# UNIVERSITY OF CALICUT
## (Abstract)

B.Sc Programme in Physics - under Choice Based Credit Semester System-Scheme and syllabus-implemented with effect from 2009 admission-approved-orders issued.

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**GENERAL AND ACADEMIC BRANCH – I 'J' SECTION**

**No. GAI/J2/3725/07 Dated, Calicut University P.O .26.06.09**

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Read: 1. U.O.No.GAI/J2/3601/08(vol II) dtd 19/06/09.

2 Minutes of the meeting of Board of Studies in Physics (UG) held on 29.04.2009.

3. Item No. 2 (xviii) of the minutes of the meeting of the Faculty of Science held on 05.05.09.

4. Item No.II. A.19 of the minutes of the meeting of the Academic Council held 14.05.09.

## O R D E R

Choice based Credit Semester System and Grading has been introduced for UG Curriculum in the affiliated colleges of the University with effect from 2009 admission onwards and the regulations for the same implemented vide paper cited 1st above.

Vide paper read as 2, the Board of studies resolved to approve the Syllabus of BSc Programme in Physics under Choice based Credit Semester System prepared in the workshop conducted for the purpose. The Board also approved the regulation for the same.

The Faculty of Science vide paper read as 3rd endorsed the minutes of the meeting of the Board of studies in Physics(UG).

The Academic Council, vide paper read as 4th above, approved the minutes of the Faculty of Science.

Sanction has therefore been accorded for implementing the scheme and syllabus of BSc Programme in Physics under Choice based Credit Semester System in the University with effect from 2009 admission onwards.

Orders are issued accordingly .

Syllabus is apended.

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

To

The Principals of all affiliated Colleges
offering BSc Programme in Physics.

Copy to: PS toVC, PA toPVC,PA toR, Controller of Examination, EX.Sn,DR BSc.EGI,Enquiry,Information centrers,G&A-I A.F.G Sns,G&A-II.III branches, System Administration-with a request to upload in University website .

Forwarded/By Order

**SECTION OFFICER**

# UNIVERSITY OF CALICUT

Restructuring UG Curriculum

**Syllabus**

**for**

**BSc. Degree (Physics) Programme**

*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***

**COURSE STRUCTURE UNDER CCSS OF B.Sc. PRORGAMME**

| Sem | Course Title | Instruct. hrs/week | Credit | Exam hrs | Weightage | | Total Credit |
|---|---|---|---|---|---|---|---|
| | | | | | Int | Ext | |
| I | Common course I | 4 | 3 | 3 hrs | 25% | 75% | **15** |
| | Common course II | 5 | 3 | | | | |
| | Common course III | 4 | 4 | | | | |
| | Core course I | 2 | 1 | | | | |
| | Core course Practical I | 2 | * | | | | |
| | 1st Complementary course I | 4 | 2 | | | | |
| | 2nd Complementary course I | 2 | 2 | | | | |
| | 2nd Complementary course Practical I | 2 | * | | | | |
| | **TOTAL** | **25** | 15 | | | | |
| II | Common course IV | 4 | 4 | 3 hrs | 25% | 75% | **18** |
| | Common course V | 5 | 4 | | | | |
| | Common course VI | 4 | 4 | | | | |
| | Core course II | 2 | 2 | | | | |
| | Core course Practical II | 2 | * | | | | |
| | 1st Complementary course II | 4 | 2 | | | | |
| | 2nd Complementary course II | 2 | 2 | | | | |
| | 2nd Complementary course Practical II | 2 | * | | | | |
| | **TOTAL** | **25** | 18 | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| III | Common course VII | 5 | 4 | 3 hrs | 25 % | 75% | **17** |
| | Common course VIII | 5 | 4 | | | | |
| | Core course III | 3 | 3 | | | | |
| | Core course Practical III | 2 | * | | | | |
| | 1st Complementary course III | 5 | 4 | | | | |
| | 2nd Complementary course III | 3 | 2 | | | | |
| | 2nd Complementary course Practical III | 2 | * | | | | |
| | **TOTAL** | **25** | **17** | | | | |
| IV | Common course IX | 5 | 4 | 3 hrs | 25 % | 75% | **25** |
| | Common course X | 5 | 4 | | | | |
| | Core course IV | 3 | 3 | | | | |
| | Core course Practical IV | 2 | 4 | | | | |
| | 1st Complementary course IV | 5 | 4 | | | | |
| | 2nd Complementary course IV | 3 | 2 | | | | |
| | 2nd Complementary course Practical IV | 2 | 4 | | | | |
| | **TOTAL** | **25** | **25** | | | | |
| V | Core course V | 3 | 3 | 3 hrs | 25 % | 75% | **16** |
| | Core course VI | 3 | 3 | | | | |
| | Core course VII | 3 | 3 | | | | |
| | Core course VIII | 3 | 3 | | | | |
| | Open Course I | 2 | 4 | | | | |
| | Core course Practical V | 5 | * | | | | |
| | Core course Practical VI | 5 | * | | | | |
| | Course work/Project work/Industrial visit | 1 | * | | | | |
| | **TOTAL** | **25** | **16** | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Core course IX | 3 | 3 | | | | |
| | Core course X | 3 | 3 | | | | |
| | Core course XI | 3 | 3 | | | | |
| | Core course XII (Elective) | 2 | 2 | | | | |
| VI | Core course Practical VII | 5 | 8 | 3 hrs | 25 % | 75% | **29** |
| | Core course Practical VIII | 5 | 8 | | | | |
| | Course work/Project work/Industrial visit | 1 | 2 | | | | |
| | **TOTAL** | **25** | **29** | | | | |

**TOTAL CREDITS** **120**

| **Total Theory Papers** | **Total Practical Papers** |
|---|---|
| English-6 Nos(Common course 1,2,4,5,7,9)<br>Language-4 Nos(Common course 3,6,8,10)<br>Core course theory-14 Nos<br>1st Complementary theory-4 Nos<br>2nd Complementary theory-4 Nos | Core course practical-8 Nos (3 exams)<br>2nd Complementary practical-4 Nos (1 exam)<br>**Project-1 No** |

# 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 | 1 |
| | 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 | | **25** | **15** |
| 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 | | **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 | | **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 | 4 |
| | | 1st Complementary Course IV– Mathematics | 90 | 5 | 4 |
| | | 2nd Complementary Course IV | 54 | 3 | 2 |
| | | 2nd Complementary Course Practical IV | 36 | 2 | 4 |
| | | Total | | **25** | **25** |

| | | | | | |
|---|---|---|---|---|---|
| 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 – Thermal and Statistical Physics | 54 | 3 | 3 |
| | | Open Course – (*course from other streams*) | 36 | 2 | 4 |
| | PH5 B13(P) | Core Course Practical V - Practical II | 90 | 5 | * |
| | PH5 B14(P) | Core Course Practical VI - Practical III | 90 | 5 | * |
| | PH5 B15 (PR) | Project | | 1 | * |
| | | Total | | **25** | **16** |
| VI | PH6 B16 | Core Course IX - Electronics (Analog and Digital) and Informatics | 72 | 4 | 3 |
| | PH6 B17 | Core Course X - Solid State Physics, Spectroscopy and Laser physics | 72 | 4 | 3 |
| | PH6 B18 | Core Course XII - Nuclear Physics, Particle Physics and Astrophysics | 72 | 4 | 3 |
| | PH6 B19 | Core Course XIII (Elective) | 54 | 2 | 2 |
| | PH6 B20 (P) | Core Course Practical VII – Practical II | 90 | 5 | 8 |
| | PH6 B21 (P) | Core Course Practical VIII – Practical III | 90 | 5 | 8 |
| | PH6 B22(Pr) | Project | | 1 | 2 |
| | | Total | | **25** | **29** |
| **Total Credits** | | | | | **120** |

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

## 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.

## Semester I

## Core Course I

## PH1 B01: METHODOLOGY OF SCIENCE AND PHYSICS – 36 hours

### Part A: Methodology And Perspectives Of Sciences

**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**

What does physics deal with? - brief history of physics during the last century-the inconsistency between experiments and theories- Birth of new science concepts .

Exaple of quantum concepts – examples :- Design of an experiment , experimentation ,

Observation,data collection: Key breakthroughs in physics and scientific research – Example from Relativity - scientific imagination and the need for rigorous experimental evidence – Need for mathematical language for physics – Electronic computer as one of the greatest tools for combination of mathematics and physics – Role of invention of new - Scientific instruments- interaction between physics and life science – interaction between physics and technology.

**Referances:**

1. A brief history and philosophy of Physics - Alan J. Slavin- http:/ www.trentu. Ca/ academic / history- 895 .html

2. 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

3. Attitude of teachers towards physics and paranormal phenomena, HenrykSzyd Lowsky-www.conceptsofphysics. net/IV -4-685.pdf.

**Semester -2**

**Core course –II - 36 hours**

## PH2 B03: PROPERTIES OF MATTER, WAVES & ACOUSTICS

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

Elasticity: Basic ideas, Work Done per Unit Volume, 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 8.11, 8.16, 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, Fouriers Theorem, Wave Velocity and Group Velocity

(Sections:11.1 to11.9 , 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 UltrasonicWaves 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

2Text 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)

**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, Center 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 formulation 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

(Section 3.1 to 3.9 of Classical Mechanics by G.Aruldhas )

**UNIT-3**

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

Electromagnetism and Galilean transformation,Michelson Morley experiment, Ether hypohesis,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

Section 10.1 to 10.11 ,10.14 to 10.17 Classical Mechanics by G.Aruldhas

**Text books for study**

1) Mechanics by J C Upadhyaya 2003 edition

2) Classical Mechanics by G.Aruldhas 2008

**Reference books**

1).Mechanics by D.S.Mathur 2). Classical Mechanics by Takwala and Puranic

3). Classical Mechanics by J C Upadhyaya 4) Classical Mechanics by Goldstein

5).Berkeley Physics cource Vol 1 6).Feynman Lectures on Physics Vol 1

7. Elements of Mechanics – K Rama Reddy, S Raghavan & D V N Sarma- Universities Press
8. Introduction to Mechanics – Mahendra K Verma – Universities Press

**Semester-4**

**Core Course – IV (54 hours)**

**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)

**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 amd 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**

Electricity and magnetism by Arthur F Kip

Physics Vol. II by Resnick and Halliday

**Semester-5**

**Core Course – V** (54 hrs)

**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)

**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 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 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 funtion, energy levels, zero point energy.

(Sections 5.1, 5.3 to 5.11 & appendix to chapter 5 of Modern Physics by 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. Quatum 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

**PH5 B11: PHYSICAL OPTICS AND MODERN OPTICS**

**UNIT I (12 hours)**

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)

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)

**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, Fresnal Biprism, Determination of $\lambda$ and $d\lambda$ of Sodium Light (Sections:14.1-14.4,14.6-14.9 (Brijlal, Subramaniyam, & Avadhanulu, Sections 12.1-12.9 Ajoy Ghatak)

**UNIT II (20 hours)**

**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)

**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)

**Fresnel Diffraction (4 hours)**

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

**UNIT III (7 hours)**

**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 IV (4 hours)**

**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 V ( 6 hours)**

**Fiber Optics**

Optical fiber, Numerical aperture, step index fiber, pulse dispersion, graded index fiber, 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 VI ( 5 hours)**

**Nonliner 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**

Optics by Ajoy Ghatak

Optics by Subramaniam,Brijlal & Avadhanulu – New edition

Optics by Mathur

Nonlinear Optics- B.B.Laud

Laser Fundamentals- Silfast

Wave Optics and its Applications – Rajpal S Sirohi – Orient Longman
Optical Communications – M Mukunda Rao – Universities Press

**Semester-5**

**Core Course – VIII - (54 hrs)**

**PH5 B12: THERMAL AND STATISTICAL PHYSICS**

**Unit- I**

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)

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 hrs)

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 hrs)

(Relevant topics from Chapters 8 & 9 – Heat and Thermodynamics by D S Mathur-Revised fifth edition)

**Unit – II**

Thermodynamic functions-Enthalpy, Helmhlotz function, Gibbs function-Maxwell's thermodynamic relations-Claussius-Clapeyron equation from Maxwell's thermodynamic relations- Applications of Claussius-Clapeyron equation. (6 hrs)

(Relevant topics from Ch. 9-Heat and Thermodynamics by D S Mathur-Revised fifth edition)

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)

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 – IX (72 hours)**

**PH6 B16: ELECTRONICS AND INFORMATICS**

**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, phase shift and crystal oscillators - their expressions for frequency.
Sections (13.1-13.5, 14.1 - 14.13, 14.15-14.20)

**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)

**9. Informatics (18 hrs)**

(*Syllabus is to be added)*

**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 – X (72 hrs)**

**PH6 B17 : SOLID STATE PHYSICS, SPECTROSCOPY AND LASER PHYSICS**

**UNIT –1 SOLID STATE PHYSICS**

**1. Crystal Physics - 15 hours**

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 hours**

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 hours**

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 hours**

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 hours**

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 hours**

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 hours**

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 hours**

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)

**9. 18 hrs** (*Syllabus is to be added)*

**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 (72 hrs)**

**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 (5$^{th}$ 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 ($5^{th}$ 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. **Astro physics 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)

**8. 18 hrs** (*Syllabus is to be added)*

**Suggested Reference Materials (Books and Materials: )**

Nuclear Physics: D.G. Tayal

Atomic Physics: J.B. Rajam

Atomic Physics: John Yarwood

Introduction to Astrophysics: H L Duorah & Kalpana Duorah

Mayer – Jensen Shell Model and Magic Numbers: R Velusamy, Dec 2007

The Enigma of Cosmic Rays: Biman Nath, Resonance – Feb 2004, March 2004

Black body radiation: G.S. Ranganath, Resonance – Feb. 2008.

Advanced Physics Second Edition – Keith Gibbs – Cambridge University Press

**Semester-6**

**Core Course – XII (54 hrs)**

**PH6 B19: ELECTIVE**

(For students of B.Sc. Program in Physics)

*(Detailed syllabus attached as Annexure)*

**PH5 D01: OPEN COURSE –I**

**Semester 5**

(For students from other streams)

(54 hrs)

*(Detailed syllabus attached as Annexure)*

## B.Sc PROGRAMME INPHYSICS (CORE)

## PRACTICALS

Note. At the end of 4th & 6th semesters, external practical examination will be conducted. The minimum number of experiments for appearing examination will be decided by the Board of Studies. 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).

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

### 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**

**$5^{th}$ & $6^{th}$ 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**

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

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)

**C-Programming**

18. Solution of equations by iteration method
19. Work done and Angular momentum

20. Projectile motion-List the height, horizontal range, range and time of flight ( Plot graph in graph sheet).
21. LCR Circuit
22. Taylor series - Sin $\theta$, Cos $\theta$
23. Decimal to binary and Binary to decimal
24. Motion of a rocket- velocity at different instances
25. Mean & standard deviation

## 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..

## 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 tunneling 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 Hours** )

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 Hours)**

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 Hours)**

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 Hours)**

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

**5. Electronics (10 Hours)**

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 Hours)**

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 Hours)**

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 Hours)**

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 Hours)**

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 Hours)**

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 Hours)**

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 Hours)**

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. ” - 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

**GENERAL PATTERN OF QUESTION PAPER FOR**
**B.SC. PROGRAMME IN PHYSICS**

**Reg. No:** **Code:**
**Name:**

**I/II/III/IV/V/VI Semester Degree Examination - 2009,**
**B.SC. PROGRAMME IN PHYSICS**
**Core Course – PH1 B02 : Mechanics**

**Time: 3 hours** **Total Weightage: 25**

**Section A**
**(Answer all questions)**
*(Objective type questions, in bunches of four objective type questions, Each bunch carries a weightage of 1)*

1. Bunch of 4 objective type questions (weightage 1)
   i) question 1
   ii) question 2
   iii) question 3
   iv) question 4
2. Bunch of 4 objective type questions (weigthage 1)
   i) question 1
   ii) question 2
   iii) question 3
   iv) question 4
3. Bunch of 4 objective type questions (weightage 1)
   i) question 1
   ii) question 2
   iii) question 3
   iv) question 4

Total weigtage 1 x 3 = 3

**Section B**
**(Answer any 6, each has weightage 1 )**
*( 8 Short answer type questions)*

Total weigtage 1 x 6 = 6

**Section C**
**(Asnwer any 4, each has weightage 2)**
*(6 short essays/ Problems)*

Total weigtage 2 x 4 = 8

**Section D**
**(Answer any 2, each has weightage 4)**
*(4 long essays)*

Total weigtage 4 x 2 = 8

**GENERAL PATTERN OF QUESTION PAPER FOR**

**B.SC. PROGRAMME IN CHEMITRY/MATHEMATICS etc.**

**Reg. No:** **Code:**
**Name:**

**I/II/III/IV/V/VI Semester Degree Examination - 2009,**
**B.SC. PROGRAMME IN CHEMITRY/MATHEMATICS etc.**

**Complementary Course – PHC 01 : Properties of matter & thermodynamics**

**Time: 3 hours** **Total Weightage: 25**

**Section A**
**(Answer all questions)**

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

1. Bunch of 4 objective type questions (weightage 1)
   - v) question 1
   - vi) question 2
   - vii) question 3
   - viii) question 4
2. Bunch of 4 objective type questions (weigthage 1)
   - ix) question 1
   - x) question 2
   - xi) question 3
   - xii) question 4
3. Bunch of 4 objective type questions (weightage 1)
   - xiii) question 1
   - xiv) question 2
   - xv) question 3
   - xvi) question 4

Total weigtage 1 x 3 = 3

**Section B**
**(Answer any 6, each has weightage 1 )**
*( 8 Short answer type questions)*

Total weigtage 1 x 6 = 6

**Section C**
**(Asnwer any 4, each has weightage 2)**
*(6 short essays/ Problems)*

Total weigtage 2 x 4 = 8

**Section D**
**(Answer any 2, each has weightage 4)**
*(4 long essays)*

Total weigtage 4 x 2 = 8