B.Sc PHYSICS

BOARD OF STUDIES IN PHYSICS (UG)

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12. **Dr. Gijo Jose**
    Assistant Professor
    Department of Physics
    St Berchmans College
    Changanassery

DEFINITIONS

'Semester' means a term consisting of a minimum of **450** contact hours distributed over **90** working days, inclusive of examination days, within **18** five-day academic weeks.

'Academic Week' is a unit of five working days in which distribution of work is organized from Monday to Friday, with five contact hours of one hour duration on each day.

'Programme' means a three year programme of study and examinations spread over six semesters, according to the regulations of the respective programme, the successful completion of which would lead to the award of a degree.

'Course' means a complete unit of learning which will be taught and evaluated within a semester.

'Common Course I' means a course that comes under the category of courses for English and ***'Common Course II'*** means additional language, a selection of both is compulsory for all students undergoing undergraduate programmes.

'Core course' means a course in the subject of specialization within a degree programme.

'Complementary Course' means a course which would enrich the study of core courses.

'Open course' means a course outside the field of his/her specialization, which can be opted by a student.

'Credit' is the numerical value assigned to a course according to the relative importance of the content of the syllabus of the programme**.**

'***Parent Department'*** means the department which offers core courses within a degree programme.

'Grade' means a letter symbol (A, B, C, etc.), which indicates the broad level of performance of a student in a course/ semester/programme.

'Grade point' (GP) is the numerical indicator of the percentage of marks awarded to a student in a course.

Words and expressions used and not defined in this regulation shall have the same meaning assigned to them in the Act and Statutes.

COURSE STRUCTURE OF BSc ZOOLOGY PROGRAMME

The U.G.programme in Zoology includes

(a) Common Courses
(b) Core Courses
(c) Complementary Courses
(d) Open Course
(e) Investigatory Project

No course shall carry more than 4 credits.

Student shall have the option to choose Open courses offered by any other Department.

Programme Duration	6 Semesters
Total Credits required for successful completion of the programme	120
Minimum credits required from common courses	38
Minimum credits required from Core courses + Complementary + Project	79
Minimum credits required from Open course	3
Minimum attendance required	75%

EXAMINATIONS

The evaluation of each course shall contain two parts:

(i) In-Semester Assessment (ISA)
(ii) End-Semester Assessment (ESA)

The in-semester to end-semester assessment ratio shall be 1:4, for both courses with or without practical. There shall be a maximum of **80** marks for end-semester evaluation and maximum of **20** marks for in-semester evaluation. For all courses (theory & practical), grades are given on a 07-point scale based on the total percentage of marks. ***(ISA+ESA)*** as given below

Percentage of Marks	Grade	Grade Point
90 and above	A+ - Outstanding	10
80-89	A - Excellent	9
70-79	B - Very Good	8
60-69	C - Good	7
50-59	D - Satisfactory	6
40-49	E - Adequate	5
Below 40	F - Failure	4

Note: Decimal are to be rounded to the next whole number

CREDIT POINT AND CREDIT POINT AVERAGE

Credit Point (CP) of a course is calculated using the formula

CP = C x GP, where C = Credit; GP = Grade point

Credit Point Average (CPA) of a Semester/Programme is calculated using the formula

CPA = TCP/TC, where TCP = Total Credit Point; TC = Total Credit

Grades for the different semesters and overall programme are given based on the corresponding CPA as shown below:

CPA	Grade
Above 9	A+ - Outstanding
Above 8, but below or equal to 9	A - Excellent
Above 7, but below or equal to 8	B -Very Good
Above 6, but below or equal to 7	C – Good
Above 5, but below or equal to 6	D – Satisfactory
Above 4, but below or equal to 5	E – Adequate
4 or below	F – Failure

Note: A separate minimum of 30% marks each for in-semester and end-semester (for both theory and practical) and aggregate minimum of 40% are required for a pass for a course. For a pass in a programme, a separate minimum of Grade **E** is required for all the individual courses. If a candidate secures **F** Grade for any one of the courses offered in a Semester/Programme only **F** grade will be awarded for that Semester/Programme until he/she improves this to **E** grade or above within the permitted period. Candidate who secures **E** grade and above will be eligible for higher studies.

MARKS DISTRIBUTION FOR END-SEMESTER EXAMINATION AND IN-SEMESTER EVALUATION

The end-semester examination of all semesters shall be conducted by the College at the end of each semester. In-semester evaluation is to be done by continuous assessment. Marks distribution for end-semester and in-semester assessments and the components for in-semester evaluation with their marks are shown below:

Components of the in-semester evaluation and their marks are as below.

1) For all courses without practical

a) Marks of end-semester Examination: 80
b) Marks of in-semester evaluation: 20

All the three components of the in-semester assessment are mandatory.

Components of In- semester Evaluation	Marks
Attendance	5
Assignment /Seminar/Viva	5
Test paper(s) (1 or 2) (1x10=10; 2x5=10)	10
Total	**20**

2) For all courses with practical

a) Marks of theory –End-semester Examination: 60

b) Marks of theory –In-semester Evaluation: 10

Components of Theory: In-semester Evaluation	Marks
Attendance	3
Assignment/Seminar/Viva	2
Test paper(s) (1 or 2)	5
Total	**10**

a) Marks of Practical: End-semester Examination: 20

b) Marks of Practical: In-semester Evaluation: 10

Components of Practical: In-semester evaluation	Marks
Attendance	2
Record	5
Lab involvement	3
Total	**10**

PROJECT EVALUATION

Components of Project Evaluation	Max. Marks
In-semester Evaluation	20
Dissertation (End-semester)	50
Viva-Voce (End-semester)	30
Total	**100**

ASSIGNMENTS

Assignments are to be done from 1st to 4th Semesters. At least one assignment should be done in each semester.

SEMINAR/VIVA

A student shall present seminar for each course in the 5th semester.
Student shall appear for a Viva-voce examination for each course in the 6th semester.

ATTENDANCE EVALUATION

1) For all courses without practical

Percentage of attendance	Marks
90 and above	5
85 – 89	4
80-84	3
76-79	2
75	1

(Decimals are to be rounded to the next higher whole number)

2) For all courses with practical

% of Attendance	Marks for theory
90 and above	3
80--89	2
75--79	1

% of Attendance	Marks for practical
90 and above	4
85--89	3
80--84	2
75--79	1

(Decimals are to be rounded to the next higher whole number)

IN-SEMESTER ASSESSMENT - TEST PAPERS

At least one in-semester test-paper is to be attended in each semester for each course. The evaluations of all components are to be published and are to be acknowledged by the candidates. All documents of in-semester assessments are to be kept in the college for two years. The responsibility of evaluating the in-semester assessment is vested on the teacher(s), who teach the course.

PATTERN OF QUESTIONS

Questions shall be set to assess knowledge acquired, standard application of knowledge, application of knowledge in new situations, critical evaluation of knowledge and the ability to synthesize knowledge. The question setter shall ensure that questions covering all skills are set. He/She shall also submit a detailed scheme of evaluation along with the question paper.

A question paper shall be a judicious mix of objective type, short answer type, short essay type /problem solving type and long essay type questions.

Pattern of questions for end-semester examination for theory paper without practical

	Total no. of questions	Number of questions to be answered	Marks of each question	Total marks
	10	10	1	10
	12	8	2	16
	9	6	4	24
	4	2	15	30
TOTAL	**35**	**26**	x	**80**

Pattern of questions for end-semester examination for theory papers with practical

	Total no. of questions	Number of questions to be answered	Marks of each question	Total marks
	8	8	1	8
	10	6	2	12
	6	4	4	16
	4	2	12	24
TOTAL	**28**	**20**	x	**60**

SEMESTER I
FOUNDATION COURSE IN PHYSICS

Credits – 3 (Theory 2+ Practical 1)
No. of contact hours – 36
Scope : This course will be an introduction to the pursuit of Physics, its history and basic foot steps. The course also aims at emphasizing the importance of measurement which is central to physics.
Prerequisites: This is an introductory course. Any student who opts to take Physics as the core subject for B. Sc. should attend this course.
Module I
Evolution of Physics: (2 hr for guidance only)
Hypotheses; theories and laws in science- verification (proving), corroboration and falsification (disproving), Revision of scientific theories and laws. Significance of Peer Review. Publications and patents.
Historical perspective on Physics and its method (5 hrs for guidance only)
Ancient perspectives on the universe - Geocentric model of Ptolemy - Copernican revolution. Galileo, and his emphasis on experiments and observations. Kepler's laws. Newton and the deterministic universe - Maxwell and the unification of electricity, magnetism and optics. Fundamental particles and the unification of all forces of nature.

Planck's hypothesis of quantum. Quantum mechanics. Einstein and his theories of relativity. Contributions by S. N. Bose, M. N. Saha, C. V. Raman, quantum theory of Raman effect - S. Chandrasekhar and Chandrasekhar's limit.
(The above topics are meant for self study by the students under the guidance of teachers. All from a historical and qualitative perspective -derivations not required but related pequations may be applied at its fundamental level)
www.britannica.com. This online Encyclopedia is a good resource for module I (See articles on Ptolemaic System, Copernican System, Galileo, Johannes Kepler, James Clerk Maxwell, Electromagnetism, Max **Planck, Quantum Mechanics and Relativity**.)

Vignettes in Physics – G. Venkataraman, Universities Press - this series of books gives authentic accounts of contributions of Indian physicists (See 'Bose and his Statistics', 'Saha and his formula', 'Raman and his effect' and 'Chandrasekhar and his limit')
Chapter 15: Modern Physics By R A Serway, C J Moses and C A Moyer. Thomson Pub.
Module II
Waves (10 hrs)
Waves in one dimension - Sinusoidal waves - Linear combination of sinusoidal waves- Polarisation - Monochromatic Plane waves - wave nature in electric and magnetic field, wave nature of alternating current and voltage. Simple Harmonic Motion (SHM), Relation between SHM and uniform circular motion, SHM represented in complex exponential form, Second order differential Equation for SHM and solutions.
Chapter 9: Introduction to Electrodynamics 3rd Edn By avid J Griffiths PHI
Chapter 1: THE PHYSICS OF WAVES AND OSCILLATIONS TMH 1st Edition
Author: N Bajaj

Module III

Measuring instruments (9 hours)

Measurement of time – water clocks – sun dials – pendulum clocks – digital clocks – atomic clocks.

Length measurement – rulers – standard metre – micrometers – screw gauges- travelling microscope – laser range finder- sonar – GPS.

Angle measurement – spectrometer verniers - scale and telescope - measurement of stellar parallaxes .

Electrical measurement - Working principle of galvanometer, voltmeter, ammeter and digital multimeters.

Instrumentation Devices & Systems - C. S. Rangan, G. R. Sarma, V. S. V. Mani McGraw-Hill

http://www.howstuffworks.com/ This site provides good information on measuring instruments

Module IV

Error Analysis (10 hours)

Basic ideas – uncertainties of measurement – importance of estimating errors – dominant errors – random errors – systematic errors - rejection of spurious measurements

Estimating and reporting errors – errors with reading scales, errors of digital instruments – number of significant digits –absolute and relative errors - standard deviation – error bars and graphical representation.

Propagation of errors – sum and differences – products and quotients – multiplying by constants – powers

Calibration – need for calibration – methods of calibration.

An Introduction to Error Analysis: The Study of Uncertainties in Physical Measurements, John R. Taylor - Univ. Science Books

http://www.upscale.utoronto.ca/PVB/Harrison/ErrorAnalysis/

http://phys.columbia.edu/~tutorial/index.html

Reference

1. Gieryn, T.F. **Cultural Boundaries of Science**., Univ. Chicago Press, 1999.
2. N Bajaj, **The Physics of Waves and Oscillations** TMH 1st Edition.
3. Collins H. and T. Pinch. **The Golem: What Everyone Should Know About Science**.,Cambridge Univ Press, 1993.
4. Hewitt, Paul G, Suzanne Lyons, John A. Suchocki & Jennifer Yeh, **Conceptual Integrated Science**, Addison-Wesley, 2007
5. Newton RG. The Truth of Science : New Delhi, 2nd edition
6. Bass, Joel, E and et.al. **Methods for Teaching Science as Inquiry**, Allyn & Bacon,2009
7. http://www.howstuffworks.com/
8. John R. Taylor. **An Introduction to Error Analysis: The Study of Uncertainties in Physical Measurements,** Univ. Science Books
9. http://www.upscale.utoronto.ca/PVB/Harrison/ErrorAnalysis/
10. http://phys.columbia.edu/~tutorial/index.html
11. Scientific Endeavour J A lee Longman.

SEMESTER II

MECHANICS AND PROPERTIES OF MATTER

Credits – 3 (Theory 2+ Practical 1)
No. of contact hours – 36
Scope: This course would empower the student to acquire engineering skills and practical knowledge, which help the student in their everyday life. This syllabus will cater the basic requirements for their higher studies. This course will provide a theoretical basis for doing experiments in related areas.
Prerequisites: Basic mechanics, reasoning power, initiative skills and calculus

Module 1 : Mechanics

Motion under Gravity (Teaching hours: 12)
The compound pendulum, Symmetric Compound pendulum, Assymetric Compound Pendulum, Kater's pendulum, Velocity and Acceleration in Cartesian, Polar and Cylindrical coordinate systems, Uniformly rotating frames, Centripetal acceleration, Centripetal force, Centrifugal force, Coriolis force, Motion under a central force – Kepler's laws, Gravitational law, Gravitational field, Conservative and non – conservative forces, Conservation of Energy, Variable mass Systems – Rocket

Books for study:
Fundamentals of Physics – Halliday, Resnik and Walker (John Wiley & sons) 10th Edn.
An introduction to mechanics Daniel Kleppner& Robert J. Kolenkow, McGraw Hill 2nd Edn.
MIT16 – 07F09 - Lecture 5 - Other coordinate systems
Berkeley Physics – volume 1 – Mechanics 3rd Edn.

Rotational Mechanics (Teaching hours: 6)
Moment of Inertia of a Thin uniform Rod, Moment of Inertia of a Ring, Moment of Inertia of a Thin Circular Disc, Moment of Inertia of an annular disc, Moment of Inertia of a solid Sphere, Moment of Inertia of a hollow sphere, Moment of Inertia of a solid cylinder, Fly wheel

Books for study:
Fundamentals of Physics – Halliday, Resnik and Walker (John Wiley & sons) 10th Edn
An introduction to mechanics Daniel Kleppner& Robert J. Kolenkow, McGraw Hill 2nd Edn
Berkeley Physics – volume 1 – Mechanics 3rd Edn
Mechanics – D.S.Mathur – S.Chand 3rd Edn

Module 2 : Oscillations and Waves

Oscillations and Waves (Teaching Hours : 6)
Natural Oscillations, Damped Oscillations, Forced Oscillations, Resonance
Equation of a progressive wave, Energy density of a progressive wave, Energy flux, Distribution of energy, Superposition of waves of same frequency and different frequencies, Beats, Doppler Effect
Vibration, Waves &Acoustics – D. Chattopadhyay – Books & Allied Pvt Ltd, Calcutta 1st Edn

An introduction to mechanics Daniel Kleppner& Robert J. Kolenkow, McGraw Hill 2nd Edn
Berkeley Physics – volume 1 – Mechanics 3rd Edn
Refresher course in Physics. Vol. 1 – C.L.Arora

Module 3 : Properties of Matter

Elasticity (Teaching hours: 6)

Poisson's ratio, Bending of Beams – bending moment, Young's modulus – Cantilever method and Mirror and Telescope method, Young's modulus – uniform and non uniform bending – microscope method, Torsional oscillations – Rigidity modulus, Static Torsion – Mirror and Telescope method, I – Section Girder

Properties of Matter- Brijlal and N. Subrahmaniam – S. Chand 3rd Edn
Properties of Matter - -D.S.Mathur – S.Chand 3rd Edn
Fundamentals of Physics – Halliday, Resnik and Walker – John Wiley & sons 10th Edn
Refresher course in Physics. Vol. 1 – C.L.Arora

Fluid Mechanics (Teaching hours: 6)

Transverse waves on the surface of a liquid - Effect of gravity and Effect of surface tension, Factors affecting Surface Tension, Applications

Derivation of Posieuille's Formula, Viscosity by variable pressure head method, Derivation of Stoke's Formula, Lubricants

Properties of Matter- Brijlal and N. Subrahmaniam – S. Chand 3rd Edn
Properties of Matter - -D.S.Mathur – S.Chand 3rd Edn
Fundamentals of Physics – Halliday, Resnik and Walker – John Wiley & sons 10th Edn
Refresher course in Physics. Vol. 1 – C.L.Arora

Reference

1. Fundamentals of Physics - Halliday and Resnik (John Wiley)
2. Berkeley Physics – volume 1 – Mechanics
3. The Feynman Lectures on Physics – volume 1
4. Conceptual Physics - Paul G Hewitt – Pearson
5. An introduction to mechanics , Daniel Kleppner & Robert J. Kolenkow, McGraw Hill
6. Mechanics - D.S.Mathur – S.Chand and Co
7. Refresher Course in Physics - Vol1- C.L.Arora
8. Properties of Matter - -D.S.Mathur – S.Chand
9. Properties of Matter- Brijlal and N. Subrahmanyam – S . Chand and Co.
10. Advanced Physics - Materials and Mechanics - Tom Duncan –John Murray London
11. Vibration, Waves and Acoustics - D.Chattopadhyay – Books and Allied Pvt Ltd
12. Classical Mechanics – Goldstein

SEMESTER III

BASIC ELECTRONICS

Credits – 4 (Theory 3+ Practical 1)

Number of contact hours – 54

Scope of the Syllabus: To know the principles and applications of Electronics is most necessary for a Physics student. This course is intended to provide this know-how.

Module-I (18 Hours)

P-N junction diode

Band theory of solids — P-N junction diode- — barrier formation in a P-N Junction diode — current flow mechanism in forward and reverse biased diodes — *V-I* characteristics — expression for diode current (no derivation) — static and dynamic resistances — Junction capacitance — diode equivalent circuit — ideal diode —avalanche and Zener breakdown

Rectifiers: Half wave, centre tapped full wave and bridge rectifiers — circuit diagram, working, input and output wave forms — expression for I_{dc} and I_{rms} — efficiency of a rectifier (derivation not required) — ripple factor of half wave and full wave rectifiers — comparison of rectifier circuits.

Filter circuits: Shunt capacitor filter — series inductor filter — LC filter — CLC or π filter — voltage regulation: line regulation and load regulation — Zener diode shunt regulator — design of circuit — optimum value of current limiting resistor.

Clipping and Clamping circuits: Positive clipper — negative clipper — biased clipper — combinational clipper — circuit diagram and working — input and output wave forms — positive clamper and negative clamper — input and output wave forms.

Special type of diodes: Zener diode — Zener diode characteristics— equivalent diagram of Zener diode — Zener diode as voltage regulator - tunnel diode - varactor – PIN diode - Schottky diode – LED – LCD - photo diode.

A Text Book of Applied Electronics-R.S.Sedha: S.Chand Co., Chapters- 10,11,12,13, 19,20.

Basic Electronics-B.L.Theraja: S.Chand Co. Chapters 12,13,14, 15, 16 ,17,18, 19.

Module-II (18 Hours)

Bipolar Junction Transistors (BJT)

Transistor construction — transistor action — working of NPN and PNP transistor — common base, common emitter and common collector configurations and their characteristics — active, saturation and cut off regions — current gain α , β , γ and their relationships —

Experiment to obtain the characteristics of transistor in the CB and CE modes — comparison of CE, CB and CC configurations.

Transistor Biasing and *h* parameters: Leakage currents — thermal runaway — need for biasing — load line — Q-point — factors affecting stability of Q- point-stability factor – different methods of transistor biasing — fixed bias — fixed bias with emitter resistor — voltage divider bias — advantages and disadvantages of different biasing methods.
Transistor equivalent circuits – dc equivalent circuit – ac equivalent circuit – h parameters - h parameters of an ideal CB and CE transistor – hybrid equivalent circuit – hybrid equations for CB, CE transistor amplifier.

Basic Ideas of FET and MOSFET

A Text Book of Applied Electronics-R.S.Sedha: Multi colour Edn. S.ChandCo.Chapters-14,15, 16

Basic Electronics-B.L.Theraja: S.Chand Co. Chapters 4, 20 , 21 & 26.

Module - III (18 hours)

Transistor as an Amplifier: Classification of amplifiers — small signal operation of CE amplifier — phase reversal, ac and dc equivalent circuits — derivation of input resistance, output resistance, current gain, voltage gain, power gain - difference between voltage and power amplifiers — ac load line — classification of power amplifiers — Class A amplifier — overall efficiency of class A amplifier — Class B amplifier: characteristics --- push-pull operation — maximum efficiency of class B push–pull amplifier — crossover distortion.

Multistage Amplifiers: Gain of a multistage amplifier — decibel gain — power gain — types of coupling — analysis of a two stage RC coupled amplifier — frequency response — expression for overall gain (no derivation) — band width — advantage and disadvantage of RC coupling

Feedback in amplifiers: Positive and negative feedback and its effects on input impedance, output impedance and gain — Different types of feedback (Block diagrams only) — Negative feedback in Transistor amplifiers -- CE amplifier without emitter bypass capacitor -- emitter follower.

Transistor as an Oscillator: sinusoidal oscillators — principle of oscillators — Barkhausen criterion for self sustained oscillations — Tuned collector oscillator — Hartley and Colpitt's Oscillators – RC Phase shift oscillators –expressions for frequency of oscillations — crystal oscillator.

A Text Book of Applied Electronics-R.S.Sedha: S. Chand Co., Chapters-22-31

Basic Electronics-B.L.Theraja: S.Chand Co. Chapters 22, 23, 25 & 28

Reference Books

Electronic principles, 7th Edition by by Albert Malvino and David J Bates, , TMH Edn. Pvt Ltd.

Electronic Dvices and circuits by Allen Mottershed

Principle of Electronics V.K. Metha, Rohit Mehta, , 11th ed., S.Chand and Company Ltd, 2011
Electronic Principles-Sahdev (Dhanpat Rai Co.)
Electronic Devices and Circuit Theory-Robert L Boylestad&Louis Nashelsky, PHI, Pearson
Electronic Principles and Applications-Schuler(McGrawHill)
Foundations of Electronics-D Chattopadhyay,P.C.Rakshit,B Saha,N.N.Purkait(New ge International Publishers)
Electronic Devices and Circuits-Sajeev Gupta(Dhanpat Rai Publications)
Basic Electronics and Linear Circuits-N.N.Bhargava,D.C.Kulshreshtha&S.C.Gupta, (Tata McGrawHill)
Introduction to Semiconductor Devices, Kevin, Brennan Cambridge Univ. Press
The Art of Electronics, Paul Horowitz and Winfield Hill, Cambridge Univ. Press
Basic Electronics by J B Gupta, S K Kalaria and Sons

SEMESTER IV

ELECTRICITY, MAGNETISM AND ELECTRODYNAMICS

Credits – 4 (Theory 3+ Practical 1)

No. of contact hours – 54

Scope: Electricity, magnetism and Electrodynamics have the key role in the development of modern technological world. Without electric power and communication facilities and data storage devices life on earth stands still. A course in electricity and electrodynamics is thus an essential component of physics programme at graduate level. This course is expected to provide a sound foundation in electricity, magnetism and electrodynamics.

Prerequisites: Knowledge of Vector analysis, Vector calculus and fundamentals of electricity and magnetism.

Module I

Varying Currents: (12 hrs)

Growth and decay of current in an inductive circuit-charge and discharge of a capacitor through a resistance - measurement of high resistance by capacitor leak method- DC applied to LCR series circuit(charge case)-discharging of capacitor through LR circuit(discharge case)- Theory of BG-measurement of K of BG using standard capacitance.

Electricity and Magnetism- J.H.Fewkes & John Yarwood Chapters 3 & 5 (university tutorial press)

Alternating currents & Circuit theory (14 hrs)

RMS and peak values-AC through series LCR(acceptor circuit) and parallel LCR circuit(rejecter circuit)-Q factor-power in AC-power factor-measurement of power in AC circuit-AC watt meter-Distribution of three phase current: star connection – delta connection -Ideal voltage and current sources-Thevenin's and Norton's theorems-Maximum power transfer theorem- Superposition Theorem

Electricity and Magnetism- J.H.Fewkes & John Yarwood chapter 6(university tutorial press)

Fundaments of Magnetism and Electricity D N Vasudeva Chapter 21 and 22.

Module II

Electrostatics- (10hrs)

Electric field- Coulombs law-Continuous charge distribution-Divergence and curl of electrostatic fields, Gauss' Law-Applications Fields due to: Spherically symmetric charge distribution, Uniformly charged spherical conductor, Line charge, Infinite plane sheet of charge, Electric field at a point between two oppositely charged parallel plates. Electric potential-Poisson's equation and Laplace's equation, The potential of a localized charge distribution, Work and Energy in electrostatics-The work done to move a charge - Energy of a point charge distribution and continuous charge distribution.

Introduction to Electrodynamics- David J Griffiths- PHI 3rd ed. Chapter 2

Magnetostatics (8 hrs)

Magnetic fields -Magnetic forces-Currents-Biot-Savart Law-steady currents-magnetic field of a steady current- -Straight line currents of Steady currents – The divergence and curl of B-Applications of Ampere'law. Comparison of magnetostatics and electrostatics

Introduction to Electrodynamics- David J Griffiths- PHI 3rd ed . Chapter 5,7 & 8

Module III

Electrodynamics, Mawell Equations and Electromagnetic waves (10 hrs)

Ohms law-electromotive force- motional emf-electromagnetic induction—induced electric field-Electrodynamics before Maxwell-Maxwell's equations-magnetic charge—Conservation laws-charge and energy-continuity equation-Poyntings theorem-

Conservation of momentum (qualitative only)-Electromagnetic waves in vacuum-wave equations for E and B monochromatic plane waves-energy, momentum and intensity of electromagnetic waves.

Introduction to Electrodynamics- David J Griffiths-3rd PHI Chapter 9

References

1 Electricity and Magnetism – J.H.Fewkes & John Yarwood -University tutorial Press

2 Fundaments of Magnetism and Electricity D N Vasudeva - S chand

3 Electricity and Magnetism A S Mahajan and AA Rangwala -TMH

4 Introduction to electrodynamics- David J Griffiths- PHI-3rd ed.

5 Electromagnetics Matthew N Sadiku- Oxford 4th Edn

6 Electromagnetics with applications Kraus/Fleish 5th Edn – TMH

7 Electromagnetics J A Edminister 2nd Edn - TMH

8 Electromagnetic Fields TVS Arunmurthi – S. Chand

9 Elements of Electromagnetics - Sadiku

SEMESTER V

CLASSICAL MECHANICS AND RELATIVITY

Credits – 4 (Theory 3+ Practical 1)
No. of contact hours – 54

Scope: This course is a prelude to advanced theoretical studies in Condensed Matter Physics, Spectroscopy, Astrophysics, Electrodynamics and Nuclear Physics.
Prerequisites: Student should have essential knowledge of Algebra, Calculus and Newtonian Mechanics.

Module – I
Lagrange Dynamics (18 hours)

Basic concepts. Constraints and degrees of freedom - Examples of holonomic and non-holonomic constraints. Generalized coordinates – Difficulty introduced by the constaints and their removal – Principle of virtual work – D'Alemberts Principle - Lagrange's equations from D' Alembert's principle.Newton's equations from Lagrange's equation – Applications of Lagrange's equation – one dimensional harmonic oscillator – planetary motion – Compound pendulum. Lagrange equation for L-C circuit. Symmetry and conservation laws – Homogeneity of space and conservation of linear momentum-Isotropy of space and conservation of angular momentum- Homogeneity of time and conservation of energy.

Module II

Hamiltonian Dynamics (18 hours)

. Hamilton's principle and Lagrange's equation. Superiority of Lagrangian mechanics over Newtonian approach. Generalized momentum and cyclic coordinates. Hamiltons function and conservation of energy. Hamilton's equations of motion –Hamilton's equation in Cartesian Polar coordinates and spherical coordinates. Examples of Hamiltonian dynamics – One and two dimensional harmonic oscillator - Motion of a particle in central force field.

Classical Mechanics – K. Sankara Rao, Prentice Hall of India.
Classical Mechanics, J C Upadhyaya, Himalaya Publishing House.

Module III
Special Theory of Relativity.(18 hours)

Inertial and non inertial frames of reference – Galilean transformation – Significance of Michelson – Morley experiment – postulates of STR- Lorentz transformation – spatial contraction - time dilation – composition of velocities – Mass of a moving particle – Equivalence of mass and energy Energy and Momentum.Particles with zero mass. Force in relativistic mechanics. Lorentz transformation for force.

Concepts of modern Physics, Arthur Beiser
Classical Mechanics, J C Upadhyaya, Himalaya Publishing House.
Classical Mechanics – K. Sankara Rao, Prentice Hall of India

Reference:

1 Classical Mechanics - 3rd Edition: Herbert Goldstein, Charles Poole & John Safk,

Pearson Education (Indian Edn.)
2 Mechanics, Hans & Puri, TMH
3 Classical Mechanics – Rana & Joag, TMH
4 Classical Mechanics – Greiner, Springer International Edn.
5 Classical Mechanics- Vimal Kumar Jain Ane Books Pvt. Ltd.
6 Classical Mechanics J C Upadhyaya. Himalaya publishing house.
7 Classical Mechanics – David Morin
8 Lagrangian Dynamics – Schaums Outline Series

SEMESTER V

PHYSICAL OPTICS AND ATOMIC SPECTROSCOPY

Credits – 4 (Theory 3+ Practical 1)
No. of contact hours – 54
Scope: This course aims to provide necessary foundation in optics and photonics which prepare the students for an intensive study of advanced topics at a later stage.
Prerequisites: Concepts of waves, basics in Mathematics.

Module I
Interference (12 hrs)
Introduction. Thin films-plane parallel film-interference due to reflected light-conditions for brightness and darkness-interference due to transmitted light-Haidinger fringes-interference in wedge shaped film-colours in thin films- Newton's rings. Michelson interferometer – construction -working and applications.
Optics by Subramanayam, Brijlal, MN Avadhanalu, S.Chand Chapter 14 and15

Diffraction (8 hrs)
Fresnel Diffraction – Huygens- Fresnel theory –zone plate –Difference between zone plate and convex lens. Comparison between interference and diffraction –diffraction pattern due to a straight edge, single silt. Fraunhoffer diffraction at a single slit, double slit, N slits, theory of plane diffraction grating.
Optics by Subramanayam, Brijlal, MN Avadhanalu, S.Chand Chapter 17 and 18

Module II
Polarization (12hrs)
Concept of polarization – (plane of polarization)-polarization by reflection-Brewster's law-polarization by refraction-pile of plates. Polarization by double refraction-(calcite crystal). Anisotropic crystals –optic axis –Double refraction-Huygens explanation of double refraction. Positive and Negative crystals-Electromagnetic theory of double refraction. Types of polarized light-Retarders or wave plate- Quarter wave plate –Half wave plate- Production and Detection of elliptically and circularly polarized light- Optical Activity-Fresnels Explanation of Optical Rotation-(Analytical treatment not needed) – Specific Rotation-Laurents half shade polarimeter
Optics by Subramanayam, Brijlal, MN Avadhanalu, S.Chand. Chapter – 20

Module-III
Atomic spectra
Emission and absorption spectra, atomic spectra, wave number, Bohr atomic model(Bohr's postulates) , Vector atom model, quantum numbers associated with vector atom model, space quantization, electron spin, coupling of orbital and spin angular momentum, spectroscopic terms and their notation, selection rules. Behaviour of magnetic dipole in external magnetic field; Larmors' precession and theorem. Spin orbit interaction energy of the single valance electron.
Coupling Schemes; LS Coupling Scheme and JJ coupling scheme, Interaction energy in L-S coupling (sp configuration), Lande interval rule, Interaction energy in JJ Coupling (sp configuration), comparison of spectral terms in L-S And J-J coupling. Hyperfine structure of

spectral lines and its origin; isotope effect, nuclear spin. Zeeman Effect (normal and Anomalous), Lande g-factor, Paschen-Back effect of a single valence electron system. Stark effect of Hydrogen atom.

References

1. Optics 3rd edition- Ajoy Ghatak, TMH
2. Optical Electronics – Ajoy Ghatak and K Thyagarajan, Cambridge
3. Optics and Atomic Physics D P Khandelwal, Himalaya Pub. House
4. Optics S K Srivastava, CBS Pub. N Delhi
5. A Text book of Optics S L Kakani, K L Bhandari, S Chand.
6. Arthur Beiser, Shobhit Mahajan, S Rai Choudhury Concept of Modern Physics (2010), Tata Mc Graw Hill Co Ltd, New Delhi
7. Rajam J B, Atomic Physics (2009), S Chand & Co, New Delhi
8. Fewkes J H and Yarwood J Atomic Physics Vol II (1991) Oxford University Press
9. Introduction to optics – Pedrotti & Pedrotti
10. Optics – Eugene Hecht & Ganesan

SEMESTER V

THERMAL AND STATISTICAL PHYSICS

Credits – 4 (Theory 3+ Practical 1) **No. of contact hours – 54**

Scope: This course is to develop a working knowledge of statistical mechanic and to use this knowledge to explore various applications related to topics in material science and the physics of condensed matter.

Prerequisites: Basics of calculus and quantum mechanics.

Module I

Thermal Physics (18 hrs)

Laws of Thermodynamics: Zeroth law. First law- internal energy, Applications of first law, Indicator diagram, Work done during isothermal and adiabatic process, slopes, relation between them , cooling due to Adiabatic reversible processes . Reversible and irreversible processes, Second law, Heat Engines, Carnot cycle and theorem, Work done by the engine per cycle, efficiency, Otto Engine

Thermodynamics and Statistical physics Brij Lal, N.Subrahmanyam and P S Hemne (S. Chand &Co, Multi colour edition 2007) Chapters 4,5

Module II

Thermodynamic relations and Heat Transmission (18 hrs)

Entropy, entropy changes in reversible and irreversible processes, Entropy – temperature diagrams and equations**.** Physical significance of entropy. Clausius Clepeyron Equation. Thermodynamic potentials: Enthalpy, Gibbs and Helmholtz functions, Maxwell's relations and applications, Concepts of adiabatic and isothermal elasticity

Modes of heat transfer, Searle's & Lee's experiment, black body radiation, Stefan-Boltzmann Law, Wein's displacement law, Rayleigh -Jean's Law, Planck's law (no derivation).

Thermodynamics and Statistical physics Brij Lal, N.Subrahmanyam and P S Hemne (S. Chand &Co, Multi colour edition 2007) Chapters 5,6,8,15

Module III

Statistical Mechanics (18hrs)

Micro and Macro states, thermodynamic probability, energy states, energy levels, degenerate energy levels, degenerate gas, phase space, concept of entropy and thermodynamic probability. Ensembles.

Classical Statistics: Maxwell-Boltzmann Distribution law, thermodynamics of an ideal monoatomic gas, Classical entropy expression, Gibbs' paradox.

Quantum Statistics:

Need of quantum statistics- Indistinguishability of particles- Spin and Statistics- Ideas of Bose Einstein distribution law and its application to black body radiation, Fermi Dirac Statistics and its application to electron gas

Thermodynamics and Statistical physics Brij Lal, N.Subrahmanyam and P S Hemne (S. Chand &Co, Multi colour edition 2007) Chapters 9,10,11,12

Reference:

1. Heat and Thermodynamics, Mark W Zemaskay and Richard H Dittman, Tata McGraw-Hill Publishing Co. (Special Indian Edition)
2. Thermodynamics and Statistical Mechanics, Greiner, Springer

3. Berkeley Physics Course Volume 5; Statistical Physics; Frederick Reif. McGraw Hill.
4. A Treatise on Heat; Saha and Srivastava, The Indian Press, Allahabad.
5. Statistical Mechanics, R.K. Pathria, Pergamon press, Oxford

SEMESTER V
LINEAR INTEGRATED CIRCUITS AND DIGITAL ELECTRONICS
Credits – 4 (Theory 3+ Practical 1)
No. of contact hours – 54

Scope: This course is expected to provide necessary back ground for applications of electronics in mathematical computation.

Prerequisites: Basic knowledge of electronics and Mathematics

Module I

Operational Amplifiers (14 hours)

Introduction – Op-Amp operational Overview – Op-Amp supply voltages – IC Identification – Packages – Parameters. Op-amp as an Voltage Amplifier-Inverting Amplifier – Non inverting amplifier – Non inverting amplifier as a buffer –Voltage follower – Summer Amplifier – Differential Amplifier- Comparators- Integrator – Differentiator

Applied Electronics- R S Sedha, S Chand, Revised Edition

Module II

Number Systems, Operations, and Codes (16hrs)

Decimal Numbers, Binary Numbers, Decimal-to-Binary Conversion, Hexadecimal Numbers, Octal Numbers, Binary Coded Decimal (BCD), Digital Codes ,The AND Gate ,The OR Gate, The NAND Gate, The NOR Gate, The Exclusive-OR and Exclusive-NOR Gates, Programmable Logic, Boolean Operations and Expressions, Laws and Rules of Boolean Algebra, DeMorgan's Theorem, Boolean Analysis of Logic Circuits, Simplification Using Boolean Algebra, Standard Forms of Boolean Expressions, Boolean Expressions and Truth Tables, The Karnaugh Map, Two, three and four variables, Karnaugh Maps.

Digital Fundamentals- Thomas L. Floyd, Pearson International Edition, 9th Edition, Chapter 2, 3 and 4

Module III

Combinational Logic (12 hrs)

The Universal Property of NAND and NOR Gates, Combinational Logic Using NAND and NOR Gates, Basic Adders, Parallel Binary Adders, Comparators, Decoders, Encoders, Code Converters, Multiplexers (Data Selectors), Demultiplexers, Parity Generators/Checkers, Latches, Edge-Triggered Flip-Flops,

Digital Fundamentals- Thomas L. Floyd, Pearson International Edition, 9th Edition, Chapter 5, 6 and 7

Sequential logic (12 hrs)

Asynchronous Counter Operation, Synchronous Counter Operation, Up/Down Synchronous Counters, Design of Synchronous Counters, Cascaded Counters, Basic Shift Register Functions, Serial In/Serial Out Shift Registers, Serial In/Parallel Out Shift Registers, Parallel In/Serial Out Shift Registers, Parallel In/Parallel Out Shift Registers, Bidirectional Shift Registers, Shift Register Counters, Decade counter.

Digital Fundamentals- Thomas L. Floyd, Pearson International Edition, 9th Edition, Chapter 8 and 9

Reference:

Board of Studies in Physics (UG), SB College, Changanacherry

1. Digital design- M Morris Mano PHI
2. Digital principles and applications 6th Edn. Malvino, Leach and Saha TMH
3. Digital Electronics- William H Gothmann PHI
4. Digital circuits and design- S Salivahanan and S Arivazhakan PHI
5. Digital Electronics- Sedha S Chand
6. Pulse, Digital and switching wave forms –Millam and Taub.
7. Digital computer electronics- Malvino, Brown TMH
8. Digital electronics- Tokheim(TMH)

SEMESTER V
OPEN COURSE
AMATEUR ASTRONOMY

Credits- 4 **No. of contact hours:72**

Scope: To help the students to comprehend the Cosmos and its origin and to develop scientific aptitude.

Prerequisites: This course in intended mainly for the students of other disciplines. So a secondary level knowledge of mathematics and physics is enough to study this course. But an inquisitive mind and curiosity are essential from the part of a student.

Module 1
Observation of sky- 24 hrs

The tools of Astronomy- refractor and reflector- magnification. The advent of Radio Astronomy. Hubble's Telescope, The Worldwide Telescope (WWT), GMRT (India), Telescopes of the future. Constellations (Ursa major, Crux, Orion). Equatorial constellations- passage of sun through the zodiac. Classification of stars and galaxies. Apparent and absolute magnitude.

Celestial sphere- poles and equator- coordinate systems- equatorial- equinoxes. Cosmic distance. Cepheids. Universe of galaxies. Sidereal, apparent and mean solar time, seasons. Diurnal motion of sun- summer solstice- winter solstice. Currently used calendars. International Date Line.

Text Books:

(1) Architecture of the Universe (**ch**- 2, 5 & 12)- Necia H. Apfel & Allen Hynek- The Benjamin Cummings publishing company, Inc. (**2)**. Cosmic Vistas- A popular History of Astronomy (**ch**- 3)- Biman Basu- National Book Trust, India. (**3)**. Joy of Starwatching (**ch**- 3, 8 &10)- Biman Basu- National Book Trust, India.

Module II
Solar system and beyond – 24 hrs

The sun- solar atmosphere- sun spots- flares- prominences- coronal holes- solar pulsations- the missing neutrinos. Earth- rotation- time keeping- revolution - orbital changes. Moon- distance- Appolo misson-moon illusion- origin. Lunar and solar eclipses. New moon and full moon.

Definition of a planet- terrestrial planets- mercury, venus, earth, mars. Giants of the solar system- Jupiter, Saturn, Uranus, Neptune. Comparison of planets. Minor members of solar system- Asteroids, comets. Distance to stars- parallax method.

Text Book:

(1) Architecture of the Universe (**ch**- 2, 14, 15, 17, 18, 19, 20)- Necia H. Apfel & Allen Hynek- The Benjamin Cummings publishing company, Inc.

Module III
Our universe – 24 hrs.

Early models of universe- Earth at the centre- Aristotle- Ptolemy- a spinning earth- unanswered questions- Sun at the centre- Copernican model. Planetary paths- Kepler's laws. Beyond the eye- Galileo and his observations - Starry messenger- force of gravity. Milky Way- Cluster of galaxies.

Life cycle of a star- star clusters- stellar evolution- red giant- death of a star- white dwarf- novae- super novae- neutron star- black hole. Doppler effect- radial velocities of galaxies- expanding universe- age and size of universe. Big bang- microwave radiation – detection of CMBR. Extraterrestrial Life, SETI (Search for extra terrestrial intelligence).

Text Books:

1.Architecture of the Universe (**ch**- 3, 4, 8& 9)- Necia H. Apfel & Allen Hynek- The Benjamin Cummings publishing company, Inc. **2**. Chandrasekhar and his limit(**ch**- 2)- G. Venkataraman- Universities press. **3**. Cosmic Vistas- A popular History of Astronomy(**ch**- 4, 5, 6, 7, 8)- Biman Basu- National Book Trust, India.

References:

(1) Astronomy: A Self-Teaching Guide, 7th Edition by Dinah L. Moché.
Publisher: John Wiley & Sons, Inc.
(2) Astronomy: A Beginners Guide To The Universe, by Steve Mcmillan Eric Chaisson.
Publisher: Pearson Education.
(3) Astronomy tutorial developed by Dept. Physics & Astronomy, University of Tennessee, USA
URL: **http://csep10.phys.utk.edu/astr161/lect/index.html**
(4) Understanding the Universe, James B. Seaborn, Springer
(5) Elements of Cosmology, Jayant V. Narlikar, Universities Press
(6) Introduction to Astrophysics. Baidyanath Basu:,Prentice-Hall of India Pvt. Ltd
(7) Astrophysics of the Solar System, K. D. Abhyankar ,Universities Press
(8) **http://solarsystem.nasa.gov/planets/**
(9) **http://www.nineplanets.org/**

For additional reading:

(1)A Guide to the Night Sky - P. N. Shankar (2)Clusters Nebulae & Galaxies - P. N. Shankar (3) How to Build a Telescope - P. N. Shankar (4)Story of Astronomy - Uday Patil (All these books are available for free download at the IUCAA website.URL: http://www.iucaa.ernet.in/~scipop/ebooks.html)
(5) http://en.wikipedia.org/wiki/Book:Astronomy

SEMESTER V

OPEN COURSE
RENEWABLE ENERGY

Total Hours -72 Total credit -4

Scope: The course creates awareness among students about energy management and sustainable energy technologies.

Module I

Energy Sources (23hrs)

Force, Energy, and Power-Energy conservation-Fundamental forms of energy: Kinetic energy, Gravitational energy, Electrical energy and Nuclear energy-Energy conversion, efficiencies and capacity factors- Present day energy use, Petroleum,Natural gas, and Coal - Fossil fuels and climate change-Advantages and disadvantages of conventional electricity generation- Renewable energy sources-Advantages and disadvantages of renewable energy- India's current fuel usage-Status and potential of renewable energy.

Solar thermal energy

Solar water heater-Nature and availability of solar radiation-Magic of glass-Active solar heating-Passive solar heating-Solar thermal engines and Electricity generation-Concentrating solar collectors-Economics, Potential and Environmental Impact

Solar Photovoltaic

The PV effect: Basic principles- PV systems for remote power-Grid connected PV systems – Costs of energy from P V - Environmental impact and safety- PV integration, resources and future prospects

Text Books for study:

1. Renewable energy-Power for a sustainable future, Godfrey Boyle (Oxford university press)
2. Non-Conventional Energy Resources, D.S Chauhan, S.K Srivastava (New age international Publishers)

Module II

Bioenergy and Wind Energy (21hrs)

Introduction to Bioenergy-Biomass as a solar energy store-Biomass as a fuel-primary biomass energy sources-secondary biomass sources-Physical processing of biomass-Thermochemical processing-Biochemical processing-Environmental benefits and impacts-Economics

Introduction to wind energy-Energy and power in the wind-wind turbines-Power and energy from wind turbines-Environmental impact – Economics-Wind energy potential

Text Book for study:

1. Renewable energy-Power for a sustainable future, Godfrey Boyle (Oxford university press)

Module III

Integration, management and storage of renewable energy (23hrs)

Storage of intermittently generated renewable energy- Electrical storage: Batteries and Accumulators, Superconducting electromagnetic energy storage - Fuel cell - Mechanical storage - Storage as thermal energy

Integration of renewable energy-Integrating electricity from renewables-The variability problem-Hydrogen as a fuel-promoting renewables

The value of energy management - Principles of energy management- Energy auditing-Basic components of energy audit

Text Books for study:

1. Renewable energy resources, John Twidell& Weir
2. Renewable energy-Power for a sustainable future, Godfrey Boyle (Oxford university press)
3. Renewable energy sources, TasneemAbbasi, S.A. Abbasi (PHI Learning Private Limited)
4. Energy Management Handbook, Wayne C. Turner (The Fairmont Press)

Project work- 5 (hrs) (credit-1)

Solar still, Solar cooker, biogas plant prototype etc.

Reference books

1. Solar energy, H.P Garg (Tata McGraw-Hill)
2. Renewable Energy Technologies: Practical Guide for Beginners,Solanki(PHI Learning)
3. Renewable Energy Sources And Emerging Technologies, Ranjan Rakesh, Kothari D. P., Singal K. C. (PHI Learning)
4. Solar Energy : Principles of Thermal Collection and Storage,S. P. Sukhatme J. K. Nayak (Tata McGraw-Hill)

SEMESTER VI
COMPUTATIONAL PHYSICS

Credits – 4 (Theory 3+ Practical 1) **No. of contact hours – 54**.

Scope: This course is intended to give an insight to computer hardware and computer applications.

Prerequisites: Basic mathematics and electronics

Module 1

Microprocessors (20 hrs)

Introduction to microprocessors- microprocessor operations (with relevance to 8085 microprocessor): 8085 bus organization-address bus- data bus- control bus, internal data operations- 8085 registers- accumulator- flags- program counter- stack pointer, externally initiated operations.

The 8085 microprocessor architecture- pinout and signals- internal architecture of 8085 microprocessor. Machine language- assembly language- high level language.Instruction cycle, machine cycle and T state- instruction format- addressing modes.The 8085 instruction set- simple programmes for data transfer, addition and subtraction.

Characteristics of a computer- I/O devices- memory and storage devices- RAM, ROM, Primary and secondary memory.

Microprocessor architecture, programming and applications- Ramesh S. Gaonkar (Penram Int. Pub.) Chapter.1,2,3,5,6,7.

Fundamentals of Microprocessors and microcomputers- B. Ram (Dhanpat Rai Pub.) Chapter 1.

Module II

Programming in C++ (20 hrs)

Introduction- C++ programming basics- loops and decisions- basic ideas of structures, arrays, functions, objects and classes.

Object oriented programming in Turbo C++- Robert Lafore (Galgotia Pub.)
Chapter 1,2,3,4.

Module III

Numerical methods (14 hrs)

Errors in numerical calculations: general error formula – error in a series approximation.

Iteration principle- solution of algebraic equations- bisection, false position and Newton-Raphson methods- algorithms. Numerical integration- trapezoidal rule and Simpson's 1/3 rule – algorithm.

Numerical solution of differential equation- Euler's method and second order Runge-Kutta method- algorithm.

Computer oriented numerical methods. V Rajaraman 3rd Edn PHI, Ch. 3,8and 9

References

1. Microprocessor architecture, programming and applications- Ramesh S. Gaonkar (Penram Int. Pub.)
2. Fundamentals of Microprocessors and microcomputers- B. Ram (Dhanpat Rai Pub.)
3. Microcomputers and Microprocessors- John Uffenbeck (PHI Pub.)
4. Object oriented programming in Turbo C++ - Robert Lafore (Galgotia Pub.)
5. Programming with C++ - John R. Hubbard (Mc Graw Hill Pub.)
6. Numerical method- V. Rajaram (PHI Pub.)
7. Introductory methods of Numerical methods -S.S .Sastry (PHI Pub.)
8. Numerical method with computer programming in C++ - Ghosh (PHI Pub.)
9. Numerical Methods for scientists & Engineers K Sankara Rao PHI 3rd Edn

SEMESTER VI
NUCLEAR AND PARTICLE PHYSICS

Credits – 4 (Theory 3+ Practical 1) **No. of contact hours – 54**

Scope: This course intended to explore the interior of nucleus and interaction between nucleons

Prerequisites: Basic mathematics and quantum mechanics.

Module I

Nuclear Structure (13 hours)

Nuclear composition – Nuclear electrons – Discovery of neutron - Nuclear properties: Nuclear radii – Spin and magnetic moment - Stable nuclei - Binding energy, Liquid drop model - Semi empirical binding energy formula - Shell model - Meson theory of nuclear forces – Discovery of pion – Detectors of nuclear radiations - Ionisation chamber- G.M Counter - An Idea about Large Hadron Collider.

Text Books: 11.1 to 11.7 Concepts of Modern Physics – Arthur Beiser (5th Edition),
Chapter 29, Modern Physics – R Murugeshan, Er. Kiruthiga Sivaprasath
Modern Physics- Raymond S. Serway, Clement J Moser, Curt A Moyer- 3rd edition (Cengage Learning)

Module II

Nuclear Transformations (15 hours)

Elementary ideas of radio activity - Alpha decay - Tunnel theory of alpha decay - Derivation for the formula for decay constant - Beta decay - Positron emission - Electron capture - Inverse beta decay and the discovery of neutrino - The solar neutrino mystery - Gamma decay - Fundamental ideas of nuclear isomerism and internal conversion - The concept of interaction cross section - Neutron capture cross section of cadmium - Slow neutron cross sections - Reaction rate - Nuclear reactions - Center of mass frame of reference and Q value of a nuclear reaction - Nuclear fission - Nuclear reactors - Breeder reactors - Nuclear fusion -Nuclear fusion in stars – Proton - Proton Cycle - Carbon Nitrogen Cycle - Formation of heavier elements - Fusion reactors - Confinement methods.

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

Biological Effects of radiation and Nuclear medicine (12 hours)

Direct and indirect physical damage - Indirect chemical damage - Dose, Dose Rate and dose distribution- Damage to critical tissues - Human exposure to radiation - Risk assessment
Nuclear medicine: Projection imaging: X-Radiography and the Gamma Camera- Positron emission tomography - Magnetic resonance imaging - Radiation therapy

Text Book: Chapter 7 & 9 Nuclear Physics, Principles and applications-John Lilley

Module III

Particle Physics: (14 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: colour and flavour - 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 (5th Edition)

References

Introduction to modern Physics- H.S Mani & G.K Mehta (Affliated East-West PVT LTD)
Introductory nuclear physics by Kenneth S. Krane.(John Wiley & Sons, 1988).
Introduction to the physics of nuclei and particles by R.A. Dunlap. (Singapore: Thomson Asia, 2004).
Nuclear Physics – Irving Kaplan
Nuclear Physics D C Tayal

SEMESTER VI
CONDENSED MATTER PHYSICS
Credits – 4 (Theory 3+ Practical 1)
No. of contact hours – 54

Scope: This course is intended to provide an introduction to the physics of Condensed Matter. This study attempts to explain various types of phenomena like electro-magnetic properties, super-conductivity and super fluidity.

Prerequisites: Basics of Mathematics, quantum mechanics

Module I

Crystal structure and Bonding (12 hrs)

Crystal Structure - Crystalline Matter - Bravias Lattice - Crystal Systems - Crystal Planes - and Miller Indices - Lattice Constants - Reciprocal Lattice - Crystal Structures - sc, bcc, fcc and hcp - Bragg's Law - Experimental Methods of X-Ray diffraction - Powder method.

Bonding in Solids - Ionic, Covalent, Van der Waal and Metallic Bonding (qualitative) - Binding Energy in Crystals - Madelung Constant.

Free Electron Theory and Band Theory of Solids (15 hrs)

Free Electron theory in one dimension- Formation of Energy Bands-Bloch Theorem (Statement) - Kronig Penney Model –Brillouin Zones (qualitative) –Effective Mass- Carriers in Solids-Metals, Insulators and Semiconductors-Band Structure-Intrinsic and Extrinsic Semiconductors-Electric Conductivity-Temperature Dependence- Hall effect.

M. Elementary Solid State Physics: (Pearson) Chapter1,2,5&6, Ali Omar
Solid State Physics, P.K. Palanisamy, Scitech publications Chapter 1,2&6
Solid State Physics, S.Chand R.K Puri & V.K.Babber, Chapter 3&6.

Module II

Dielectric and Magnetic Properties of Solids (10Hrs)

Review of Basic Equations - Dielectric Constant - Dipole Moment-Polarizability-Clausius-Mosotti Relation- Ferroelectricity - Classification of Magnetic Materials-Langevin's theory - Paramagmetism - Curie-Weiss Law- Curie temperature - Antiferromagnetism and Ferrimagnetism – Magnetisation - Magnetic Domain Structure – Spintronics - Spin Waves.

M. Elementary Solid State Physics: Ali Omar (Pearson) Chapter 8& 9
Solid State Physics, P.K. Palanisamy, Scitech publications , Chapter 7&8
Solid State Physics, R.K Puri & V.K.Babber, S.Chand Chapter8
Mircea.S.Rogalski & B.Palmer, Solid State Physics. Chapter 8&9

Module III

Superconductivity (10 hrs)

Zero resistance - Superconducting Phenomenon - Critical Temperature - Meissner Effect-Type I& II Superconductors - BCS theory (qualitative) - London Equation -Josephson Effect – SQUID - High Tc superconductors and applications.

Elementary Solid State Physics: Ali Omar (Pearson) Chapter 10
Solid State Physics, P.K. Palanisamy, Scitech publications , Chapter 10

Materials Science and Technology (7hrs)
Amorphous Semiconductors - Liquid Crystals – Polymers - Thin films - Properties-Crystalline Materials and Applications - Nanostructures and Nanometerials- Applications.

Elementary Solid State Physics: Ali Omar (Pearson) Chapter 12
Thin film fundamentals, A.Goswami.New Age International,2008. Chapter1
Nanostructures And Nanomaterials Synthesis, Properties, And Applications, Guozhong Cao, Imperial College Press, 2004 Chapter 3 and 5.

References

1. Kittel, C. Introduction to Solid State Physics, 8th edition (Wiley)
2. Ashcroft, N.W. & Mermin, N.D. Solid State Physics, TMH
3. Blakemore, J.S. Solid State Physics, 2nd edition (Cambridge)
4 C.L. Arora, Solid State Physics. S Chand.
5. S.O.Pillai, Solid State Physics. New Age International Pub.
6. Superconductivity, Superfluids and Condensate James F Annett Oxford

SEMESTER VI
BASIC QUANTUM MECHANICS & SPECTROSCOPY

Credits – 4 (Theory 3+ Practical 1)
No. of contact hours – 54

Module I

Particles and Waves (18 Hrs)

Inadequacies in Classical Physics. Blackbody Radiation : Quantum Theory of Light. Photoelectric Effect. Compton Effect. Wave Nature of Matter-.De-Broglie Hypothesis. Wave-Particle Duality. Davisson-Germer Experiment. Wave description of Particles by Wave Packets. Group and Phase Velocities and Relation between them. Heisenberg's Uncertainty Principle (proof not required): Application of uncertainty principle. Ground state energy of hydrogen atom- non existence of electron in the nucleus. Wave mechanics. Basic postulates of wave mechanics. Schrodinger Wave Equation. Properties of wave function. Physical meaning of wave function. Normalization of Wave Function.

Modern Physics : R Murugeshan & K Sivaprasath, S Chand,2011, Chapter 11 & 12,

Module II

Quantum Mechanics (18 Hrs)

Postulates of Quantum mechanics. Quantum mechanical operators. Eigen function and eigen values. Hermitian operators. Properties of hermitian operators. Hamiltonian operator. Expectation values. Properties of eigen functions and boundary conditions. Probability Density and Probability current density. Ehrefest theorem(qualitative).

Applications of Schrödinger Wave Equation:

Free Particle. Particle in a one dimensional box. Extension to three dimensional box –Finite One dimensional square well potential.— Particle in a rectangular potential barrier.
Quantum mechanical tunneling. Linear harmonic oscillator.

Modern Physics : R Murugeshan & K Sivaprasath, S Chand,2011, Chapter 11 & 12,

Module III

Molecular Spectroscopy (18 hours)

Molecular energy levels. Electronic, rotational and vibrational energies – rotational spectra – explanation in terms of rigid rotator model – vibrational energy levels – explanation in terms of harmonic oscillator.
Electronic energy levels of atoms – Fluorescence and phosphorescence – Raman effect – experimental arrangement and results - classical theory and its failure – quantum theory of Raman effect. IR and Microwave spectroscopes.

References:

1. L. I. Schiff, Quantum Mechanics, 3rd edition, (McGraw Hill Book Co., New York 1968).
2. E. Merzbacher, Quantum Mechanics, 3rd edition, (John Wiley & Sons, Inc1997)
3. J.L. Powell & B. Crasemann, Quantum Mechanics, (Addison-Wesley

Pubs.Co.,1965)
4. A. Ghatak & S. Lokanathan, Quantum Mechanics: Theory and Applications, 5th Edition,
(Macmillan India , 2004)
5. E. M. Lifshitz and L. D. Landau, Quantum Mechanics: Non-Relativistic Theory (Course ofTheoretical Physics, Vol 3), 3rd Edition, Butterworth-Heinemann (1981).
6. Quantum Physics – Stephen Gasirowicz Pub. Pearson Education (Indian Edn.)
7. Quantum Mechanics - Greiner, 4th Edition, Springer International Edn.
8. Quantum Mechanics G. Aruldhas, Premtice Hall of India.
9. Quantum Mechanics – V Devanathan
10. Concepts of Modern Physics - Arthur Beiser, Tata Mc Graw Hill.
11. C. Banwell and E. Mccash; Fundamentals of Molecular Spectroscopy.
12. G. Aruldhas; Molecular structure and Spectroscopy.

SEMESTER VI
CHOICE BASED COURSE
ASTRONOMY AND ASTROPHYSIC

Module I

Introduction to observational astronomy (30 hours)

Celestial sphere. Constellations and nomenclature of stars. The cardinal points and circles on the celestial sphere. Equatorial. ecliptic and galactic system of co-ordinates. Aspects of sky from different places on the earth. Sidereal, Apparent and Mean solar time and their relations. Equation of time. Ephemeris and Atomic Times. Calendar. Julian date and heliocentric correction.

World Book Encyclopedia of Science, Volume. 1
Textbook of Astronomy and Astrophysics with Elements of Cosmology, V. B. Bhatia, Narosa Publishing House.
Exploring the Night Sky with Binoculars, Patrick Moore, Cambridge University Press.

Module II
Stars (30 hours)

Sun –internal structure and atmosphere- photosphere- sunspots - chromospheres – corona –solar flares –prominences. Stellar structure - hydrostatic equilibriumstructure equations - energy sources - energy transport. Types of stars – classification and HR diagram.
Formation - Interstellar dust and gas – Jeans' mass - formation of protostars – evolution of planetary systems with special reference to Sun -Pre-main sequence evolution; nuclear fusion. P-P chain and CNO cycle. Energy production in massivestars. Evolution on the main sequence - Late stages of evolution. Fate of massive stars, supernovae - White dwarfs - Chandrasekhar limit - Neutron stars – Pulsars – Black holes
Astrophysics: Stars and galaxies, K. D. Abhyankar, Tata McGraw Hill
The Physics of Stars, A.C. Philips, Wiley

Module III

Galaxies and the expanding Universe (30 hours)

Galaxies-their morphology and classification. Cepheid variables and distance measurements. Origin and evolution of Galaxies. Large scale structure of the universe – isotropy and homogeneity. Expanding universe – Doppler effect – red shift – distance scale –Hubble law. Standard Big bang theory , cosmic microwave

background and its discovery ; early universe – nucleosynthesis in early universe –inflationary model of the universe – age of the universe and its determination. Dark matter – Dark energy.

Introduction to Cosmology, J. V. Narlikar, Cambridge University Press.
Particle Astrophysics, Donald Perkins, Oxford
Astrophysics: Stars and galaxies, K. D. Abhyankar, Tata McGraw Hill
Concepts of Modern Physics : Arthur Beiser (5th edn.)

References:

1. An Introduction to Astrophysics - Baidyanath basu PHI.
2. Understanding the Universe - James B. Seaborn – Springer.
3. The Physical Universe – An Introduction to Astronomy – Frank H. Shu- University Science Books.
4. The First Three Minutes - Steven Weinberg.

SEMESTER VI
CHOICE BASED COURSE
INFORMATION TECHNOLOGY

Credits – 3
No. of contact hours – 90
Scope: To learn about the fascinating world of information technology and to use the tools available in Internet and the World Wide Web for a deep study of the subjects related to physics in better way by the students themselves.
Prerequisites: Awareness of basic computer operations.

Module – I (32 hrs)
Information And Its Use : Information Technology – Quality of information – Message transmission – Electronic Office – E mail – Document storage – Computers in Industry – Different types – Graphical user interface
"Information Technology – The Breaking Wave", D.Curtin, K.Sen and K.Morin, Tata McGraw Hill, 1999. Chapter – 1, 2
Computer Networks: Importance of Networks. Components of Networks. Classification of Networks: Broad cast networks-Switched networks. Switching Techniques. Types of Networks – LAN – MAN – WAN. Networking Models – OSI reference model – TCP/IP reference model-Comparison between the OSI and TCP/IP models. Network Topology – Bus-Star-Ring-Tree-Mesh-Cellular. Network Architecture – Client/Server, Peer-to-Peer
Computer Networks – A.S. Tanenbaum - Prentice Hall of India, Chapter - 1
Computer Fundamentals – P.K. Sinha 3rd Edn. BPB Publications, Chapter – 17
THE INTERNET: Internet Protocols – Internet Protocol (IP)-Transmission Control Protocol (TCP) -Internet Address – Structure of Internet Servers Address-Address Space-Internet Infrastructure -Services on Internet – Domain Name System-SMTP and Electronic mail – Http and World Wide Web-Usenet and News groups-FTP-Telnet-Network Security – Ideas of secret key Algorithms and Public key Algorithms-Digital Signature-E-mail Privacy-Internet Tools – Search Engines-Web browsers- Internet explorer, Netscape Navigator, Mozilla Firefox(Working Knowledge)
Computer Networks – A.S. Tanenbaum – PHI, Chapter – 5,6,7
Computer Fundamentals – P.K. Sinha 3rd Edn. BPB Publications, Chapter – 18

Module – II (32 hrs)
THE HTML: What is HTML? Basic Tags of HTML – HTML-TITLE-BODY - Starting an HTML document – The <!DOCTYPE>declaration-setting boundaries with <HTML>-the HEAD element-the BODY element-the STYLE element and the SCRIPT element. -Formatting of text – Headers-Formatting Tags-PRE tag-FONT tag-Special Characters. Working with Images-META tag -Links – Anchor Tag -Lists – Unordered Lists-Ordered Lists-Definition Lists -Tables – TABLE, TR and TD Tags-Cell Spacing and Cell Padding-Colspan and Rowspan -Frames – Frameset-FRAME Tag-NOFRAMES Tag - Forms – FORM and INPUT Tag-Text Box-Radio Button-Checkbox-SELECT Tag and Pull Down Lists-Hidden-Submit and Reset -Some Special Tags–COLGROUP-THREAD,TBODY-TFOOT-_blank-_self,_parent-_top-IRFRAME-LABEL-Attribute for <SELECT>- TEXTAREA
HTML4 – 2nd Edn. Rick Darnell, Techmedia, Chapter – 1, 2,3,4,5

Module – III (26 hrs)

Basic Idea of DBMS: Need for Data Base – Database Systems versus File systems - View of Data - Data Abstraction-Instances and Schemas - Data Models – ER Model-Relational Model-Network Model-Hierarchical Model (general ideas) -Basic ideas about Structured Query Language

Fundaments of Database System – Elmasri, Ramez and Navathe Shamkant B. 4th Edn. Person Education, India, 2004. Chapter – 1

MS – OFFICE/OPEN OFFICE (Working Knowledge): Word processors – PowerPoint - **Spreadsheets – Databases**

(No specific text book is preferred. MS office (97, 98, 2000, /Open Office which is installed in the lab can be used. Working practice must be given)

Reference

1. "Information Technology – The Breaking Wave", D.Curtin, K.Sen and K.Morin, Tata McGraw Hill, 1999.
2. Computer Networks – A.S. Tanenbaum - Prentice Hall of India
3. Computer Fundamentals – P.K. Sinha 3rd Edn. BPB Publications
4. Internet and World Wide Web – Deitel
5. HTML4 – 2nd Edn. Rick Darnell, Techmedia
6. Database System Concepts – Silberschatz-Korth-Sudarshan 4th Edn – Tata Mac Graw Hill
7. "Information Technology and systems", Green, B.C., Longman Scientific & Technical Publishers, England, 1994.
8. Networks – Tirothy S. Ramteke – 2nd Edn. Pearson Edn – New Delhi, 2004
9. Data and Computer Communucation, William Stalling, PHI, New Delhi.
10. Mastering HTML4 – Ray D.S. and Ray E.J. – BPB
11. HTML – The Complete Reference – Tata Mc Graw Hill
12. Fundaments of Database System – Elmasri, Ramez and Navathe Shamkant B. 4th Edn.v Pearson Education, India, 2004.

CHOICE BASED COURSE
SEMESTER VI
RENEWABLE ENERGY TECHNOLOGY

Credits – 3
No. of contact hours – 90

Scope: This course is designed to make the students aware of challenging energy crisis and alternative energy solutions.
Prerequisites: Concepts of work- power- energy, heat energy- Modes of energy transfer- Heat engines, Concepts of Physical optics, Fundamental of Electricity.

Module I
Introduction to Energy Sources (6 hours)
Energy consumption as a measure of Prosperity – World energy futures – Energy sources and their availability – New energy technologies – Renewable energy sources
Non-conventional Sources of Energy - G D Rai Chapter 1
Solar Energy (20 hours)
Solar radiation geometry – Solar radiation measurements – Principles of the conversion of solar radiation in to heat – Flat plate collectors – Energy balance equation and collector efficiency – Concentrating collector: Focusing type – Performance analysis of a parabolic collector – Selective absorber coatings – Solar energy storage systems – Solar pond – Principle of operation and extraction of thermal energy – Solar heating and solar cooling of buildings – Solar electric power generation: Solar photo-voltaic cells
Non-conventional Sources of Energy - G D Rai Chapters 2,3,4&5

Module II
Wind Energy (14 hours)
Basic principles of wind energy conversion – site selection considerations – Classification of wind energy conversion systems – types of wind machines – Performance analysis of wind machines – Schemes for electric generation – Applications of wind energy – Environmental aspects.
Non-conventional Sources of Energy - G D Rai Chapter 6
Geothermal Energy (14 hours)
Nature of geothermal fields - Geothermal resources – Hot dry rock resources – Magma resources – Geothermal exploration – Advantages and disadvantages of geothermal energy – Applications of geothermal energy – Operational and environmental problems.
Non-conventional Sources of Energy - G D Rai Chapter 8
Energy from Biomass (11 hours)
Biomass conversion technologies – Biomass as a source of energy – Energy plantation – Methods for obtaining energy from biomass – Biogas generation – Biodegradation – Biogas plants – Biogas from waste – Community biogas plants – Thermal gasification of biomass.
Non-conventional Sources of Energy - G D Rai Chapter 7

Module III
Energy from the Oceans (15 hours)

Ocean thermal electric conversion (OTEC) – Introduction – Open cycle OTEC system – Closed cycle OTEC system – Hybrid cycle – Prospects of OTEC in India.

Energy from Tides – Basic principle of tidal power – Operation methods of utilization of tidal energy – Single cycle and double cycle systems – Advantages and limitations of tidal power generation - Prospects of tidal energy in India.

Ocean waves – Energy and power from the waves – Wave energy conversion devices - Advantages and limitations of wave energy.

Non-conventional Sources of Energy - G D Rai Chapter 9

Energy storage (10 hours)

Fuel cells – Design and principle of operation of a fuel cell – Classification of fuel cells – Conversion efficiency of fuel cells – Applications of fuel cells.

Non-conventional Sources of Energy - G D Rai Chapter 10

Hydrogen energy – Hydrogen production (Electrolysis, thermochemical methods) – Hydrogen storage – hydrogen as an alternative fuel for motor vehicles.

Non-conventional Sources of Energy - G D Rai Chapter 11

References:

1. Non – Conventional Energy Sources: G D Rai (Khanna Publishers)
2. Renewable Energy Technologies : Solanki C S (Prentice-hall Of India Pvt Ltd)
3. Renewable Energy Sources & Their Environmetal Impact : Abbasi (Prentice-hall of India Pvt Ltd)
4. Renewable Energy Sources for Sustainable Development N.S.Rathore N.L.Panwar (New India Publishing Agency)
5. Renewable Energy : Ulrich Laumanns And Dieter Uh Dirk Abmann (James & James Science Publishers)
6. Understanding Renewable Energy Systems : Volker Quaschning (James & James Science Publishers)
7. Renewable Energy: Global Perspectives : Azmal Hussain (Icfai University Press)
8. New And Renewable Energy Technologies For Sustainable Development : Naim Hamdia Afgan, Da Graca Carvalho Maria, Maria Da Graca Carvalho (Taylor & Francis Group)
9. Renewable Energy from the Ocean : Avery, William H.; Wu, Chih; Craven, John P. (Oxford University Press)
10. Fundamentals of Renewable Energy Systems : Mukherjee D (New Age International (p) Limited)
11. Renewable Energy Sources & Emerging Tech., : Kothari D P (Prentice-hall Of India Pvt Ltd)
12. Energy From Biomass : Willeke Palz, D. Pirrwitz (Springer)
13. Understanding Renewable Energy Systems : Volker Quaschning (James & James Science Publishers)
14. Ocean, Tidal, And Wave Energy: Power From The Sea : Lynn Peppas (Crabtree Publishing Company)
15. Fuel Cells, Geothermal Energy And Tidal Power: Emerging Scenario In Alternate Energy : Sameer A Zodgekar (Icfai University Press)

SEMESTER VI
CHOICE BASED COURSE
NANOSCIENCE AND NANOTECHNOLOGY

Credits – 3
No. of contact hours – 90
Scope: Today's science and engineering disciplines are at a crossroad where they can couple strongly with each other to give rise to new and emerging disciplines such as, the field of Nanoscience and Nanotechnology. This field is truly interdisciplinary in nature, and concerns with the fabrication and manipulations of few atoms and molecules to form mesocpic structures with dimensions ranging between 1-100 nm. In order to get a nano object to functions is necessary to assemble the constituent atoms or molecules, perhaps into a large single molecule such as a protein. These objects are of the size of a nanometer (10^{-9} m). The science of nanometer scale objects is Nanoscience. The resulting technology is called Nanotechnology. This introductory course is provided to get knowledge in Nanoscience and nanotechnology.
Prerequisites: Basics of Mathematics, quantum mechanics, semiconductor physics.

Module I
Basic Physical Properties of Nanostructures (11hrs)
Structure - Size Dependence of Properties -Crystal Structures -Face-Centered Cubic Nanoparticles -Tetrahedrally Bonded Semiconductor Structures -Lattice Vibrations -Size Dependence of Properties -Energy Bands -Reciprocal Space-Effective Masses -Fermi Surfaces - Insulators, Semiconductors, and Conductors -Energy Bands and Gaps of Semiconductors - Localized Particles - Mobility –Excitons-Donors, Acceptors, and Deep Traps.

Methods of Characterization (11hrs)
Structure- Atomic Structures - Crystallography- Particle Size Determination- Surface Structure- Microscopy-Transmission Electron Microscopy- Field Ion Microscopy-Scanning Microscopy.
Properties of Individual Nanoparticles (11hrs)
Metal Nanoclusters -Magic Numbers -Geometric Structure -Electronic Structure -Reactivity - Fluctuations -Magnetic Clusters -Bulk to Nanotransition- Semiconducting Nanoparticles -Optical Properties -Photofragmentation -Coulombic Explosion -Rare Gas and Molecular Clusters -Inert-Gas Clusters -Superfluid Clusters -Molecular Clusters -Theoretical Modeling of Nanoparticles - Methods of Synthesis -RF Plasma -Chemical Methods -Thermolysis -Pulsed Laser Methods.
Introduction to Nanotechnology, Charles P. Poole, Jr. and Frank J. Owens, Wiley, 2003 Chapter 2,3 and 4

Module II
Carbon Nanostructures (11hrs)
Carbon Molecules -Nature of the Carbon Bond -New Carbon Structures-Carbon Clusters -Small Carbon Clusters -Carbon Nanotubes -Fabrication -Structure -Electrical Properties-Vibrational Properties-Mechanical Properties -Applications of Carbon Nanotubes -Computers -Fuel Cells - Chemical Sensors-Catalysis -Mechanical Reinforcement -Field Emission and Shielding.
Bulk Nanostructured Materials (11hrs)

Solid Disordered Nanostructures -Methods of Synthesis -Failure Mechanisms of Conventional Grain-Sized Materials -Mechanical Properties -Nanostructured Multilayers -Electrical Properties-Porous Silicon -Metal Nanocluster Composite Glasses -Nanostructured Crystals -Natural Nanocrystals -Crystals of Metal Nanoparticles -Nanoparticle Lattices in Colloidal Suspensions -Photonic Crystals.

Nanostructured Ferromagnetism (11hrs)

Basics of Ferromagnetism -Dynamics of Nanomagnets -Nanopore Containment of Magnetic Particles -Nanocarbon Ferromagnets -Ferrofluids -Effect of Bulk Nanostructuring of Magnetic Properties -Giant and Colossal Magnetoresistance.

Introduction to Nanotechnology, Charles P. Poole, Jr. and Frank J. Owens, Wiley, 2003 Chapter 5,6 and 7

Module III

Quantum Wells, Wires, and Dots (12hrs)

Preparation of Quantum Nanostructures -Size and Dimensionality Effects -Size Effects -Potential Wells-Partial Confinement -Conduction Electrons and Dimensionality -Fermi Gas and Density of States-properties Dependent on Density of States -Excitons -Single-Electron Tunneling -Applications -Infrared Detectors -Quantum Dot Lasers-Superconductivity.

Nanomachines and Nanodevices (12hrs)

Microelectromechanical Systems (MEMSs) -Nanoelectromechanical Systems (NEMSs) -Fabrication Nanodevices and Nanomachines -Molecular and Supramolecular Switches.

Introduction to Nanotechnology, Charles P. Poole, Jr. and Frank J. Owens, Wiley, 2003 Chapter 9 and 13

References:

1. MEMS/NEMS ; micro electro mechanical systems/nano electro mechanical systems Volume 1,Design Methods,, Cornelius T. Leondes, Springer, 2006.
2. Nano: the essentials, T. PRADEEP,TMH ,2007.
3. Nanoscale Materials ,Luis M. Liz-Marzán and Prashant V. Kamat, Kluwer Academic Publishers, 2003
4. Nanoscience,Nanotechnologies and Nanophysics, C. Dupas, P. Houdy and M. Lahmani,Springer-Verlag , 2007.
5. Nanotechnology 101, John Mongillo, Greenwood Press, 2007.
6. Semiconductor Nanostructures for Optoelectronic Applications, Todd Steiner, ARTECH HOUSE, 2004.
7. What is What in the Nanoworld,A Handbook on Nanoscience and Nanotechnology, Victor E. Borisenko and Stefano Ossicini , WILEY-VCH Verlag, 2008.
8. Nanotechnology and Nano-Interface Controlled Electronic Devices, M. Iwamoto,K. Kaneto,S. Mashiko Elsevier Science, Elsevier Science, 2003.
9. S emiconductors for Micro and Nanotechnology—An Introduction for Engineers Jan G. Korvink and Andreas Greiner, WILEY-VCH Verlag ,2002.

SEMESTER VI
CHOICE BASED COURSE
OPTOELECTRONICS

Credits – 3
No. of contact hours – 90
Scope: This century is going to be the century of Optoelectronics or Photonics – the light wave technology. Today we have optical technologies replacing electronic memories, amplifiers etc. These enable high speed computing. Hence no Physics student can avoid this latest field of science and technology.
Prerequisites: Basic concepts of Optics, Quantum Mechanics, Electronics and Solid State Physics.

Module I
Optoelectronic Fundamentals
Introduction to Photonics (12 hrs)
(i) Optical radiation and light- Luminescence and Radiation-Radiation source parameters– Receiver parameters (1.1.1, 1.1.2,1.1.4 &1.1.5 of Ref.1)-Photometric and Radiometric terms and units- Inverse square law – verification by photometer- comparison of efficiency of light sources available in the market and recommended values of illumination for various activities (General awareness) (Ch.6 of Ref.2).
(ii) Introduction to Photonics – electrons Vs photons – Electronics Vs Optics Photonics (1.1 to 1.3 of Ref.3)- Photonics and light technology and applications-introduction (1.2 to 1.5 of Ref.4)
(iii) Properties of Photons (2.1 of Ref.4)-
(iv) Gausian beams – beam characteristics and parameters (2.4 of Ref.4)
(v) Light Characteristics – Power, energy, peak power, beam radius, intensity, divergence, beam quality, brightness, brilliance, radiation pressure, optical levitation (2.7 of Ref.4)

Optical process in semiconductors (16 hrs)
Electron hole pair formation and recombination. Radiative and non radiative recombination. Absorption in semiconductors – indirect transitions, exciton absorption, donor- acceptor band impurity band absorption. Long wavelength absorption. Franz Keldysh and Stark effect. Radiation in semiconductors. Stokes shift in optical transitions. Deep level transitions, Auger recombination. (Ch.3 of Ref.5)

Module II
Optical Devices
Radiation sources (12hrs)
(i) LED –Principle –characteristics (V-I & light – current)–materials-efficiencies- LED structures- hetero junction and edge emitting LED-. Applications &advantages.
(ii) Semiconductor lasers – Homo junction and hetero junction and Quantum well lasers – Principle -Optical and carrier confinement
Photodetectors (12hrs)
Introduction- Classification of detectors- Qualitative idea of each type- Photo detector parameters – Noise mechanisms (Ch.4 of Ref.1, Ch.5.3 of Ref.3)– Principle and operation of Photodiode, APD, Phototransistor, PIN photodiode- opto isolators

Solar cells (6 hrs)

Principle-. V-I characteristics- Fill factor – conversion efficiency (Qualitative study)-Hetero junction solar cells. (Ch.10 of Ref.5, Ch.6 of Ref.1)

Module III

Optical Communication

(i) Introduction (5hrs)

Introduction to Optical communication- Historical perspective- Advantages and disadvantages of optical communication links in comparison with radio and microwave system and with guided systems- measurement of information and the capacity of telecommunication channel- Communication system architecture- basic optical communication system – Definition of attenuation, pulse duration and band width. Ch. 1 of Ref.9)

(ii) Optical Modulation. (15hrs)

Direct modulation of LED and diode laser. Digital and analog modulation of LED and diode laser. External modulation. Birefringence, Pockel effect , phase modulation. Wave guide modulators . Electro-optic , Magneto- optic and acousto- optic modulators. Bipolar controller modulator. (Ref.1,7,10)

(iii) Fibre optic communication (12hrs)

Introduction to Optical fibres and fibre optic communication (Ch.1 of Ref.11 and Ch.1.1 to1.3 of Ref.13)- Types of optical fibres- Numerical aperture- Fibre bundles, cables- strength-fibre optical properties- Fibre materials – Classification of fibres – Step index and graded index- mono mode and multi mode fibres –plastic fibres- latest developed fibres (Ch.2,3 of Ref.11)- Fibre loses.

References:

1. Optoelectronic Engineering S.N. Biswass, Dhanpat Rai Publications
2. A Text book of Optics- Brijlal, Subramoniam, S Chand & Co
3. Photonics Elements and Devices, V. V. Rampal , Wheeler Publishing Co
4. Photonics, Ralf Menzel, Springer
5. Semiconductor optoelectronic devices – Pallab Bhattacharya PHI
6. Optoelectronics Wilson and Hawkes
7. Optoelectronics Jasprit Singh
8. Semiconductor Physics and Devices – Donald A Neamen, Tata McGraw-Hill
9. Optical communication system- John Gowar , Prentice Hall of India
10. Optical Electronics – Ajoy Ghatak and K Thyagarajan Cambridge
11. Optical fibres and fibre optic communication systems, Subir Kumar Sarkar, S.Chand & Co
12. Semiconductor Physics and Optoelectronis, V. Rajendran et al, Vikas Publishing House
13. Fibre Optic Communication, D.C.Agarwal, Wheeler Publishing
14. Physics of Semiconductor devices, Dilip K Roy, University Press.
15. Physics of Semiconductor devices, S M Sze, Wiley Eastern Limited

SYLLABUS FOR PRACTICAL – CORE COURSES

A minimum of 8 experiments should be done in each practical course component

SEMESTER I

Course PH1B01U

1. Vernier Calipers - Volume of a cylinder, sphere and a hollow cylinder
2. Screw gauge - Volume of a sphere and a glass plate
3. Spherometer - Thickness of a glass plate, radius of curvature of a convex surface and a concave surface
4. Beam balance - Mass of a solid (sensibility method), radius measurement of capillary tube using mercury
5. Travelling microscope - Radius of a capillary tube
6. Multimeter -Measurement of resistance, potential difference, current
7. Multimeter -Checking of capacitor ,diode ,inductance and transistor
8. Identification of electronic components- Coil, capacitor, resistor, transistor, triac, diac, I C's 741,555 etc.
9. Viscosity of a liquid -Variable pressure head
10. Spectrometer - Angle of prism

SEMESTER II

COURSE PH2B01U

1. Cantilever- pin & microscope –Determination of Young's modulus
2. Carey Foster's Bridge-Measurement of resistivity
3. Symmetric Compound Pendulum-Determination of radius of gyration(K) and Acceleration due to gravity (g)
4. Surface tension - Capillary rise method
5. Half wave rectifier with and without filter-ripple factor and load regulation
6. Conversion of Galvanometer into voltmeter
7. Viscosity-constant pressure head- coefficient of viscosity (η) of the liquid
8. Spectrometer- Refractive Index of material of Prism
9. Field along the axis of a coil-Variation of magnetic field along the axis of a circular coil
10. Electro chemical equivalent of copper

SEMESTER III

COURSE PH3B01U

1. Cantilever – Scale and Telescope-Determination of Young's modulus
2. Carey Foster's Bridge-Temperature coefficient
3. Asymmetric Compound Pendulum-Determination of K and g
4. Spectrometer-refractive index of a liquid –Hollow prism
5. Diode Characteristics.
6. Potentiometer-Measurement of resistivity
7. Full wave rectifier using diode – Ripple factor and load regulation
8. Transistor characteristics- CE configuration
9. Gates AND,OR,NOT- Verification of Truth Table
10. Torsion pendulum - Rigidity modulus

SEMESTER IV
COURSE PH4B01U

1. Non-uniform bending- Pin and Microscope method
2. Thermal conductivity of bad conductor- Lee's Disc
3. Bridge rectifier with filter and without filter- Ripple factor and load regulation
4. Spectrometer-prism- i-d curve
5. Potentiometer-Calibration of low range voltmeter
6. Searle's Vibration Magnetometer-Magnetic moment
7. Transistor Characteristics - CB configuration
8. Diode clamper- Positive and negative
9. Study of UJT characteristics
10. Sweep generator using transistor

SEMESTER V
COURSE PH5B01U

1. Fly Wheel – Moment of Inertia
2. Uniform bending – Young's Modulus-Optic lever method
3. Static torsion- Rigidity modulus
4. Viscosity- Stoke's method
5. Viscosity- Searle's rotation viscometer method
6. Thermal conductivity of rubber
7. Melde's String – Measurement frequency
8. Sonometer – Verification of laws, Measurement of density of solid.
9. A.C Sonometer- Frequency of a.c.
10. Liquid Lens- Refractive index of Liquid

Course PH5B02U

1. Spectrometer – Grating- wave length

2. Spectrometer- prism-Dispersive power
3. Liquid lens-Optical constants of a convex lens
4. Air wedge-Diameter of wire
5. Potentiometer-Calibration of low range ammeter
6. Potentiometer-Calibration of high range voltmeter.
7. Conversion of Galvanometer into ammeter
8. LCR circuit analysis-Series, parallel and Q-factor
9. Mirror Galvanometer-Figure of merit
10. B.G - charge sensitivity – Standard capacitor method

Course PH5B03U

1. Characteristics of Zener diode
2. Voltage regulation using Zener diode
3. Voltage multiplier- Doubler and Tripler.
4. Characteristics of FET
5. Regulated power supply using IC 741
6. Wave shaping R C circuits - Integrator and differentiator
7. Diode clipper- Positive, Negative and Biased
8. Hartley Oscillator –frequency
9. Colpitt's oscillator –frequency
10. Phase shift oscillator- frequency

Course PH5B04U

1. Spectrometer – Grating- dispersive power
2. Spectrometer – Cauchy's constants
3. Newton's rings- Determination of wave length.
4. Laser- Determination of wave length
5. Ultrasonic- Determination of velocity of ultrasonic waves
6. Single slit – Diffraction using Laser
7. Verification of Thevenin's and Norton's theorem
8. Deflection and Vibration Magnetometer- m & B_h
9. e/m – Thomson's apparatus- Bar magnet/magnetic focusing
10. B.G - Measurement of capacitance

SEMESTER VI
Course PH6B01U

1. Young's Modulus –Koenig's method
2. Torsion pendulum- n and I - using two identical masses
3. Spectrometer- Small angled prism-Refractive index of material of prism (Supplementary angle method)
4. Field along the axis of circular coil-Moment of magnet (null method)
5. Kater's pendulum-g
6. Kundt's tube- Velocity of sound
7. Sp.heat of liquid –Newton's law of cooling
8. Computer programming – Simple Pendulum –Calculation of 'g' from experimental data.
9. Computer programming – Solving differential equation - Rungekutta method – II order.
10. Computer programming – Multiplication of any two matrices- (m x n) and (n x q)

Course PH6B02U

1. Universal gates IC – NAND,NOR-Realize basic gates from universal gates.
2. B.G. –Measurement of high resistance by leakage method
3. BCD to 7 segment decoder (IC)
4. Astable multivibrator – using transistor
5. Monostable multivibrator- using transistor
6. Monostable multivibrator – IC 555
7. 8085 Microprocessor – sorting in ascending and descending order.
8. Computer programming –Conversion of temperature scale
9. Computer programming –sorting the numbers in ascending and descending order C++
10. Computer programming – Solving a quadratic equation

Course PH6B03U

1. Thermistor – Temperature coefficient of resistance
2. Regulated power supply – Transistor and Zener diode
3. Regulated power supply – Using IC's- LM 7805,7905,7809,7909,7812,7912
4. Construction and measurement of a dual Regulated power supply with filter.
5. Op-Amp - Adder and Subtractor
6. R.C. Coupled amplifier - Gain
7. Amplitude modulation
8. Pulse width modulation
9. Ring counter using 74194 and 74151
10. Astable multivibrator – IC 555

Course PH6B04U

1. D/A Converter using IC

2. 4 bit Shift register
3. Flip-Flop – R.S
4. J.K Flip-Flop
5. Schmitt trigger using 7414
6. Op- Amp – Inverter, non inverter and buffer.
7. 8085 Microprocessor - BCD addition and subtraction
8. 8085 Microprocessor – multiplication of two eight bit numbers with result 16 bit.
9. Computer programming – Solving a linear equation- Bisection method.
10. Computer programming – Solving a equation by Newton – Raphson method
11. Computer programming- Generation of Fibonacci series

References:

1. Properties of Matter - D.S. Mathur
2. Optics - Subramanyan & Brijlal
3. Electricity &Magnetism - Sreevastava
4. Electronics Lab Manual (Vol.1) - K.A.Navas
5. Laboratory manual for electronic devices and circuits- David A Bell
6. Electronic Laboratory Primer- A design approach- S Poorna Chandra and B Sasikala.
7. A text book of practical Physics _ Indu Prakash and Ramakrishnan.

COMPLEMENTARY PHYSICS FOR MATHEMATICS

SEMESTER I

MT1C01U – PROPERTIES OF MATTER, MECHANICS AND FOURIER ANALYSIS

Credits – 3 (Theory 2+ Practical 1) No. of contact hours – 36

Prerequisies: Basic knowledge of mechanics, electricity, magnetism, properties of matter and mathematical tools.

Scope: The syllabus will cater into the basic requirements for his/her higher studies.

Module I

Elasticity (12 hrs)

Elastic moduli- Poisson's ratio- twisting couple- determination of rigidity modulus- static and dynamic methods- static torsion- torsion pendulum- bending of beams- cantilever-uniform and non-uniform bending

Mechanics- H.S.Hans and S.P.Puri. (Tata McGraw-Hill)

Properties of Matter- Brijlal and N. Subrahmanyam (S. Chand and Co.)

Mechanics- J.C. Upadhyaya (Ram Prasad and sons)

Module II

Rotational dynamics of rigid bodies (10 hrs)

Angular velocity- angular momentum- torque- conservation of angular momentum- angular acceleration- moment of inertia- parallel and perpendicular axes theorems- moment of inertia of rod, ring, disc, cylinder and sphere- flywheel

Mechanics- H.S.Hans and S.P.Puri. (Tata McGraw-Hill)

Properties of Matter- Brijlal and N. Subrahmanyam (S. Chand and Co.)

Mechanics- J.C. Upadhyaya (Ram Prasad and sons)

Module III

Oscillations (9 hrs)

Periodic and oscillatory motion- simple harmonic motion- differential equation- expression for displacement, velocity and acceleration- graphical representation- energy of a particle executing simple harmonic motion- damped oscillation- forced oscillation and resonance

Fourier analysis (5 hrs)

Fourier's theorem- evaluation of Fourier coefficients- analysis of square wave, saw tooth wave and triangular wave

Mechanics- H.S.Hans and S.P.Puri. (Tata McGraw-Hill)

Properties of Matter- Brijlal and N. Subrahmanyam (S. Chand and Co.)

Mechanics- J.C. Upadhyaya (Ram Prasad and sons)

Mathematical methods for Physicists – G. B. Arfken and H.J. Weber (Academic press)

Reference:

1. Mechanics- H.S.Hans and S.P.Puri. (Tata McGraw-Hill)
2. Properties of Matter- Brijlal and N. Subrahmanyam (S. Chand and Co.)
3. Mechanics- J.C. Upadhyaya (Ram Prasad and sons)
4. Mathematical methods for Physicists – G. B. Arfken and H.J. Weber (Academic press)

SEMESTER II

MT2C01U – ELECTRIC AND MAGNETIC PHENOMENA, THERMODYNAMICS AND SPECIAL THEORY OF RELATIVITY

Credits – 3 (Theory 2+ Practical 1) No. of contact hours – 36

Scope: This syllabus will cater the basic requirements for their higher studies.

Prerequisites: Basic knowledge of electricity, magnetism, heat thermodynamics, mathematical tools.

Module I

Dielectric materials (7 hrs)

Dielectrics- polar and non-polar dielectrics- polarization- field of a polarized object- Bound charges- field inside a dielectric- Gauss's law in the presence of dielectrics- Electric displacement - linear dielectrics- susceptibility, permittivity, dielectric constant.

Magnetic Materials (7 hrs)

Magnetization in materials - Magnetisation - Effect of magnetic field on atomic orbits - diamagnetism,paramagnetism,ferromagnetism - field of a magnetised object - bound currents - magnetic field inside matter - Amperes's law in magnetised materials - The Auxiliary field , Magnetic Susceptibility and permeability

Introduction of Electrodynamics- D.J. Griffiths (PHI) Chapter 4&6

Solid State Physics- R. K. Puri and V.K. Babbar (S. Chand and Co.)

Module II

Thermodynamics (12 hrs)

Thermodynamic systems- thermodynamic equilibrium- thermodynamic processes- isothermal process- adiabatic process- zeroth law of thermodynamicsfirst law of thermodynamics- heat engine- the Carnot engine- refrigeratorconcept of entropy- second law of thermodynamics- third law of thermodynamics- Maxwell's thermodynamic relations

Thermodynamics- Zemansky and Dittmann (Tata McGraw-Hill)

Heat and Thermodynamics- Brijlal and Subrahmanyam (S. Chand &Co)

Module III

Special theory of relativity (10 hrs)

Introduction- Galilean transformation- Newtonian principle of relativity- special theory- postulates- Lorentz transformation- length contraction- time dilationrelativity of simultaneity- addition of velocities- relativistic mass transformationmass energy relation

Introduction to Modern Physics- H.S. Mani and G.K. Mehta (Affiliated East West press Pvt. Ltd)

Concepts of Modern Physics- A. Beiser (Tata McGraw-Hill, 5th Edn.)

Modern Physics- R. Murugeshan (S. Chand and Co.)

Modern Physics- G.Aruldas and P.Rajagopal (PHI Pub)

Reference:

1. Introduction to Modern Physics- H.S. Mani and G.K. Mehta (Affiliated East West press Pvt. Ltd)
2. Concepts of Modern Physics- A. Beiser (Tata McGraw-Hill, 5th Edn.)
3. Modern Physics- R. Murugeshan (S. Chand and Co.)
4. Introduction of Electrodynamics- D.J. Griffiths (PHI Pvt. Ltd)
5. Modern Physics- G.Aruldas and P.Rajagopal (PHI Pub)

6. Thermodynamics- Zemansky and Dittmann (Tata McGraw-Hill)
7. Heat and Thermodynamics- Brijlal and Subrahmanyam (S. Chand &Co)

MT3C01U – QUANTUM MECHANICS, SPECTROSCOPY, NUCLEAR PHYSICS, BASIC ELECTRONICS AND DIGITAL ELECTRONICS

Credits – 3 (Theory 2+ Practical 1)
No. of contact hours – 54

Module I

Elementary Quantum theory (12 hrs)

Introduction- black body radiation and Planck's quantum hypothesis-photoelectric effect- Einstein's explanation- de Broglie hypothesis- matter wave- Davisson-Germer experiment- uncertainty principle (derivation not expected) -wave function- conditions-normalization- Schroedinger equation-stationary states- non-normalizable wavefunctions- box normalization

Spectroscopy (12 hrs)

Atom models- Thomson's model-Rutherford's nuclear atom model-Bohr atom model- Somerfeld's relativistic atom model- vector atom model- Fine structure of Hydrogen atom -Rotational and vibrational spectra of rigid diatomic molecules- Raman effect-quantum theory

Introduction to Modern Physics- H.S. Mani and G.K. Mehta (Affiliated East West press Pvt. Ltd)
Concepts of Modern Physics- A. Beiser (Tata McGraw-Hill, 5th Edn.)
Modern Physics- G.Aruldas and P.Rajagopal (PHI Pub)
Quantum Physics- S. Gasiorowicz (John Wiley & Sons)

Module II

Atomic nucleus and radioactivity (10 hrs)

Nuclear constituents- different nuclear types- properties of nuclei- size- masscharge-density- binding energy- packing fraction -nuclear stability -spin - magnetic dipole moment -electric quadrupole moment -properties of nuclear forces -radioactivity- radiations -law of radioactive decay - half life- mean life-radioactivity units -radio active series-radio active dating- carbon dating-artificial radioactivity

Introduction to Modern Physics- H.S. Mani and G.K. Mehta (Affiliated East West press Pvt. Ltd)
Concepts of Modern Physics- A. Beiser (Tata McGraw-Hill, 5th Edn.)
Modern Physics- R. Murugeshan (S. Chand and Co.)
Modern Physics- G.Aruldas and P.Rajagopal (PHI Pub)

Module III

Basic electronics (13 hrs)

PN junction diode – forward and reverse characteristics-Diode as a rectifier-Half wave, Full wave and Bridge rectifier-shunt capacitor filter-expressions for efficiency and ripple factor-Zener diode- Zener diode as a voltage regulator-Line regulation and load regulation- transistors- CB, CE and CC configurations- relations connecting current gains α,β and γ-characteristics in CE

mode- biasing of transistor-different biasing techniques-transistor as an amplifier-Operational amplifiers - Ideal Op-amp - Inverting amplifier - Non inverting amplifier.

Digital electronics (7 hrs)

Different number systems – decimal, binary, octal, hexa decimal number systems- conversion between different number systems- binary mathematics addition and subtraction- basic theorems of Boolean algebra- de Morgan's theorems AND, OR, NOT, NAND, NOR, XOR gates- truth tables- half adder- full adder

Basic electronics- B. L. Theraja (S. Chand and Co.)
Elements of electronics- M.K. Bagde, S.P. Sngh and K. Singh (S. Chand and Co.)
Digital principles and applications- A. P. Malvino and P.Leach

Reference:

1. Introduction to Modern Physics- H.S. Mani and G.K. Mehta (Affiliated East West press Pvt. Ltd)
2. Concepts of Modern Physics- A. Beiser (Tata McGraw-Hill, 5th Edn.)
3. Modern Physics- R. Murugeshan (S. Chand and Co.)
4. Quantum Physics- S. Gasiorowicz (John Wiley & Sons)
5. Basic electronics- B. L. Theraja (S. Chand and Co.)
6. Elements of electronics- M.K. Bagde, S.P. Sngh and K. Singh (S. Chand and Co.)
7. Modern Physics- G.Aruldas and P.Rajagopal (PHI Pub)
8. Digital principles and applications- A. P. Malvino and P.Leach

MT4C01U – PHYSICAL OPTICS, LASER PHYSICS AND ASTROPHYSICS

Credits – 3 (Theory 2+ Practical 1)

No. of contact hours – 54

Module I

Interference (12 hrs)

Interference of light- Principle of superposition- conditions for maximum and minimum intensities- coherent sources- Interference by division of wave front and division of amplitude- Young's double slit experiment (division of wave front) –Expression for fringe width- Newton's rings by reflected light (division of amplitude) - measurement of wavelength of sodium light by Newton's rings- interference in thin films

Diffraction (8 hrs)

Introduction – Difference between Interference and diffraction- Fresnel and Fraunhofer diffraction- Fresnel Diffraction at a straight edge- Theory of plane transmission grating- Determination of wavelength (normal incidence) –resolving power- dispersive power

A Text book of Optics- N. Subrahmanyam, Brijlal and M.N.Avadhanulu (S. Chand and Co.)
Optics- Satyaprakash (Ratan Prakash Mandir)
Optics- A. Ghatak (Tata McGraw-Hill)

Module II

Polarization (15 hrs)

Introduction- polarized and unpolarized light- plane of vibration –plane of polarization - polarization by reflection- Brewster's law- polarization by refraction through pile of plates – law of Malus- uni-axial and biaxial crystals – double refraction- principal plane- polarization by double refraction- polarization by selective absorption- polaroid- polarization by scattering- elliptically and circularly polarized light- half wave and quarter wave plates

A text book of Optics- N. Subrahmanyam, Brijlal and M.N.Avadhanulu (S. Chand and Co.)
Optics- Satyaprakash (Ratan prakash Mandir)
Optics- A. Ghatak (Tata McGraw-Hill)

Module III

Laser Physics (10 hrs)

Interaction of electromagnetic radiation with matter- stimulated absorption- spontaneous emission- stimulated emission- principle of laser-population inversion- Einstein's coefficients- Types of lasers- Ruby laser-Neodymiun YAG laser- He-Ne laser- Properties of laser beams- Application of laser beams

Astrophysics (9 hrs)

Temperature and color of a star- brightness- size of a star- elements present in a stellar atmosphere- mass of star- life time of a star- main sequence stars- HR diagram- evolution

of stars- white dwarf- supernova explosion- neutron star- black hole- (all topics to be treated qualitatively)

Introduction to Modern Physics- H.S. Mani and G.K. Mehta (Affiliated East West press Pvt. Ltd)
Concepts of Modern Physics- A. Beiser (Tata McGraw-Hill, 5th Edn.)
Modern Physics- R. Murugeshan (S. Chand and Co.)
Modern Physics- G.Aruldas and P.Rajagopal (PHI Pub)
An introduction to Astrophysics- Baidyanath Basu

Reference:

1. Introduction to Modern Physics- H.S. Mani and G.K. Mehta (Affiliated East West press Pvt. Ltd)
2. Concepts of Modern Physics- A. Beiser (Tata McGraw-Hill, 5th Edn.)
3. Modern Physics- R. Murugeshan (S. Chand and Co.)
4. A text book of optics- N. Subrahmanyam, Brijlal and M.N.Avadhanulu (S. Chand and Co.)
5. Optics- Satyaprakash (Ratan prakash Mandir)
6. Modern Physics- G.Aruldas and P.Rajagopal (PHI Pub)
7. An introduction to Astrophysics- Baidyanath Basu
8. Optics- A. Ghatak (Tata McGraw-Hill)

COMPLEMENTARY PHYSICS FOR MATHEMATICS

A minimum of 8 experiments should be done in each practical course

SEMESTER I

1. Vernier Calipers - Volume of a cylinder, sphere and a beaker
2. Screw gauge - Volume of a sphere and a glass plate
3. Beam balance - Mass of a solid (sensibility method)
4. Radius of a capillary tube- using (1) travelling microscope
5. Density of a liquid - U-Tube and Hare's apparatus
6. Viscosity of a liquid - Variable pressure head
7. Surface Tension – Capillary rise method.
8. Cantilever - Pin & Microscope – Determination of Young's Modulus
9. Symmetric Compound Pendulum-Determination of radius of gyration(K) and Acceleration due to gravity (g)
10. Spectrometer – Angle of the Prism.

SEMESTER II

1. Cantilever – Scale and Telescope-Determination of Young's modulus
2. Asymmetric Compound Pendulum-Determination of K and g
3. Coefficient of Viscosity – Constant pressure head
4. Spectrometer - Refractive Index of material of prism.
5. Liquid lens - Refractive Index of glass using liquid of known refractive index
6. Potentiometer-Calibration of low range voltmeter
7. Characteristics of Zener diode
8. Construction of half wave rectifier with and without filter – Ripple factor and Load regulation
9. Mirror Galvanometer – Figure of merit
10. Torsion pendulum - Rigidity modulus

SEMESTER III

1. Non-uniform bending-Young's modulus - Pin and Microscope method
2. Field along the axis of circular coil- Variation of magnetic field and determination of B_H
3. Carey Foster's Bridge - Measurement of resistivity
4. Liquid lens - Refractive index of liquid
5. Searle's vibration Magnetometer-Magnetic moment
6. Tangent Galvanometer – Ammeter calibration
7. Spectrometer – Prism – Dispersive power
8. Potentiometer-Calibration of low range ammeter
9. Construction of full wave rectifier with and without filter – Ripple factor and Load regulation
10. Construction of regulated power supply using Zener diode

SEMESTER IV

1. Uniform bending –Young's modulus- Optic lever method
2. Torsion pendulum (Equal mass method) - Rigidity modulus and Moment of Inertia
3. Fly wheel - Moment of Inertia
4. Static Torsion - Rigidity modulus
5. Spectrometer - Grating Dispersive power
6. Newton's rings - Wave length
7. Deflection and Vibration Magnetometer- m & B_h
8. Conversion of Galvanometer into voltmeter
9. Transistor characteristics- CE configuration
10. Gates – AND , OR, NOT- verification of truth table
11. Construction of CE amplifier – gain

References

1. Properties of matter - D.S. Mathur
2. Optics - Subrahmanyan & Brijlal
3. Electricity &Magnetism - Sreevastava
4. Electronics Lab Manual (Vol.1) - K.A.Navas
5. Laboratory manual for electronic devices and circuits- David A Bell
6. Electronic Laboratory Primer- A design approach- S Poorna Chandra and B Sasikala.
7. A text book of Practical Physics _ Indu Prakash and Ramakrishnan.

SEMESTER I
CH1C01U –PROPERTIES OF MATTER, MECHANICS AND PARTICLE PHYSICS

Credits – 3 (Theory 2+ Practical 1)

No. of contact hours – 36

Scope: This syllabus will cater the basic requirements for their higher studies. This course will provide a theoretical basis for doing experiments in related areas.

Prerequisites: Basic knowledge of mechanics, properties of matter, mathematical tools.

Module I

Elasticity (12 hrs)

Elastic moduli- Poisson's ratio- twisting couple- determination of rigidity modulus- static and dynamic methods- static torsion- torsion pendulum- bending of beams- cantilever- uniform and non-uniform bending

Mechanics- H.S.Hans and S.P.Puri. (Tata McGraw-Hill)
Properties of Matter- Brijlal and N. Subrahmanyam (S. Chand and Co.)
Mechanics- J.C. Upadhyaya (Ram Prasad and sons)

Module II

Rotational dynamics of rigid bodies (10 hrs)

Angular velocity- angular momentum- torque- conservation of angular momentum- angular acceleration- moment of inertia- parallel and perpendicular axes theorems- moment of inertia of rod, ring, disc, cylinder and sphere- flywheel

Mechanics- H.S.Hans and S.P.Puri. (Tata McGraw-Hill)
Properties of Matter- Brijlal and N. Subrahmanyam (S. Chand and Co.)
Mechanics- J.C. Upadhyaya (Ram Prasad and sons)

Module III

Oscillations (9 hrs)

Periodic and oscillatory motion- simple harmonic motion- differential equation- expression for displacement, velocity and acceleration- graphical representation- energy of a particle executing simple harmonic motion- damped oscillation- forced oscillation and resonance

Particle Physics (5 hrs)

Fundamental interactions in nature- gauge particles- classification of particles-antiparticles- elementary particle quantum numbers- conservation laws- quark model (qualitative)

Modern Physics- R. Murugeshan (S. Chand and Co.)
Mechanics- J.C. Upadhyaya (Ram Prasad and sons)

References

Mechanics- H.S.Hans and S.P.Puri. (Tata McGraw-Hill)
Properties of Matter- Brijlal and N. Subrahmanyam (S. Chand and Co.)
Concepts of Modern Physics- A. Beiser (Tata McGraw-Hill, 5th Edn.)

SEMESTER II

CH2C01U – ELECTRIC AND MAGNETIC PHENOMENA, THERMODYNAMICS AND ELEMENTARY SOLID STATE PHYSICS

Credits – 3 (Theory 2+ Practical 1)

No. of contact hours – 36

Scope: This syllabus will cater the basic requirements for their higher studies.
Prerequisites: Basic knowledge of electricity, magnetism, heat, thermodynamics, mathematical tools.

Module I

Dielectric materials (7 hrs)

Dielectrics- polar and non-polar dielectrics- polarization- field of a polarized object- Bound charges- field inside a dielectric- Gauss's law in the presence of dielectrics- Electric displacement - linear dielectrics- susceptibility, permittivity, dielectric constant.

Magnetic materials (7 hrs)

Magnetization in materials - Magnetisation - Effect of magnetic field on atomic orbits - diamagnetism,paramagnetism,ferromagnetism - field of a magnetised object - bound currents - magnetic field inside matter - Amperes's law in magnetised materials - The Auxiliary field , Magnetic Susceptibility and permeability

Introduction of Electrodynamics- D.J. Griffiths (PHI) Chapter 4&6
Solid State Physics- R. K. Puri and V.K. Babbar (S. Chand and Co.)

Module II

Crystalline solids (10 hrs)

Crystalline and amorphous solids- crystal lattice- basis- unit cell- lattice parameters- crystal systems- crystal planes and directions- miller indices- simple cubic- fcc -bcc hcp structures- packing fraction- NaCl structure- crystal diffraction- Bragg's law

Solid State Physics- R. K. Puri and V.K. Babbar (S. Chand and Co.)
Introduction to Solid State Physics-C. Kittel(John Wiley & Sons,7th Edn.)

Module III

Thermodynamics (12 hrs)

Thermodynamic systems- thermodynamic equilibrium- thermodynamic processes- isothermal process- adiabatic process- zeroth law of thermodynamics- first law of thermodynamics- heat engine- the Carnot enginerefrigerator- concept of entropy- second law of thermodynamics- third law of thermodynamics- Maxwell's thermodynamic relations

Thermodynamics- Zemansky and Dittmann (Tata McGraw-Hill)
Heat and Thermodynamics- Brijlal and Subrahmanyam (S. Chand &Co)

References:

1. Thermodynamics- Zemansky and Dittmann (Tata McGraw-Hill)
2. Heat and Thermodynamics- Brijlal and Subrahmanyam (S. Chand &Co)

SEMESTER III
CH3C01U – QUANTUM MECHANICS, SPECTROSCOPY ,NUCLEAR PHYSICS AND ELECTRONICS
Credits – 3 (Theory 2 + Practical 1)
No. of contact hours –54

Scope: This syllabus will cater the basic requirements for their higher studies.
Prerequisites: Basic knowledge of electricity, modern physics, mathematical tools.

Module I

Elementary Quantum theory (12 hrs)

Introduction- black body radiation and Planck's quantum hypothesis-photoelectric effect- Einstein's explanation- de Broglie hypothesis- matter wave- Davisson-Germer experiment- uncertainty principle (derivation not expected) -wave function- conditions-normalization- Schroedinger equation -stationary states- non-normalizable wavefunctions- box normalization

Spectroscopy (12 hrs)

Atom models- Thomson's model-Rutherford's nuclear atom model-Bohr atom model- Somerfeld's relativistic atom model- vector atom model- Fine structure of Hydrogen atom -Rotational and vibrational spectra of rigid diatomic molecules- Raman effect-quantum theory

Introduction to Modern Physics- H.S. Mani and G.K. Mehta
Concepts of Modern Physics- A. Beiser (Tata McGraw-Hill, 5th Edn.)
Modern Physics- R. Murugeshan (S. Chand and Co.)
Modern Physics- G.Aruldas and P.Rajagopal (PHI Pub)

Module II

Atomic nucleus and radioactivity (10 hrs)

Nuclear constituents- different nuclear types- properties of nuclei- size- mass charge-density- binding energy- packing fraction -nuclear stability -spin - magnetic dipole moment -electric quadrupole moment -properties of nuclear forces -radioactivity- radiations -law of radioactive decay - half life- mean life radio activity units -radio active series-radio active dating- carbon dating artificial radioactivity

Nuclear fission and fusion (7 hrs)

Nuclear fission- energy release in fission reactions- liquid drop model of fission chain reaction- nuclear reactor- power and breeder reactor- atom bomb nuclear fusion- energy production in stars- thermo nuclear reactions in sun- p-p chain - C-N cycle

Introduction to Modern Physics- H.S. Mani and G.K. Mehta
Concepts of Modern Physics- A. Beiser (Tata McGraw-Hill, 5th Edn.)
Modern Physics- R. Murugeshan (S. Chand and Co.)
Modern Physics- G.Aruldas and P.Rajagopal (PHI Pub)

Module III

Basic electronics (13 hrs)

PN junction diode – forward and reverse characteristics-Diode as a rectifier-Half wave, Full wave and Bridge rectifier-shunt capacitor filter-expressions for efficiency and ripple factor-Zener

diode- Zener diode as a voltage regulator-Line regulation and load regulation- transistors- CB, CE and CC configurations- relations connecting current gains α,β and γ-characteristics in CE mode- biasing of transistor- different biasing techniques -transistor as an amplifier-Operational amplifiers - Ideal Op-amp - Inverting amplifier - Non inverting amplifier.

A Text Book of Applied Electronics-R.S.Sedha: S.Chand Co. Multi Colour Edn. Chapters
Basic Electronics- B. L. Theraja (S. Chand and Co.)
Elements of Electronics- M.K. Bagde, S.P. Sngh and K. Singh (S. Chand and Co.)

CH4C01U – PHYSICAL OPTICS, LASER PHYSICS AND SUPERCONDUCTIVITY

Credits – 3 (Theory 2+ Practical 1)

No. of contact hours –54
Scope: This syllabus will cater the basic requirements for their higher studies.
Prerequisites: Basic knowledge of optics, Properties of matter, mathematical tools.

Module I

Interference (12 hrs)

Interference of light- Principle of superposition- conditions for maximum and minimum intensities- coherent sources- Interference by division of wave front and division of amplitude- Young's double slit experiment (division of wave front) –Expression for fringe width- Newton's rings by reflected light (division of amplitude) - measurement of wavelength of sodium light by Newton's rings- interference in thin films

Diffraction (8 hrs)

Introduction – Difference between Interference and diffraction- Fresnel and Fraunhofer diffraction- Fresnel Diffraction at a straight edge- Theory of plane transmission grating- Determination of wavelength (normal incidence) –resolving power- dispersive power

A text book of Optics- N. Subrahmanyam, Brijlal and M.N.Avadhanulu (S. Chand and Co.)
Optics- Satyaprakash (Ratan prakash Mandir)
Optics- A. Ghatak (Tata McGraw-Hill)

Module II

Polarization (15 hrs)

Introduction- polarized and unpolarized light- plane of vibration –plane of polarization - polarization by reflection- Brewster's law- polarization by refraction through pile of plates – law of Malus- uni-axial and biaxial crystals – double refraction- principal plane- polarization by double refraction- polarization by selective absorption- polaroid- polarization by scattering- elliptically and circularly polarized light- half wave and quarter wave plates

A text book of optics- N. Subrahmanyam, Brijlal and M.N.Avadhanulu (S. Chand and Co.)
Optics- Satyaprakash (Ratan prakash Mandir)
Optics- A. Ghatak (Tata McGraw-Hill)

Module III

Laser Physics (10 hrs)

Interaction of electromagnetic radiation with matter- stimulated absorption- spontaneous emission- stimulated emission- principle of laser-population inversion- Einstein's coefficients- Types of lasers- Ruby laser-Neodymiun YAG laser- He-Ne laser- Properties of laser beams- Application of laser beams

Superconductivity (9 hrs)

Super conducting phenomenon- Occurrence- BCS theory (qualitative) Meissner Effect- Type I and Type II superconductors- Josephson effects- High temperature superconductors- Applications of Superconductivity

Solid State Physics- R. K. Puri and V.K. Babbar (S. Chand and Co.)
Reference:

Introduction to Modern Physics- H.S. Mani and G.K. Mehta (Affiliated East West press Pvt. Ltd)
Concepts of Modern Physics- A. Beiser (Tata McGraw-Hill, 5th Edn.)
Modern Physics- R. Murugeshan (S. Chand and Co.)
Modern Physics- G.Aruldas and P.Rajagopal (PHI Pub)
Solid State Physics- R. K. Puri and V.K. Babbar (S. Chand and Co.)

SYLLABUS FOR PRACTICAL – COMPLEMENTARY COURSES

COMPLEMENTARY PHYSICS FOR CHEMISTRY

A minimum of 8 experiments should be performed in each practical course

SEMESTER I

1. Vernier Calipers - Volume of a cylinder, sphere and a beaker
2. Screw gauge - Volume of a sphere and a glass plate
3. Beam balance - Mass of a solid (sensibility method)
4. Radius of a capillary tube- Using (1) travelling microscope
5. Density of a liquid - U-Tube and Hare's apparatus
6. Viscosity of a liquid - Variable pressure head
7. Surface Tension – Capillary rise method.
8. Cantilever - Pin & Microscope – Determination of Young's Modulus
9. Symmetric Compound Pendulum-Determination of radius of gyration(K) and Acceleration due to gravity (g)
10. Spectrometer – Angle of the Prism.

SEMESTER II

1. Cantilever – Scale and Telescope-Determination of Young's modulus
2. Asymmetric Compound Pendulum-Determination of K and g
3. Coefficient of Viscosity – Constant pressure head
4. Spectrometer - Refractive Index of material of prism.
5. Liquid lens - Refractive Index of glass using liquid of known refractive index
6. Potentiometer-Calibration of low range voltmeter
7. Characteristics of Zener diode
8. Construction of half wave rectifier with and without filter – Ripple factor and Load regulation
9. Mirror Galvanometer – Figure of merit
10. Torsion pendulum - Rigidity modulus

SEMESTER III

1. Non-uniform bending-Young's modulus-Pin and Microscope method
2. Field along the axis of circular coil- Variation of magnetic field and determination of B_H
3. Carey Foster's Bridge - Measurement of resistivity
4. Liquid lens - Refractive index of liquid
5. Searle's vibration Magnetometer-magnetic moment
6. Tangent Galvanometer – Ammeter calibration
7. Spectrometer – Prism – Dispersive power
8. Potentiometer-Calibration of low range ammeter
9. Construction of full wave rectifier with and without filter – Ripple factor and Load regulation
10. Construction of regulated power supply using Zener diode

SEMESTER IV

1. Uniform bending – Young's modulus-Optic lever method

2. Torsion pendulum (Equal mass method) - Rigidity modulus and Moment of Inertia
3. Fly wheel - Moment of Inertia
4. Static Torsion - Rigidity modulus
5. Spectrometer - Grating Dispersive power
6. Newton's rings - Wave length
7. Deflection and Vibration Magnetometer- m & B_h
8. Conversion of Galvanometer into voltmeter
9. Transistor characteristics- CE configuration
10. Gates – AND , OR, NOT- verification of truth table
11. Construction of CE amplifier – gain

References

1. Properties of Matter - D.S. Mathur
2. Optics - Subrahmanyan & Brijlal
3. Electricity &Magnetism - Sreevastava
4. Electronics Lab Manual (Vol.1) - K.A.Navas
5. Laboratory manual for electronic devices and circuits- David A Bell
6. Electronic Laboratory Primer- A design approach- S Poorna Chandra and B Sasikala.
7. A text book of Practical Physics _ Indu Prakash and Ramakrishnan.