, 8.2)

Text books:

1. Principles of electronics by VK Mehta - 2008 edition (S. Chand)
2. Introduction to Micro computers by Aditya P Mathur (Tata McGarw Hill)
3. Digital principles and applications by leach and Malvino (Tata McGraw Hill)

Reference

1. Digital Computer Fundamentals (Thomas.C. Bartee)
2. Electronics principles by Malvino
3. Physics of Semiconductor Devices- Second Edition – Dilip K Roy – Universities Press

Semester-6

Core Course – IX - 54 hrs (Credit – 3)

PH6 B16: THERMAL AND STATISTICAL PHYSICS

Unit- I

1. Thermal equilibrium-zeroth law-concept of heat and temperature-thermodynamic variables-extensive and intensive parameters-thermodynamic equilibrium-thermodynamic process-indicator diagram-work done in quasistatic process-work in isothermal, adiabatic, isobaric and isochoric processes-concepts of path and point functions-internal energy-first

law-applications-application of first law to heat capacities-(relation between C_p and C_v) – equation to adiabatic process.(**12 hours)**

2. Reversible and irreversible processes , Conditions for reversibility-heat engine, Carnot engine, derivation for expression for efficiency, efficiency, Carnot's refrigerator-Second law-Carnot's theorem and its proof. (7 **Hours)**

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3.Entropy and adiabatics- definition of entropy-Change of entropy in a Carnot cycle-Change of entropy in an reversible cycle (Claussius theorem) -Change of entropy in an irreversible cycle (Claussius inequality)- Change in entropy of a perfect gas during a process-Change in entropy in a irreversible process-change in entropy due to free expansion-Change in entropy due to spontaneous cooling by conduction, radiation….etc, -Principle of increase of entropy-Entropy and available energy-Entropy and disorder-Nernst heat theorem-entropy temperature diagrams**(10 hours**).
(Relevant topics from Chapters 8 & 9 – Heat and Thermodynamics by D S Mathur-Revised fifth edition)

4. Thermodynamic functions-Enthalpy, Helmhlotz function, Gibbs function-Maxwell's thermodynamic relations-Claussius-Clapeyron equation from Maxwell's thermodynamic relations- Applications of Claussius-Clapeyron equation.
(Relevant topics from Ch. 9-Heat and Thermodynamics by D S Mathur- Revised fifth edition) **6 Hrs**

UNIT II

5. Statistical distributions-Maxwell-Boltzmann statistics (no derivation)-Distribution of molecular energies in an ideal gas-Average molecular energy- Equipartition theorem-Maxwell-Boltzmann speed distribution law-Expressions for rms speed, most probable speed and mean speed. **8 Hrs**

(Chapter 9.1, 9.2 and 9.3-Concepts of Modern Physics-Arthur Beiser)

6. Bose Einstein and Fermi Dirac distribution laws (no derivations)- Application of BE distribution law to black body radiation-Planck's radiation law-Stefan's law-Wien's displacement law-Fermi energy-Expression for Fermi energy of electron system-electron

energy distribution- average electron energy at absolute zero-Degeneracy pressure and its astrophysical significance. **11 Hrs**

(Relevant topics from Chapter 9, Concepts of Modern Physics – Arthur Beiser)

References:

1. Thermodynamics and statistical mechanics-Brijlal Subramanium
2. Physics- Resnick and Halliday
3. Heat and Thermodynamics-Zemansky
4. Heat and Thermodynamics-DS Mathur (V Edn.)
5. Thermodynamics – Y V C Rao – Universities Press
6. Statistical Mechanics – An Elementary Outline – Avijit Lahiri – Universities Press
7. Advanced Physics Second Edition – Keith Gibbs – Cambridge University Press

Semester-6

Core Course – X 54 hrs (Credit – 3)

PH6 B17 : SOLID STATE PHYSICS, SPECTROSCOPY AND LASER PHYSICS

UNIT –1 SOLID STATE PHYSICS

1. Crystal Physics

15 Hrs

Lattice Point & Space Lattice-Basis and crystal structure, unit cells and lattice Parameters, Unit cells v/s primitive cells, Crystal systems, crystal symmetry. The 23 symmetry

elements in a cubical crystal, rotation axis and inversion. Symmetry elements, Bravais space lattices-metallic crystal structure , sodium chloride, diamond, zinc sulphide, hexagonal and closed packed structure, directions, planes and Miller indices.

(Section 4.1 to 4.8, 4.11 to 4.15 and 4.18 - Solid State Physics by S.O. Pillai**)**

2. X-ray Diffraction: 5 Hrs

Bragg's slaw – Braggs X-ray spectrometer-Rotating Crystal method

Section 5.7 to 5.11- Solid State Physics by S.O. Pillai

3. Super conductivity: 6 Hrs

A survey of superconductivity-Mechanism of Superconductors-Effects of Magnetic Field-Meissner Effect-isotope Effect-Energy Gap -Coherence Length- BCS Theory (Qualitative idea only) -Application of Superconductivity, Type I and Type II superconductors.

(Section 8.1 to 8.5 & 8.10 of Solid State Physics - S.O. Pillai)

UNIT-2 MOLECULAR SPECTROSCOPY

4 . Basic Elements of Spectroscopy: 3 Hrs

Quantum of Energy-Regions of Spectrum-Representation of Spectrum-Basic Elements of Practical Spectroscopy-Signal to Noise Ratio-Resolving Power-Width & Intensity of Spectral Transitions

(Section 1.2 to 1.8 of Fundamentals of Molecular Spectroscopy by Banwell & Elaine Mcash**)**

5. Microwave Spectroscopy 3 Hrs

Classification of Molecules-Interaction of Radiation with Rotating Molecules-Rotational Spectrum of Rigid Diatomic Molecule-Example of CO-Information derived from Rotational Spectrum.

(Section 6-Rotation of Molecules, Section 6.1 to 6.6, 6.9, 6.13, 6.14 of Molecular Structure & Spectroscopy by G Aruldhas & Chapter 2 - Fundamentals of Molecular Spectroscopy by Banwell & Elaine M Mccash

6. Infra Red Spectroscopy: 10 Hrs

Vibrational Energy of an Anharmonic Oscillator-Diatomic Molecule (Morse Curve)-IR Spectra-Spectral Transitions & Selection Rules-Example of HCL-Vibration-Rotation Spectra of Diatomic Molecule-Born Oppenheimer Approximation-Instrmentation for Infra Red Spectroscopy

(Section 7 to 7.5, 7.15, 7.16 of Molecular Structures & Spectroscopy by G Aruldhas & Chapter 3 of Fundamentals of Molecular Spectroscopy by Banwell & Elaine M Mccash)

7. Raman Spectroscopy **2 Hrs**

Raman Effect, Elements of Quantum theory

(Molecular Structures & Spectroscopy by G Aruldhas & Chapter 4 of Fundamentals of Molecular Spectroscopy by Banwell & Elaine M Mccash)

8. Laser Physics **10 Hrs**

Induced Absorption-Spontaneous Emission & Stimulated Emission-Einstein Coefficients Principle of Laser-Population inversion-Pumping-Properties of Laser-Types of Laser-The Ruby laser, Helium Neon Laser & Semiconductor Laser-Application of Lasers-Yag Lasers (Qualitative ideas only)

(Chapter 12 Masers & Lasers, Solid State Physics by S.O. Pillai, Lasers –Theory & Applications by K Thyagarajan & Ajoy Ghatak)

Books for Study :

1. Solid State Physics by S O Pillai
2. Fundamentals of Molecular Spectroscopy by Banwell & Elaine M Mccash
3. Molecular Structure & Spectroscopy by G Aruldhas

Books for Reference:

1. Solid Sate Physics by M A Wahab
2. Introduction to Molecular Spectroscopy by G M Barrow
3. Raman Spectroscopy by Long D A
4. Modern Physics by R Murugeshan
5. Optical Communications – M Mukunda Rao – Universities Press
6. Principles of Condensed Matter Physics – P M Chaikin & T C Lubensky – Cambridge University Press

Semester-6

Core Course – XI 54 hrs (Credit – 3)

PH6 B18 : NUCLEAR PHYSICS, PARTICLE PHYSICS & ASTROPHYSICS

UNIT: 1 (27 hrs)

1. Nuclear Structure **9 hours**

Nuclear composition – nuclear electrons – discovery of neutron, Nuclear properties – nuclear radii –spin and magnetic moment - nuclear magnetic resonance, Stable nuclei,

Binding energy, Liquid drop model -semi empirical binding energy formula- mass parabolas, Shell model, Meson theory of nuclear forces – discovery of pion.

(Text Books: 11.1 to 11.7 Concepts of Modern Physics – Arthur Beiser (5th Edition), Nuclear Physics – Irving Kaplan (17.8)

2. Nuclear Transformations : **14 hours**

Elementary ideas of radio activity- Alpha decay-tunnel theory of alpha decay-derivation for the formula for decay constant-Beta decay-negatron emission-positron emission-electron capture-inverse beta decay and the discovery of neutrino-the solar neutrino mystery, Gamma decay- fundamental ideas of nuclear isomerism and internal conversion, The concept of interaction cross section-neutron capture cross section of cadmium-slow neutron cross sections-reaction rate-nuclear reactions-center of mass frame of reference and Q value of a nuclear reaction, Nuclear fission, Nuclear reactors-breeder reactors, Nuclear fusion-nuclear fusion in stars-proton-proton cycle-carbon nitrogen cycle-formation of heavier elements, Fusion reactors-confinement methods.

(Text Book: 12.1 to 12.12 & Appendix of Chapter 12, Concepts of Modern Physics – Arthur Beiser (5th Edition)

3. Nuclear Detectors And Counters: 4 Hours

Interactions of radiation with matter – fundamental ideas, Gas filled counters- ionization chamber – proportional counter – G.M. counter, Cloud chamber, Bubble chamber, Semi conductor detectors and scintillation counters (Qualitative study only. Maximum Weightage: 2)

(Text Book: 17 to 17.6 Atomic and Nuclear Physics-An Introduction: T.A. Littlefield and N. Thorley)

UNIT: 2 (27 hrs)

4. Cosmic Rays: 3 hours

Nature of Cosmic rays, the origin of cosmic rays, geomagnetic effects, Cosmic ray showers

(Text Book: 25.1 to 25.6 Atomic and Nuclear Physics-An Introduction: T.A. Littlefield and N. Thorley)

5. Particle Physics: 12 hours

Leptons –electron and positron-neutrinos and anti-neutrinos-other leptons, Hadrons-resonance particles, Elementary particle quantum numbers-baryon number- lepton number-strangeness-isospin-electric charge-hyper charge-basic ideas on symmetries and

conservation laws, Quarks -color and flavor, Fundamental interactions-field bosons-basic ideas of quantum chromo dynamics-Higg's boson, History of the universe, The future of universe-Dark matter.

(Text Books: 13.2 to 13.8 Concepts of Modern Physics-Arthur Beiser (5^{th} Edition)

6. Particle Accelerators 4 hours

Classification of accelerators-electrostatic accelerators-cyclic accelerators, the linear accelerator, the cyclotron, the betatron, the electron synchrotron .

(Text Books: 18.4 to 18.8 Atomic and Nuclear Physics- An Introduction: T.A. Littlefield and N. Thorley, 21.3 to 21.5 Nuclear Physics-Irving Kaplan)

7. Astrophysics and astronomy 8 hours

Stellar magnitudes an sequences, Absolute magnitude, The bolometric magnitude -Different magnitude standards, The colour index of a star, Luminosities of stars, Stellar parallax and the units of stellar distances, Stellar positions: The celestial co-ordinates.

A Qualitative study on stellar positions and constellations

(Text Book: 3.1 to 3.9 An introduction to Astro Physics-Baidyanath Basu)

Suggested Reference Materials (Books and Materials:)

1. Nuclear Physics: D.G. Tayal
2. Atomic Physics: J.B. Rajam
3. Atomic Physics: John Yarwood
4. Introduction to Astrophysics: H L Duorah & Kalpana Duorah
5. Mayer – Jensen Shell Model and Magic Numbers: R Velusamy, Dec 2007
6. The Enigma of Cosmic Rays: Biman Nath, Resonance – Feb 2004, March 2004
7. Black body radiation: G.S. Ranganath, Resonance – Feb. 2008.
8. Advanced Physics Second Edition – Keith Gibbs – Cambridge University Press

Semester-6

Core Course – XII

PH6 B19: Computational Physics (54 hrs – 3 credits)

UNIT I.

Introduction to Python Programming: 20 Hrs

Concept of high level language, steps involved in the development of a Program – Compilers and Interpreters - Introduction to Python language, Advantages of Python in comparison with other Languages - Different methods of using python: Using python as a calculator, Writing python programs and execution - Inputs and Outputs - Variables, operators, expressions and statements -- Strings, Lists, list functions (len, append, insert, del, remove, reverse, sort, +, *, max, min, count, in, not in, sum), sets, set functions(set, add, remove, in, not in, union, intersection, symmetric difference)-Tuples and Dictionaries, Conditionals, Iteration and looping - Functions and Modules - File input and file output, Pickling.

UNIT II.

Numerical Methods in physics *(Programs are to be discussed in Python)* **22 Hrs**

General introduction to numerical methods, Comparison between analytical and numerical techniques - Curve Fitting: Principle of least squares, fitting a straight line - Interpolation: Finite difference operator, Newton's forward difference interpolation formula, Solution of algebraic equations: Newton-Raphson method - Numerical differentiation and integration: Differnce table, Trapezoidal and Simpson's (1/3) method - Solution of differential equations :Runge Kutta method (Second order) -Taylor's Series : Sin(x) and Cos(x).

UNIT III>

Introduction to Computational approach in physics 12 Hrs

(Programs are to be discussed in Python)

One Dimensional Motion: Falling Objects: Introduction – Formulation: from Analytical methods to Numerical Methods - Euler Method, Freely falling body, Fall of a body in viscous medium - Simulation of free fall and numerical integration, Two dimensional motion: Projectile motion (by Euler method)-Motion under an attractive Inverse Square-law force Accuracy considerations .(elementary ideas)*(Graphics not required, data may be presented in table form)*

References:

(For Python any book can be used as reference. Moreover a number of open articles are available freely in internet. Python is included in default in all GNU/Linux platforms and It is freely downloadable for Windows platform as well. However use of GNU/Linux may be encouraged).

1. www.python.org
2. Python Essential Reference, David M. Beazley, Pearson Education
3. Core Python Programming, Wesley J Chun, Pearson Education
4. Python Tutorial Release 2.6.1 by Guido van Rossum, Fred L. Drake, Jr., editor. This Tutorial can be obtained from website (http://www.altaway.com/resources/python/tutorial.pdf)
5. How to Think Like a Computer Scientist: Learning with Python, Allen Downey , Jeffrey Elkner , Chris Meyers, http://www.greenteapress.com/thinkpython/thinkpython.pdf
6. Numerical Methods in Engineering and Science, Dr. B S Grewal, Khanna Publishers, Newdelhi (or any other book)
7. Numerical methods for scientists and engineers, K. Sankara Rao, PHI
8. Introductory methods of numerical analysis, S.S.Shastry , (Prentice Hall of India,1983)
9. Computational Physics, V.K.Mittal, R.C.Verma & S.C.Gupta-Published by Ane Books,4821,Pawana Bhawan,first floor,24 Ansari Road,Darya Ganj,New Delhi-110 002 *(For theory part and algorithms. Programs must be discussed in Python)*

Semester-6

Core Course – XIII (ELECTIVE) 54 hrs (Credit – 3)

PH6 B20 (E1): NANO SCIENCE AND TECHNOLOGY

Module 2: Introduction : (6 Hrs)

Length scales in Physics- nanometre- Nanostructures: Zero, One Two and Three dimensional nanostructures (Chapter 3, Text 2)

Band Structure and Desnsity of State at nanoscale: Energy Bands, Density of States at low dimensional structures. (Chapter 3, Text 1)

Module 2:

Electrical transport in nanostructure: (15 hours)

Electrical conduction in metals, The free electron model. Conduction in insulators/ionic crystals - Electron transport in semiconductors - Various conduction mechanisms in 3D (bulk), 2D(thin film) and low dimensional systems: Thermionic emission, field enhanced thermionic emission (Schottky effect), Field assisted thermionic emission from traps (Poole-Frenkel effect), Arrhenius type activated conduction, Variable range, Hopping conduction, Polaron conduction. (Chapter 4, Text 1)

Module 3:

Introductory Quantum Mechanics for Nanoscience: (8 hrs)

Size effects in small systems, Quatum behavious of nanometric world: Applications of Schrödinger equation – infinite potential well, potential step, potenial box; trapped particle in 3D (nanodot), electron trapped in 2D plane (nanosheet), electrons moving in 1D (nanowire, nanorod, nanobelt), Excitons, Quantun confinement effect in nanomaterials (Chapter 5, Text 1)

Module 4:

Growth techniques of nanomaterials (Elemetary ideas only): **(9 hrs)**

Top down vs bottom up techniques, Lithographic process, Non Lithographic techniques: Plasma arc discharge, sputtering. Evaporation: Thermal evaporation, Electron beam

evaporation. Chemical Vapour Deposition (CVD). Pulsed Laser Deposition, Molecular Beam Epitaxy, Sol-Gel Technique, Electro-deposition., Ball-milling. (Chapter 6, Text 1)

Module 5:

Characterisation tools of nanomaterials: (10 hrs)

Scanning Probe Microscopy(SPM) : Basic Principles of SPM techniques, The details of STM, Tunnelling current, local barrier height, local density of states. Some applications of STM. (Section 7.1.1 – 7.1.3.3, 7.1.3.5, Text 1), General concepts of AFM (Section 7.2.1 – 7.2.4 , Text1), Electron microscopy (7.3.1-7.3.6, Text -1).

Module 6:

Applications of nanotechnology: (Elementary ideas only) **(6 hrs)**

Buckminster fullerene, Carbon nanotube, nano diamomd, BN Nanotune, Nanoelectronics - single electron transistor (no derivation), Molecular machine, Nanobiomatrics (Chapter 8, Text 1).Applications of nanomaterials in energy, medicine and environment (Text 2)

Text books:

1. Introduction to Nanoscience & Nanotechnology by K. K. Chattopadhyay and A. N. Banerjee, Publisher: PHI Learning and Private Limited
2. Nanotechnology, Rakesh Rathi, S Chand & Company, New Delhi

References:

1. Nanoparticle Technology Handbook – M. Hosokawa, K. Nogi, M. Naita, T. Yokoyama (Eds.), Elsevier 2007
2. Encyclopaedia of Materials Characterization, Surfaces, Interfaces, Thin Films, Eds. Brundle, Evans and Wilson, Butterworth – Heinmann, 1992
3. Springer Handbook of nanotechnology, Bharat Bhushan (Ed.), Springer-Verlag, Berlin, 2004
4. Nano Science and Technology, VS Muraleedharan and A Subramania, Ane Books Pvt. Ltd, New delhi
5. A Handbook on Nanophysics, John D, Miller, Dominant Publishers and Distributors, Delhi-51
6. Introduction to Nanotechnology, Charles P Poole Jr. and Frank J Owens, Wiley Students Edition
7. Nano-and micro materials, K Ohno *et. al*, Springer International Edition 2009, New Delhi

Semester-6

Core Course – XIII (ELECTIVE) 54 hrs (Credit – 3)

PH6 B20 (E2): ATMOSPHERIC PHYSICS

Unit-1 **10 Hrs**

Properties of Atmosphere: Structure and Composition of atmosphere. Different layers of atmosphere, Characteristics of gases, gas laws, temperature, atmospheric thermodynamics.

Unit-2 **15 Hrs**

Observing the atmosphere: Instrumentation- Temperature, Pressure and Humidity of atmosphere, Measurement of Temperature, Pressure and Humidity of atmosphere; Clouds and Precipitation: – Cloud types, Precipitation types, Measurement of precipitation; Cloud microphysics – Warm clouds, cold clouds and Rain making, lightning and cloud chemistry; Wind- measurement, gustiner and diurnal wind variations.

Unit-3 **10 Hrs**

Atmospheric optics and radiation: Visibility - attenuation of light, turbidity – optical phenomena – rainbows – haloes – corona – glory – mirage – blue of the sky – colours at sunrise and sunset – atmospheric refraction, Radiation in the atmosphere – The spectrum, black body radiation, scattering.

Unit-4 **19 Hrs**

Atmospheric effects and energy: The atmosphere as a heat Engine – Solar energy – The earth's Heat balance - Distribution of heat energy over the earth – temperature lag, Green house effect and its impact, Global warming.

Air in motion and Remote sensing: General circulation, monsoons, weather disturbances in tropics, Reading weather maps. Remote Sensing:– general principles, Radar and GPS (elementary ideas).

TEXT

1. **Meteorology** by Albert Miller Merril *Physical Science Series*
2. **Atmospheric Science: An introductory survey**, J M Wallace and P V Hobbs

REFERENCES:

3. **Meteorology** by Albert Miller Merril Physical Science Series
4. **Meteorology** by William Donn, McGraw Hill Book Company.
5. **Introduction to the atmosphere** by H. Reihl, McGraw Hill Book Company.
6. **Introduction to Meteorology** by Franklyn W Cole, John Wiley & Sons, INC, New York, U.S.A

7. **Introduction to Theoretical Meteorology** by S L Hess
8. **Elements of Meteorology** by R.W.Longley, John Wiley & Sons, INC, New York, U.S.A
9. **Introduction to Meteorology by S Pettersen McGraw Hill Book Company**

Semester-6

Core Course – XIII (ELECTIVE) 54 hrs (Credit – 3)

PH6 B20 (E3): Materials Science & Thin Films

UNIT I .

Introduction 8 Hrs

Scope of the Science of materials - Review of atomic structure – interactions and bonds- Classification of materials and their properties- Crystalline and noncrystalline- Inorganic solids- ionic Solids- polymers- metals and alloys.

UNIT II.

Defect and Diffusion in Materials 12 Hrs

Point Defects- line defects- surface defects- volume defects- Production and removal of defects- Deformation- irradiation- quenching- annealing- recoveryrecrystallisation and grain rowth.Diffusion in solids- Fick's law- Inter diffusion and Kirkendall effect.

UNIT III.

Vacuum pumps and Gauges 12 Hrs

High vacuum production – Rotary pump –diffusion pump –High Vacuum system- Bel Jar Vacuum system- leak detection – Pilani & Penning Gauge- ionization Gauge.

UNIT IV.

Growth Techniques 12 Hrs

Thin film preparation- Physical methods-Vacuum Evaporation – Electron Beam evaporation –Flash Evaporation – Sputtering- DC sputtering- Ion Beam sputtering- Chemical methods- Electro deposition- electro plating- Chemical bath – Spray Pyrolysis. Methods of Crystal Growth – solution growth techniques.

UNIT V.

Material Characterization Techniques 10 Hrs

Structural Analysis- XRD methods- Scanning Electron Microscope-Tunneling Electron Microscope- Compositional Analysis- electron scanning for Chemical analysis- Optical Analysis- Spectro photometer- electrical analysis- Hall set up- Four Probe set up.

References

1. Materials science and engineering- V Edn- V Raghavan(PHI)

2. Introduction to Materials science and engineering – Ralls Cartney and Wolf (Wiley)

3. Thin film Phenomena- K L Chopra(McGraw Hill)

4. Handbook of Thin film technology –Meissel& Clang

Semester 5

OPEN COURSE –I

(**For students from other streams**)

Objective

To develop scientific temper and attitude in students from other streams.

Scope of the course

Since the course does not require a solid base in physics only qualitative & elementary ideas of the subject are expected from the students.

PH5 D01(1): NON CONVENTIONAL ENERGY SOURCES (54 Hours Credit – 4)

UNIT I .

Solar energy : 14 Hrs

Solar constants, Solar radiation measurements, solar energy collector, Physical principle of the conversion of solar radiation in to heat, Solar energy storage, solar heaters, solar ponds, solar cookers, solar distillation, solar furnaces, solar green houses, photovoltaic generation,solar cells, basic merits and demerits of solar energy.

UNIT II.

Wind energy: 12 Hrs

Basic principle of wind energy conversion, basic components of wind energy conversion system, wind energy collectors. Energy storage, application of wind energy.

UNIT III.

Geothermal energy and energy from biomass: 14 Hrs

Geothermal sources, hydrothermal sources, geo-pressured resources, advantages and disadvantages of geothermal energy over other energy forms, application of geothermal energy. Method of obtaining energy from biomass.

UNIT IV .

Energy from Oceans and Chemical energy resources: 14 Hrs

Ocean thermal electric conversion. Basic principle tidal power, advantages and limitation

of tidal power generation. Energy and power from waves, wave energy conversion devices. Fuel cells, and application of fuel cells, batteries, advantages of battery for bulk energy storage. Hydrogen as alternative fuel for motor vehicles.

Text books:

1. Non – Conventional Energy Resources by G. D. Rai, Khanna Publishers, 2008.
2. Solar Energy Fundamentals and application by H.P. Garg and J. Prakash, Tata McGraw- Hill Publishing company ltd, 1997.
3. Solar energy by S. P. Sukhatme, Tata McGraw- Hill Publishing company ltd, 1997.
4. Solar energy by G.D. Rai, 1995.

References

1. Energy Technology by S. Rao and Dr. B.B. Parulekar, 1997, 2nd edition
2. Power Technology by A. K. Wahil. 1993.

Semester 5

OPEN COURSE –I

(For students from other streams)

Objective

To develop scientific temper and attitude in students from other streams.

Scope of the course

Since the course does not require a solid base in physics only qualitative & elementary ideas of the subject are expected from the students.

PH5 D01 (2): AMATEUR ASTRONOMY AND ASTROPHYSICS(54 Hours Credit – 4)

Unit-1(14 hours)

Introduction & Brief history of Astronomy Astronomy & Astrology- Fascinations of Astronomy-Two important Branches of Astronomy-Amateur observational Astronomy-Different types of Amateur Observing-

Ancient Astronomy & modern astronomy-Indian & western

Celestial sphere

Ideas of celestial sphere-cardinal points-concepts of Diurnal motion- circles of reference-Great circle-small circle-vertical circle—Defenitions:- Zenith and Nadir - Horizon- Poles-equator-Meridian-celestial axis-Systems of co-ordinates :–Horizen system-Azimuth & Altitude-The equator system-ascension & declination

Unit-2(14 hours)

Earth

The zones of earth-longitude and latitude-shape of earth-Arguments in favour of earths rotation-Experimental proof for the rotation of earth-Focaults pendulum experiment(qualitative ideas)

Rotation-Revolution- - Keplers laws-perihelion-aphelion-perigee and apogee, year-month-Day.

Measurement of time

Time-sidereal time-apparent and mean solar time and their relations-equation of time – atomic time- standard times-indian standard time-Greenwich mean time

seasons-causes of seasons-calender-sidereal year-tropical year--leap year-lunar calendar-solar calendar--Julian calendar-Gregorian calendar

Unit-3 (12 hours)

solar system

sun-structure-photosphere-chromosphere-solar constant- sun temperature-sun spots-solar eclipse-corona-(planets-surface conditions and atmosphere,size,period & distance)mercury-venus-earth-mars-jupiter-saturn-uranus-neptune-comets-asteroids-meteors

astronomical telescopes

Reflecting and Refracting types—Magnification

Unit-4 (14 hours)

The stars

The parallax of a star-unit of distance-Astronomical units--parsec-light year-Magnitudes of stars-apparent magnitude-absolute magnitude-relation between them-colour index-Three categories of stars-Main sequence stars-Dwarfs-Giants-star formation-life cycle of stars-Chandra sekher limit- Novae-Binary stars -neutron star-black holes.

Cosmology

Expanding universe-Big bang theory-Dark matter-dark energy

Reference Books:

1. A Text book on Astronomy – K K Dey, Book Syntricate Pvt. Ltd.
2. Introduction to Astrophysics – Baidanath Basu, PHI, India
3. Elements of Cosmology – Jayant Narlikar, University Press,
4. Astrophysics of Solar System – K D Abhyankar, University press
5. Chandrasekhar and his limit – G Venkataraman, University Press
6. Joy of Sky Watching – Biman Basu, National Book Trust
7. Practical Astronomy-George L Hosmer & James M Robbins-Jhon Wiley & Sons
8. A Brief History of time – Stephen Hawking.
9. http://www.nineplanets.org/

Semester 5

OPEN COURSE –I

(For students from other streams)

Objective

To develop scientific temper and attitude in students from other streams.

Scope of the course

Since the course does not require a solid base in physics only qualitative & elementary ideas of the subject are expected from the students.

PH5 D01 (3): Elementary Medical Physics (54 Hours Credit – 4)

UNIT-1-NUCLEAR MEDICINE PHYSICS (16 Hours)

Nuclear physics –Introduction to Radioactivity-Artificial and natural-Physical features of radiation, conventional sources of radiation, Interaction of different types of radiation with matter—Radiation detectors-function & properties of ionisation chamber , GM counter, Scintillation detectors—Radiation quantity and quality-Radiation exposure, Units of radiation dose, Measurement of radiation dose,safety, risk, and radiation protection—Radiopharmaceuticals – Radioactive agents for clinical studies—Biological effects & Genetic effect of radiation.

(Books for study-*Techniques for radiation dosimetry* by K Mahesh and D R Vij, Wiley *Eastern Limited, Clinical nuclear medicine by Maisey, Britton, Chapman and Hall , Medical Physics by J R Cameron and J G Skofonick, Wiley Eastern)*

UNIT – 2. MEDICAL INSTRUMENTATION- 10 Hrs

Measurements of Non electrical parameters-Respiration-heart rate-temperature-blood pressure –Electrical activity of the heart-effect of electrifield on cardiac muscles-stimulation laws-Arrhythmias its detection--principles of Electro cardiography-Electromyography-Electroencephalography- measurement and displaying and recording of ECG-features of EMG & EEG and their applications.

UNIT-3-LASERS IN MEDICINE 10 Hrs

Introduction to laser-principle and production of laser- effects of laser radiation on tissues, Different types of lasers- photo thermal effects, photochemical effects -photodynamic

therapy, Laser applications in therapy and diagnosis-opthalmology,Fibreoptic endoscopy and dentistry.Laser as a beautician's tool-laser hazards-biological effects,

(Books for study -La*sers in Medicine* by R W Wayanant, Plenum Publishing Co.)

UNIT-4-MEDICAL IMAGING TECHNIQUES-TOMOGRAPHY-18 HOURS

X-ray imaging-properties of X -rays- Production of X-rays--Planar X-ray imaging-instrumentation-X-ray fluoroscopy.

γ-ray imaging-principle and working of single crystal scintillation camera(gamma camera)

Magnetic resonance imaging-Introduction-ideas of NMR-Advantages- Clinical MRI. Functional MRI, MRI instrumentation-Biological effect of NMR.

Ultrasound imaging- generation and detection of ultrasound – Properties – reflection – transmission – attenuation – Ultrasound Transducers, Ultrasound instrumentation-Mechanical and electronic probes-probes for external and internal use-Principles of A-mode-B-mode-M-mode-Scanning. Hazards and safety of ultrasound.

(Books for study – *The physics of medical imaging* by S Webb, Hilger Publications, *Biomedical Instrumentation* by R S Khandpur)

Reference books:

1 Medical Physics by Glasser O, Vol 1,2,3 Year Book Publisher Inc Chicago
2 Leslie Cromwell, "Biomedical Instrumentation and measurement", Prentice hall of India, New Delhi, 1999.
3 John G. Webster, "Medical Instrumentation Application and Design", John Wiley and sons, New York, 1998.
4 Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw-Hill, New Delhi, 1997.
5 Joseph J.carr and John M. Brown, "introduction to Biomedical equipment technology", John Wiley and sons, New York, 1997.
6 W.R.Hendee & E.R.Ritenour, Medical Imaging Physics (3rd eds), Mosbey Year-Book,
Inc., 1992.
7. Hendee & E.R.Ritenour, Medical Physics.

B.Sc PROGRAMME IN PHYSICS (CORE)

PRACTICALS

The external practical examination will be conducted at the end of 4th & 6th semesters,. No fair record is required. At the time of external examination, a student has to produce certified rough record with a minimum of **75%** of the experiments, listed in the syllabus. Valuation of the record must be done internally. Equal weightage must be given to all sections. The principle or the logic and the relevant expressions of the experiment must be shown at the time of examination (Activity oriented).

Two test papers for practical internals could be conducted by including test papers in any two convenient cycles in the place of an experiment. A batch of students can be evaluated in each class. If there are a total of 4 cycles for a practical course, a test paper each can be included in the 3rd and 4th cycles. If there are a total of 3 cycles for a practical course, a test paper each can be included in the 2nd and 3rd cycles. A model examination can also conducted after completion of all cycles. Internal grade for test papers can be awarded based on the best two performances.

PH1 B02(P), PH2 B04(P), PH3 B06(P) & PH4 B08(P) : Practical I (Credit – 5)

1st, 2nd, 3rd & 4th SEMESTER EXPTS

(Any Ten from Each Part)

Part A

1. Young's modulus-non uniform bending-using pin and microscope-(load-extension graph).
2. Young's modulus-Uniform bending-using optic lever
3. Young's modulus-Angle between the tangents
4. Surface Tension-capillary rise method-radius by vernier microscope
5. Viscosity-Poiseuille's method –(Variable Pressure head, radius by mercury pellet method, sensibility method to find mass)
6. Moment of inertia-Flywheel
7. Moment of Inertia-Torsion Pendulum
8. Rigidity modulus-static torsion
9. Compound pendulum-acceleration due to gravity, Radius of gyration
10. Liquid lens-Refractive index of liquid and glass
11. Spectrometer-solid prism-Refractive index of glass measuring angle of minimum deviation.

12. Spectrometer-solid prism- Dispersive power

Part B

13. Deflection magnetometer-TAN A, Tan B positions
14. Deflection magnetometer -Tan C Position-moment of moments
15. Searle's vibration magnetometer-moment & ratio of moments
16. Box type vibration magnetometer-m & B_h
17. Melde's string arrangement-Frequency, relative density of liquid and soild (both modes)
18. Mirror galvanometer-figure of merit
19. Potentiometer-measurement of resistance
20. Potentiometer-calibration of ammeter
21. Ballistic Galvanometer- BG constant using HMS-then find B_h.
22. B.G.-Comparison of capacities Desauty's method.
23. Spectrometer- i-d curve
24. Verification of Kirchoff's laws , Verification of Thevenin's theorem.

PH5 B13(P) & PH6 B20(P) - Practical II (Credit – 5)

5th & 6th SEM EXPTS. (Any 20)

1. Spectrometer- i_1-i_2 curve
2. Spectrometer-Cauchy's constants
3. Spectrometer-Diffraction Grating-Normal incidence
4. Laser-wavelength using transmission grating
5. Diffraction Grating-minimum deviation
6. Spectrometer-Quartz prism-Refractive indices of quartz for the ordinary and extra-ordinary rays
7. Newton's rings-wavelength of sodium light
8. Air wedge-angle of the wedge, radius of a thin wire
9. Lee's Disc
10. Potentiometer-calibration low range and high range voltmeters
11. Potentiometer- Reduction factor of TG
12. Variation of field with distance-Circular coil-moment of magnet & B_h
13. Carey Foster's bridge-resistance & resistivity
14. Carey Foster's bridge-Temperature coefficient of Resistance
15. Conversion of Galvanometer to voltmeter-checking with standard voltmeter.
16. Conversion of Galvanometer to ammeter -checking with standard ammeter.
17. BG Absolute Capacity
18. BG-High resistance by leakage method
19. BG Mutual inductance
20. Planck's constant using LED's (3no.s)
21. Polarimeter-Specific rotatory power of sugar solution.
22. Cathode ray oscilloscope-Familiarisation, Voltage sweep operations, synchronization and triggering with signal generator, multimeter.
23. Numerical aperture of an optical fibre by semiconductor laser
24. Frequency of AC using sonometer

PH5 B14(P) & PH6 B21(P) – Practical III (Credit – 5)

5th & 6th SEM EXPTS (Minimum Fifteen from Unit : I and Five from Unit : II)

Unit : I

1. Construction of full wave, Centre tapped and Bridge rectifiers
2. Characteristics of Zener diode and construction of Voltage regulator.
3. Transistor characteristics and transfer characteristics in Common Base Configuration- current again
4. Transistor characteristics and transfer characteristics in Common Emitter Configuration- current again
5. CE Transistor Amplifier-Frequency response.
6. Clipping & Clamping circuits
7. Negative feed back amplifier
8. LC Oscillator (Hartley or Colpitt's)
9. Phase shift oscillator
10. Operational Amplifier –inverting, non inverting, Voltage follower
11. LCR circuits-Resonance using CRO
12. Realisation of gates using diodes(AND, OR) & transistors (NOT), verification using IC's
13. Voltage multiplier (doubler, tripler)
14. Multivibrator using transistors.
15. Flip-Flop circuits –RS and JK using IC's
16. Verification of De-Morgan's Theorem using basic gates.
17. Half adder using NAND gates and decade counter (7490 IC)

Unit : II Numerical Methods Using Python :

18. Solution of equations by bisection and Newton-Raphson methods
19. Least square fitting – straight line fitting.
20. Numerical differentiation using difference table.
21. Numerical Integration – Trapezoidal and Simpson's 1/3 rd rule.
22. Taylor series - Sin θ, Cos θ
23. Solution of differential equation Runge-Kutta method (Harmonic Oscillator).
24. Simulation of freely falling body. Tabulation of position, velocity and acceleration as a function of time.
25. Simulation of projectile – Tabulation of position, velocity and acceleration as a function of time – Plot trajectory in graph paper from tabulated values.

COMPLEMENTARY COURSES IN PHYSICS

(For B.Sc Programme In Mathematics, Chemistry Etc.)

Aim & Objectives.

The syllabus is drafted to generate new concepts with practical thinking and multi dimensional applicability of physics in other science programmes so as to empower students who have undergone grading system of education at under graduate level.

It is restructured in order to correlate the concepts of physics with other core programmes and also to generate exhaustive interest in physics course through series of activities like problem solving, active participation in laboratory programme, smart class room lectures etc.. semesters,.

At the time of external examination, a student has to produce certified rough record with a minimum of **75%** of the experiments, listed in the syllabus. **No fair record is required.**

SEMESTER -1

Complementary course-1

PH1 C01: Properties of matter & Thermodynamics

(Hrs/ Week =2 , Hrs / Sem =36, Credit =2)

1. **Elasticity** **9 Hours**

Elastic modulii. (Elementary ideas)- Dependence of Young's modulus on temperature (posing one practical application)- Work done per unit volume- poisson's ratio (Engineering application and theoretical limits)- relation between various elastic constants- Twisting couple on a cylinder- Torsion pendulum-Determination of rigidity modulus of a wire-Bending of beams-bending moment- I-form girders- Cantilever loaded at the free end – Loaded uniformly (Derivation required)

2. **Surface Tension & viscosity** **9 Hours**

Surface tension (Elementary ideas)-Excess pressure inside a liquid drop and bubble (Effect of electrostatic pressure on a bubble-change in radius)-Work done in blowing the bubble (problem based on the formation of bigger drop by a number of smaller drops)-Variation of surface tension with temperature, impurities, contamination- Effect of evaporation and condensation.

Viscosity-Coefficient of viscosity-Derivation of poiseuille's equation, stokes equation-Determination of viscosity by poiseuille's method and stokes method-Brownian motion –Viscosity of gases

3. **Thermo dynamics** **18 Hours**

Thermodynamic processes –Indicator diagram (P-V diagram, P-T diagram, T-V diagram, T-S diagram)- Work done in Quasi static process-Work done in Isothermal, Adiabatic, Isochoric, Isobaric processes-First law of thermodynamics-Application to heat capacities-Second law of thermodynamics- Carnot's engine - Derivation of efficiency using Carnot's cycle-Carnot's theorem and its proof- Carnot's refrigerator(coefficient of performance)-

Entropy-Change of entropy in a carnot's cycle, reversible cycle , irreversible cycle-principle of increase of entropy- Entropy and available energy- entropy and disorder

Thermo dynamic functions- concept of enthalpy- Helmholtz function- Gibb's function-Maxwell's thermodynamic relations- Clausius-clapyron equation-Effect of pressure on melting point and boiling point.

Books for reference

1. Properties of matter- D S Mathur
2. Heat and Thermo dynamics- D S Mathur (V Edn)
3. Properties of matter-JC Upadhaya
4. Heat and Thermodynamics - Zemansky
5.Physics- Resnick and Halliday
6. Thermodynamics- Brijlal and Suramanium

SEMESTER - 2

Complementary course-II1

PH2 C03: Mechanics, Relativity, Waves & Oscillations

(Hrs/ Week =2 , Hrs / Sem =36, Credit =2)

1. **Frames of reference** . **4 Hours**

Inertial frame of reference-Galilean transformation equations and Invariance- Non inertial frames- Centrifugal force and Coriolis force

2. **Conservation of Energy and Momentum** **10 Hours**

Conservation of energy of a particle –Energy function- Potential energy curve- Conservative and Non conservative forces- Conservation of Linear momentum-Center of mass frame of reference- Rockets- motion under central force- Conservation of angular momentum (pose suitable example)

3. **Relativity** **8 Hours**

Postulates of special theory-Michelson Morley experiment-Lorentz transformation equations- Length contraction-Time dilation- Twin paradox- variation of mass with velocity-Mass energy relation- momentum energy relation

4**. Oscillation and waves** **8 Hours**

Simple harmonic motion (Elementary idea)- equation –examples like oscillation of simple pendulum, loaded spring-An harmonic oscillator-Damped harmonic oscillator.

Wave motion-Equation for plane progressive wave-Energy density- Pressure variations of plane waves-Fourier theorem.

5**. Quantum mechanics** **6 Hours**

Postulates of quantum mechanics-Wave function-Schrodinger equation (Time dependent & steady state form)-eigen values and eigen functions-electron microscope and scanning tunnelling microscope (Qualitative study)

Books for reference-

1. Mechanics – J C Upadhyaya
2. Special theory of relativity- Resnick
3. Modern physics –Arthur Beiser
4. Waves, Mechanics & Oscillations- S B Puri

SEMESTER - 3

Complementary course-V

PH3 C05: Optics , Laser , Electronics & communication

(Hrs/ Week =3 , Hrs / Sem =54, Credit =2)

1. Interference **12 Hrs**

Fermat's principle- Laws of reflection and refraction- verification by Fermat's principle, Superposition of two sinusoidal waves (resultant amplitude and intensity)., constructive and destructive interference- Fresnel's two mirror arrangement and bi-prism- Interference with white light- Interference by a plane film- colours of thin films- Newton's rings

2. Diffraction **8 Hrs**

Fraunhofer single slit diffraction pattern- Intensity distribution- plane diffraction grating- resolving power. Experiment with grating

Half period zones- Zone plate (comparison with convex lens)- Fresnel diffraction at straight edge

3. Polarisation **7 Hrs**

Elementary idea- Brewster' law- Double refraction- positive and negative crystals- Quarter and half wave plate- production of plane , elliptically and circularly polarized light- optical activity

4. Optical instruments **6 Hrs**

Eye piece-Ramsden eyepiece- Huygene eye piece – Telescopes- Newton telescope- Galilean telescope- spectrometer- camera

5. Electronics **10 Hrs**

Half wave, Full wave and bridge rectifier circuits- Efficiency & ripple factor- Filter circuits (capacitor filter and π filters) – Zener diode characteristics- Voltage stabilization

Transistors- CB, CE, CC Configurations- characteristics- Current amplification factors- relation connecting α , β and γ – CE Amplifier- frequency response- band width

Basic principle of feed back- L C & RC oscillators- colpit's & Hartley oscillators .

Logic gates- Universal gates- De- Morgan's theorem – Exclusive OR and Exclusive NOR gate

6. Laser physics **6 Hrs**

Induced absorption- spontaneous emission and stimulated emission- population inversion- Types of laser- Ruby laser, Helium Neon laser- semi conductor laser (qualitative study)

7 Communication principle **5 Hrs**

Transmission and reception of signals- modulation and demodulation- Types of modulation-AM, FM,PM- Optical fiber communication- step index, graded index fiber- Numerical aperture

Books for reference

1. Optics- Ajoy Ghatak
2. Optics – Subrahmanian, Brijilal
3. Laser fundamentals – Silfast
4. Lasers – theory & applications- Thyagarajan & Ghatak
5. Principles of Electronics – VK. Mehta

SEMESTER - 4

Complementary course-VII

PH4 C07: Electricity, Magnetism and Nuclear physics

(Hrs/ Week =3 , Hrs / Sem =54, Credit =2)

1. Electrostatics **10 Hrs**

Coulomb's law between charges- Electric field- field lines- Electric potential-Gauss law- application to find field due to plane sheets of charge- Electrostatic shielding (pose practical application) – electrostatic pressure- Dielectrics- capacitors

2. Current electricity **10 Hrs**

Drift velocity of charges- electric resistance- super conductivity (basic ideas)- Galvanometer- conversion of galvanometer in to Voltmeter and ammeter – potentiometer – determination of resistance- carey fosters bridge- temperature coefficient of resistance.

3. Magnetism **12 Hrs**

Earths magnetism- magnetic elements- Dia magnets-paramagnets and ferro magnets- magnetic moment-Deflection magnetometer-Tan A, Tan B and Tan C- Searles vibration magnetometer- Tangent galvanometer- Hysteresis

4. Nuclear physics **12 Hrs**

Nucleus and its properties- nuclear force- stability of nucleus- binding energy- nuclear fission- fusion- reactors- Nuclear bomb, Hydrogen bomb- Radio activity- α ,β and γ radiations- half life and mean life- C^{14} dating- Effects of radiation- Nuclear waste disposal Particle accelerators- Linear accelerator- cyclotron- Radiation detectors- gas detectors- semi conductor detectors

5. Cosmic rays and Elementary particles **10 Hrs**

Cosmic rays (primary and secondary)- cosmic ray showers-latitude effect- longitude effect- Elementary particles- Classification- Leptons- Hadrons- resonance particles- quarks- color and flavour- Higgs boson- L H C- Dark energy- Origin of universe.

Text books

1. Introduction to Electro dynamics-David J Griffith
2. Electricity and Magnetism – Arthur F kip
3. Concepts of Modern physics – Arthur Beiser
4. Nuclear physics – Irvin kaplan
5. Nuclear physics - D.G.Tayal

Lab Programme for Complimentary courses

Lab examination will be conducted at the end of 4 th semester.

The minimum number of experiments for appearing examination is 28

Basic theory of the experiment must be shown at the time of Examination

Semester-1

PH1 C02(P): Complimentary Course-II (Practical)

Hours per week-2, Hours per semester-36,Credit-0

(Any SEVEN)

1. Density of a rectangular glass plate. Mass by Common balance (sensibility method), Screw gauge, Vernier calipers given
2. Liquid lens- Refractive index of liquid and glass
3. Torsion pendulum- Rigidity modulus
4. Spectrometer- Refractive index of the material of prism
5 Deflection Magnetometer- Moment of a magnet (Tan-A position)
6 Characteristics of Diode and Zener diode
7 Potentiometer- Measurement of resistance
8 Compound pendulum- acceleration due to gravity – Radius of gyration

Semester-2

PH2 C04(P): Complimentary Course-IV (Practical)

Hours per week-2, Hours per semester-36,Credit-0

(Any SEVEN)

1 Young's modulus – Uniform bending –using optic lever
2 Static torsion – Rigidity modulus
3. Spectrometer- Grating- Normal incidence
4. Melde's string- Frequency of fork (Transverse and Longitudinal mode)
5. Deflection magnetometer- Comparison of moments-Tan B (Equal distance method)
6. Field along the axis of a circular coil
7. Half wave and Full wave rectifier
8. Potentiometer- Conversion of Galvanometer in to ammeter

Semester-3

PH3 C06(P): Complimentary Course-VI (Practical)

Hours per week-2, Hours per semester-36,Credit-0

(Any SEVEN)

1. Young's modulus- Pin and microscope (Non- Uniform bending)
2. Viscosity of liquid- Capillary flow- Variable pressure head mehod
3. Air wedge- Diameter of a wire
4. Deflection magnetometer- Pole strength of magnet –Tan C
5. Carey Fosters bridge- Resistivity of the material of wire
6. Conversion of galvanometer to voltmeter (To read 0.1 volt/ div using a potentiometer)
7. Logic gates – Verification of truth table
8. Circular coil – moment of magnet and Bh

Semester-4

PH4 C08(P): Complimentary Course-VIII (Practical)

Hours per week-2, Hours per semester-36,Credit-2

(Any SEVEN)

1. Young's modulus of a cantilever- pin and microscope
2. Surface tension- Capillary rise method –Radius by microscope
3. Moment of inertia of fly wheel
4. Melde's string- mass and density in two modes
5. Tangent galvanometer – Reduction factor
6. Potentiometer – Calibration of low range voltmeter
7. Searl's vibration magneto meter – Comparison of moments
8. Newton's rings- Wavelength of sodium light

CCSS - GENERAL PATTERN OF QUESTION PAPER FOR

CORE & COMPLEMENTARY COURCES IN PHYSICS

Reg. No: **Code:**

Name:

I/II/III/IV/V/VI Semester Degree Examination - 2009,

CCSS - B.SC. PROGRAMME

Core Course – PH1 B03 : Mechanics / Complementary Course – PHC 01 : Properties of matter & thermodynamics

Time: 3 hours **Total Weightage: 30**

Section A

(Answer all questions)

(12 Objective type questions, in bunches of four questions, Each bunch carries a weightage of 1)

1. Bunch of 4 objective type questions (Weightage 1)
    1. question 1
    2. question 2
    3. question 3
    4. question 4
2. Bunch of 4 objective type questions (Weightage 1)
    5. question 1
    6. question 2
    7. question 3
    8. question 4
3. Bunch of 4 objective type questions (Weightage 1)
    9. question 1
    10. question 2
    11. question 3
    12. question 4

Total Weightage 1 x 3 = 3

Section B

(Answer all questions, each has Weightage 1)

(9 Short answer type questions)

Question Numbers 13 to 21 Total Weightage 1 x 9 = 9

Section C

(Answer any 5, each has Weightage 2)

(7 short essays/ Problems)

Question Numbers 22 to 28 Total Weightage 2 x 5 = 10

Section D

(Answer any 2, each has Weightage 4)

(3 long essays)

Question Numbers 29 to 31 Total Weightage 2 x 4 = 8