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

GENERAL AND ACADEMIC BRANCH – I ‘J’ SECTION

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

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.

ORDER

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 appended.

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 centres,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

(Abstract)

BSc programme in Physics under Choice based Credit Semester System - w.e.f 2009 admn- finalised syllabus-approved-implemented- orders issued

GENERAL AND ACADEMIC BRANCH –I ‘J’ SECTION

No. GA I/J2/3725/07       Dated, Calicut University P.O, 04.02.2010

Read : 1.U.O of even no.dated 26.06.09
     2. Minutes of the meeting of the Board of Studies in Physics(UG) of 28.01.2010
     3. Letter from the Chairman Board of Studies in Physics(UG) dtd 01.02.2010

ORDER

The syllabus of B.Sc programme in Physics under CCSS was implemented w.e.f 2009 admission onwards vide paper read as 1st above.

The Board of Studies in Physics(UG) vide paper read as 2nd resolved to incorporate changes in the syllabus of BSc programme in Physics under CCSS and approved the corrections.

The Chairman, vide paper read as 3rd informed that the Board of Studies in Physics (UG) has finalized the syllabus of BSc Physics(Core,Complementary,Open and Elective Courses) for urgent implementation.

The Vice Chancellor, in view of urgency, approved the minutes subject to ratification by the Academic Council.

Sanction has therefore been accorded for implementing the finalised syllabus of B.Sc. programme in Physics under CCSS with effect from 2009 admission onwards.

Orders are issued accordingly. Syllabus appended.

Sd/-

DEPUTY REGISTRAR (G &A I)

For Registrar

To

The Principals of affiliated colleges offering UG programme in Physics.

Copy to:

PS to VC/PA to Registrar/Chairman,Board of Studies in Physics(UG)/CE/EX Sn /DR3/DR (BSc) /Tabulation Sn./EG1 /Exam. Enquiry /All Information Centers/Systen administrator with a request to upload in the University website/GAI,’F’,G’ Sections/GAII, GA III Branches.

Forwarded / By Order

Sd/-

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 STRUCTURE

<table>
<thead>
<tr>
<th>Semester</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Total hours</th>
<th>Hours/Week</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>A 01</td>
<td>Common Course I - English</td>
<td>72</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>A 02</td>
<td>Common Course II – English</td>
<td>90</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>A 07</td>
<td>Common Course III – Language other than English</td>
<td>72</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>PH1 B01</td>
<td>Core course I - Methodology of Science and Physics</td>
<td>36</td>
<td>2</td>
<td>2(\text{**}})</td>
</tr>
<tr>
<td></td>
<td>PH1 B02 (P)</td>
<td>Core Course Practical I - Practical I</td>
<td>36</td>
<td>2</td>
<td>*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1(^{\text{st}}) Complementary Course I - Mathematics</td>
<td>72</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2(^{\text{nd}}) Complementary Course I</td>
<td>36</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2(^{\text{nd}}) Complementary Course Practical I</td>
<td>36</td>
<td>2</td>
<td>*</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td>25</td>
<td>16(\text{@})</td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>A 03</td>
<td>Common Course IV - English</td>
<td>72</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>A 04</td>
<td>Common Course V – English</td>
<td>90</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>A 08</td>
<td>Common Course VI – Language other than English</td>
<td>72</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>PH2 B03</td>
<td>Core Course II - Properties of Matter, Waves and Acoustics</td>
<td>36</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>PH2 B04 (P)</td>
<td>Core Course Practical II - Practical I</td>
<td>36</td>
<td>2</td>
<td>*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1(^{\text{st}}) Complementary Course II - Mathematics</td>
<td>72</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2(^{\text{nd}}) Complementary Course II</td>
<td>36</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2(^{\text{nd}}) Complementary Course Practical II</td>
<td>36</td>
<td>2</td>
<td>*</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td>25</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>A 05</td>
<td>Common Course VI - English</td>
<td>90</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>A 09</td>
<td>Common Course VIII - Language other than English</td>
<td>90</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>PH3 B05</td>
<td>Core Course III - Mechanics</td>
<td>54</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>PH3 B06 (P)</td>
<td>Core Course Practical III – Practical I</td>
<td>36</td>
<td>2</td>
<td>*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1(^{\text{st}}) Complementary Course III – Mathematics</td>
<td>90</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2(^{\text{nd}}) Complementary Course III</td>
<td>54</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2(^{\text{nd}}) Complementary Course Practical III</td>
<td>36</td>
<td>2</td>
<td>*</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td>25</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>A 06</td>
<td>Common Course IX – English</td>
<td>90</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>A 10</td>
<td>Common Course X - Language other than English</td>
<td>90</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>PH4 B07</td>
<td>Core Course IV - Electrodynamics I</td>
<td>54</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Course Code</td>
<td>Course Title</td>
<td>Credits</td>
<td>Teaching Hours</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------------</td>
<td>--------------------------------------------------</td>
<td>---------</td>
<td>----------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PH4 B08 (P)</td>
<td>Core Course Practical IV – Practical I</td>
<td>36</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1&lt;sup&gt;st&lt;/sup&gt; Complementary Course IV – Mathematics</td>
<td>90</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2&lt;sup&gt;nd&lt;/sup&gt; Complementary Course IV</td>
<td>54</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2&lt;sup&gt;nd&lt;/sup&gt; Complementary Course Practical IV</td>
<td>36</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td>25</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Teaching Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>PH5 B09</td>
<td>Core Course V - Electrodynamics II</td>
<td>54</td>
<td>3</td>
</tr>
<tr>
<td>PH5 B10</td>
<td>Core Course VI - Quantum Mechanics</td>
<td>54</td>
<td>3</td>
</tr>
<tr>
<td>PH5 B11</td>
<td>Core Course VII - Physical Optics and Modern Optics</td>
<td>54</td>
<td>3</td>
</tr>
<tr>
<td>PH5 B12</td>
<td>Core Course VIII- Electronics (Analogue and Digital)</td>
<td>54</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Open Course – (course from other streams)</td>
<td>36</td>
<td>2</td>
</tr>
<tr>
<td>PH5 B13(P)</td>
<td>Core Course Practical V - Practical II</td>
<td>90</td>
<td>5</td>
</tr>
<tr>
<td>PH5 B14(P)</td>
<td>Core Course Practical VI - Practical III</td>
<td>90</td>
<td>5</td>
</tr>
<tr>
<td>PH5 B15(PR)</td>
<td>Project</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td>25</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Teaching Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>PH6 B16</td>
<td>Core Course IX - Thermal and Statistical Physics</td>
<td>54</td>
<td>3</td>
</tr>
<tr>
<td>PH6 B17</td>
<td>Core Course X - Solid State Physics, Spectroscopy and Laser physics</td>
<td>54</td>
<td>3</td>
</tr>
<tr>
<td>PH6 B18</td>
<td>Core Course XI - Nuclear Physics, Particle Physics and Astrophysics</td>
<td>54</td>
<td>3</td>
</tr>
<tr>
<td>PH6 B19</td>
<td>Core Course XII – Computational Physics</td>
<td>36</td>
<td>2</td>
</tr>
<tr>
<td>PH6 B20</td>
<td>Core Course XIII (Elective)</td>
<td>54</td>
<td>3</td>
</tr>
<tr>
<td>PH6 B21 (P)</td>
<td>Core Course Practical VII – Practical II</td>
<td>90</td>
<td>5</td>
</tr>
<tr>
<td>PH6 B22 (P)</td>
<td>Core Course Practical VIII – Practical III</td>
<td>90</td>
<td>5</td>
</tr>
<tr>
<td>PH6 B23(Pr)</td>
<td>Project</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td>25</td>
</tr>
</tbody>
</table>

Total Credits 120

<sup>©</sup> 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 five (5) credits, instead of 4 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 26 instead of 25 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) :**

<table>
<thead>
<tr>
<th></th>
<th>Course Code</th>
<th>Course Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PH6 B20 (E1)</td>
<td>NANO SCIENCE AND TECHNOLOGY</td>
</tr>
<tr>
<td>2</td>
<td>PH6 B20 (E2)</td>
<td>ATMOSPHERIC PHYSICS</td>
</tr>
<tr>
<td>3</td>
<td>PH6 B20 (E3)</td>
<td>MATERIALS SCIENCE &amp; THIN FILMS</td>
</tr>
</tbody>
</table>

**OPEN COURSES OFFERED BY PHYSICS DEPARTMENT**

(For students from other streams)

<table>
<thead>
<tr>
<th></th>
<th>Course Code</th>
<th>Course Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PH5 D01(1)</td>
<td>NON CONVENTIONAL ENERGY SOURCES</td>
</tr>
<tr>
<td>2</td>
<td>PH5 D01(2)</td>
<td>AMATEUR ASTRONOMY AND ASTROPHYSICS</td>
</tr>
<tr>
<td>3</td>
<td>PH5 D01(3)</td>
<td>ELEMENTARY MEDICAL PHYSICS</td>
</tr>
</tbody>
</table>

**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

<table>
<thead>
<tr>
<th>Component</th>
<th>Weightage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Class Participation (Attendance)</td>
<td>1</td>
</tr>
<tr>
<td>2. Regularity</td>
<td>1</td>
</tr>
<tr>
<td>3. Test Paper 1</td>
<td>1</td>
</tr>
<tr>
<td>4. Test Paper 2</td>
<td>1</td>
</tr>
<tr>
<td>5. Record</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>5</strong></td>
</tr>
</tbody>
</table>

2. The components of external practical examination are

<table>
<thead>
<tr>
<th>Component</th>
<th>Weightage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Principle, Formula and Theory</td>
<td>2</td>
</tr>
<tr>
<td>2. Adjustments and observations</td>
<td>6</td>
</tr>
<tr>
<td>3. Viva</td>
<td>1</td>
</tr>
<tr>
<td>4. Calculation and results</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>10</strong></td>
</tr>
</tbody>
</table>
**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.
Semester I
Core Course I

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

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

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
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:
4. Newton R G. The Truth of Science: New Delhi, 2nd edition

Part B: Methodology and Perspectives of Physics (12 Hours)
(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
3. The inspiring History of Physics in the Last One Hundred Years : Retrospect and prospect Prof. Dr-Ing. Lu Yongxiang http://www.twas.org.cn/twas/proLu.asp

Part C – Mathematical Methods in Physics (14 Hours)
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).

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 to 8.23, 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.Murugesan & Kiruthiga Sivaprasath)

Books for Study

Reference
1. Mechanics -- D.S. Mathur
2. Text book of Sound --Brij Lal & Subramaniam
4. Berkeley Physics course Vol 3 on Waves
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 2.11 of 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 5.1 to 5.7, 5.10, 5.11 of 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, 7.6 to 7.9, 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**
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 course Vol 1
4. Feynman Lectures on Physics Vol 1
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 \( \mathbf{E} \), Applications of Gauss law, Curl of \( \mathbf{E} \) - 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 \( \mathbf{D} \) – 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

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 \( \mathbf{B} \), 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

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 \( \mathbf{H} \), 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. Murugesan)

4) AC circuits  
12 hours
(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. Murugesan)
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.**  
   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**  
   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**  
   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**  
   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**  
   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


REFERENCE:

1. Modern Physics(II Edn.)-Kenneth Krane
3. Quantum Mechanics By G. Aruldhas
4. Berkeley Physics Course: Quantum Physics By Wichmann
5. University Physics – Zemansky
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 13.1-13.3,13.4,13.8-13.9 Ajoy Ghatak, Sections 2.1-2.6 (Brijlal, Subramaniyam, & Avadhanulu)

UNIT III (13 hours)
5. Fraunhofer Diffraction 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

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
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 feedback circuits Oscillatory Circuits-LC, RC oscillators, tuned collector oscillator, Hartley, Colpitt’s, phase shift and crystal oscillators - their expressions for frequency.

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

7. Number system  
   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  
   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
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)

3. Entropy and adiabatic- 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-Clausius-Clapeyron equation from Maxwell’s thermodynamic
relations- Applications of Clausius-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 Subramaniam
2. Physics- Resnick and Halliday
3. Heat and Thermodynamics-Zemansky
4. Heat and Thermodynamics-DS Mathur (V Edn.)
PH6 B17: SOLID STATE PHYSICS, SPECTROSCOPY AND LASER PHYSICS

UNIT –1 SOLID STATE PHYSICS

1. Crystal Physics  
   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:  
   Bragg’s law – Braggs X-ray spectrometer-Rotating Crystal method  
   Section 5.7 to 5.11 - Solid State Physics by S.O. Pillai

3. Superconductivity:  
   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:  
   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  
   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

26
6. **Infra Red Spectroscopy:** 10 Hrs
   (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
   (Qualitative ideas only)

**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 State 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 Murugesan
5. Optical Communications – M Mukunda Rao – Universities Press
Semester-6
Core Course – XI  54 hrs (Credit – 3)

PH6 B18 : NUCLEAR PHYSICS, PARTICLE PHYSICS & ASTROPHYSICS

UNIT: 1 (27 hrs)

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

2. Nuclear Transformations:  
   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.

3. Nuclear Detectors And Counters:  
   Interactions of radiation with matter – fundamental ideas, Gas filled counters- ionization chamber – proportional counter – G.M. counter, Cloud chamber, Bubble chamber, Semiconductor 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:  
   Nature of Cosmic rays, the origin of cosmic rays, geomagnetic effects, Cosmic ray showers
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.


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  
Semester-6  
Core Course – XII  
PH6 B19: Computational Physics (36 hrs – 2 credits)

UNIT I.  
Introduction to Python Programming: 15 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, Tuples, and Dictionaries, Conditionals, Iteration and looping - Functions and Modules -. File input and Output, Pickling.

UNIT II.  
Numerical Methods in physics (Programs are to be discussed in Python) 14 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: Difference 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 7 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)- 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)
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)
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 Density 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, Quantum 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, Text 1), 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 diamond, BN Nanotune, Nanoelectronics - single electron transistor (no derivation), Molecular machine, Nanobiomatricts (Chapter 8, Text 1). Applications of nanomaterials in energy, medicine and environment (Text 2)

**Textbooks:**

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:**

5. A Handbook on Nanophysics, John D, Miller, Dominant Publishers and Distributors, Delhi-51
Semester-6
Core Course – XIII (ELECTIVE)  54 hrs (Credit – 3)
PH6 B20 (E2): ATMOSPHERIC PHYSICS

Unit-1  10 Hrs

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

Unit-4  19 Hrs

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
7. *Introduction to Theoretical Meteorology* by S L Hess


UNIT I.
Introduction 8 Hrs

UNIT II.
Defect and Diffusion in Materials 12 Hrs

UNIT III.
Vacuum pumps and Gauges 12 Hrs

UNIT IV.
Growth Techniques 12 Hrs

UNIT V.
Material Characterization Techniques 10 Hrs

References
1. Materials science and engineering- V Edn- V Raghavan( PHI)
2. Introduction to Materials science and engineering – Ralls Cartney and Wolf ( Wiley)
4. Handbook of Thin film technology –Meissel& Clang
Semester 5

OPEN COURSE –I (For students from other streams)

PH5 D01(1): NON CONVENTIONAL ENERGY SOURCES (36 Hours Credit – 4)

UNIT I.

Solar energy: 9 Hrs
Solar constants, Solar radiation measurements, solar energy collector,
Physical principle of the conversion of solar radiation into heat, Solar energy storage,
solar heaters, solar ponds, solar cookers, solar distillation, solar furnaces, solar green
houses, photovoltaic generation. basic merits and demerits of solar energy.

UNIT II.

Wind energy: 9 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: 9 Hrs
Geothermal sources, hydrothermal sources, geo-pressed 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: 9 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.

References
Semester 5

OPEN COURSE – I (For students from other streams)

PH5 D01 (2): AMATEUR ASTRONOMY AND ASTROPHYSICS (36 Hours Credit – 4)

Unit 1 - Introduction & History of Astronomy 8 Hrs

Unit 2 - Astronomical tools & techniques. 10 Hrs
Observational Parameters & Terminologies: Astronomical Measurements: Astronomical Unit; Light Year; Parsec; scales on powers of 10, structure differences on size scale, boundaries of dimensions, determination of distance and standard candles - .Magnitude scales: Apparent Magnitude; Absolute Magnitude; Bolometric Magnitude Distance of star from magnitude.
Rotation, Revolution, Year, Month, Day, Julian day, Sidereal period, Synodic Period, Conjunction, Opposition, Quadrature, Inferior & Superior planets, Albedo, Aphelion & Perihelion, Apogee & Perigee, Terminator.

Celestial Sphere,
Geometry of Sphere, Definitions – Declination, Ecliptic, Celestial Equator, Equinox – Autumnal & Vernal, Horizon, Nadir & Zenith, Poles, Retardation, Axial/Orbital inclination

Physical concepts:

Unit 3 - The Sun & Solar System 10 Hrs
Sun
Sun as a star, Solar parameters, Solar Constant, Solar Photosphere, Solar Atmosphere – [chromospheres, Corona], Solar Spectrum, Quite & Disturbed Sun, Sun spot cycle, Solar
magnetic Field, Saros & Metonic cycle, Mechanism of Energy Production, Solar Wind, Maunder minimum.

**Solar system and Related Phenomenon.**


**Moon – Our nearest neighbor**

Facts & Figures, Orbit, Moon’s rotation, Liberations, Physical features, Moon’s retardation, Harvest moon, Nodes, Introduction to Year, month & Calendars.

**Unit 4 STARS & GALAXIES**

**Stars**


**Galaxies**


**Unit 5 COSMOLOGY & Extraterrestrial Intelligence**


**Reference Books:**

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. The Big & The small (Volume II) – G Venkataraman, University Press
8. Astronomy – Principles & practices, A E Roy & D Clarke, Institute of Physics Publication
Semester 5
OPEN COURSE –I
(For students from other streams)

PH5  D01 (3): Elementary Medical Physics (36 Hours  Credit – 4)

UNIT – I  NUCLEAR MEDICINE  8 Hrs

Physical features of radiation, conventional sources of radiation, exposure to natural radiation, Radiation dose units, Maximum permissible level(MPL) of radiation, Biological effects of radiation, In vitro and in vivo testing, gamma rays for imaging, radio pharmaceuticals, the gamma camera, single photo emission computed tomography (SPECT), typical nuclear medicine images and normal and abnormal manifestations.


UNIT – II  X-RAY IMAGING  8 Hrs

Physics of diagnostic x-rays, production of x-rays, beams, absorption of x-rays, x-ray imaging, x-ray fluoroscopy. X-ray computed tomography (CT scanning) five generations of scanners, reconstruction methods.

The Heart as a Pump - measurement of cardiac output, pulse velocity, rheology of blood, the heart beat, electrocardiography, heart pacemakers.

UNIT – III  MRI SCANNING  6 Hrs


(Books for study – The physics of medical imaging by S Webb, Hilger Publications, Biomedical Instrumentation by R S Khandpur)
UNIT –IV  ULTRASOUND IN MEDICINE  

6 Hrs

Ultrasound imaging, generation and detection of ultrasound, ultrasound propagation, choice of frequency, A-scan, B-scan, M-mode imaging and echo cardiography. Use of Doppler techniques for blood flow etc, Use of ultrasound in therapy, colour flow imaging

(Books for study - Medical Physics by J R Cameron and J G Skofonick, Wiley Eastern, Ultrasound in Medicine, by F Duck, IOPP)

UNIT – V  LASERS IN MEDICINE  

8 Hrs

Theory of operation, effects of laser radiation on tissue, surgical uses, ophthalmic uses, photodynamic therapy, laser hazards-biological effects, photo thermal effects, photochemical effects, laser hazards to the eye, to skin, safe exposure, other laser hazards.

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

REFERENCE BOOKS

3. Medical Physics by Glasser O, Vol 1,2,3 Year Book Publisher Inc Chicago
B.Sc PROGRAMME INPHYSICS (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 be 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 – 4)

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  
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 – 6)

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

1. Spectrometer- i₁-i₂ 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.
17. BG Absolute Capacity
18. BG-High resistance by leakage method
19. BG Mutual inductance
20. Planck’s constant using LED’s (3no.s)
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 – 6)

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)
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.
22. Taylor series - Sin θ, Cos θ
25. Simulation of projectile – Tabulation of position, velocity and acceleration as a function of time – Plot trajectory in graph paper from tabulated values.
Aim & Objectives.

The syllabus is drafted to generate new concepts with practical thinking and multidimensional applicability of physics in other science programmes so as to empower students who have undergone grading system of education at undergraduate 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 classroom 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**


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
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  
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
5. Principles of Electronics – VK. Mehta
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- $\alpha$, $\beta$, and $\gamma$
   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 4th 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 method
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 magnetometer – Comparison of moments
8. Newton’s rings- Wavelength of sodium light
CCSS - GENERAL PATTERN OF QUESTION PAPER FOR
CORE & COMPLEMENTARY COURSES 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