MAHATMA GANDHI UNIVERSITY, KOTTAYAM

CURRICULUM FOR UNDER GRADUATE PROGRAMMES IN

PHYSICS

UNDER CHOICE BASED CREDIT SYSTEM (UG CBCS) 2017

2017 ADMISSIONS ONWARDS

COURSE DESIGN - B. Sc. PROGRAMMES IN PHYSICS

The U.G. programme in Physics must include (a) Common courses, (b) Core courses, (c) Complementary courses, (d) Choice based courses, (e) Open courses and (f) Project. No course shall carry more than 4 credits. The student shall select one Open course in Semester 5 offered by the various Departments which offers the core courses or physical education department. The number of Courses for the restructured programme should contain 12 compulsory core courses, 1 open course, 1 choice based course from the frontier area of the core courses, 6 core practicals, 1 project in the area of core, 8 complementary courses, 2 complementary practicals otherwise specified, from the relevant subjects for complementing the core of study. There should be 10 common courses, or otherwise specified, which includes the first and second language of study.

PROGRAMME STRUCTURE

Programme structure

Model- I B. Sc

A	Programme Duration	6 Semesters
B	Total Credits required for successful completion of the Programme	120
C	Credits required from Common Course I	22
D	Credits required from Common Course II	16
E	Credits required from Core course (including Project) and Complementary courses	79
F	Open course	3
G	Minimum attendance required	75%

CONSOLIDATED SCHEME FOR I TO VI SEMESTERS

B. Sc. Physics Programme – (Model I)

Semester	Title of the Course	Hours/week	Credits	Total hrs	University Exam duration	Marks	
						IA	EA
1	English I	5	4	90	3	20	80
	English II/ Common Course I	4	3	72	3	20	80
	Second Language I	4	4	72	3	20	80
	PH1CRT01 - Methodology and Perspectives of Physics	2	2	36	3	15	60
	Complementary I: Mathematics I	4	3	72	3	20	80
	Complementary II: Chemistry I	2	2	36	3	15	60
	Core Practical I: PH2CRP01 Mechanicsand Properties of Matter	2	-	36	-	-	-
	Complementary II Practical I	2	-	36	-	-	-
2	English II	5	4	90	3	20	80
	English III/ Common Course II	4	3	72	3	20	80
	Second Language II	4	4	72	3	20	80
	PH2CRT02 – Mechanics and Properties of Matter	2	2	36	3	15	60
	Complementary I: Mathematics II	4	3	72	3	20	80
	Complementary II: Chemistry II	2	2	36	3	15	60
	Core Practical I: PH2CRP01 Mechanics and Properties of Matter	2	2	36	3	10	40
	Complementary II Practical I	2	2	36	3	10	40
3	English III	5	4	90	3	20	80
	II Lang/Common Course I	5	4	90	3	20	80
	PH3CRT03 – Optics, Laser and Fiber Optics	3	3	54	3	15	60
	Complementary I: Mathematics III	5	4	90	3	20	80
	Complementary II: Chemistry III	3	3	54	3	15	60
	Core Practical II: PH4CRP02 Optics and Semiconductor Physics	2	-	36	-	-	-
	Complementary II Practical II	2	-	36	-	-	-

4	English IV	5	4	90	3	20	80
	II Lang/ Common Course II	5	4	90	3	20	80
	PH4CRT04- Semiconductor Physics	3	3	54	3	15	60
	Complementary I: Mathematics IV	5	4	90	3	20	80
	Complementary II: Chemistry IV	3	3	54	3	15	60
	Core Practical II: PH4CRP02 Optics and Semiconductor Physics	2	2	36	3	10	40
	Complementary II Practical II	2	2	36	3	10	40
5	PH5CRT05 – Electricity and Electrodynamics	3	3	54	3	15	60
	PH5CRT06 – Classical and Quantum Mechanics	3	3	54	3	15	60
	PH5CRT07 –Digital Electronics and Programming	3	3	54	3	15	60
	PH5CRT08 – Environmental Physics and Human Rights	4	4	72	3	15	60
	PH5OPT0X* -Open Course	4	3	72	3	20	80
	Core Practical III: PH6CRP03 Electricity, Magnetism and Laser	2	-	36	-	-	-
	Core Practical IV: PH6CRP04 Digital Electronics	2	-	36	-	-	-
	Core Practical V: PH6CRP05 Thermal Physics, Spectroscopy and C++ programming	2	-	36	-	-	-
	Core Practical VI: PH6CRP06 Acoustics, Photonics and Advanced Semiconductor Physics	2	-	36	-	-	-
6	PH6CRT09- Thermal and Statistical Physics	3	3	54	3	15	60
	PH6CRT10 --Relativity and Spectroscopy	4	3	72	3	15	60
	PH6CRT11 – Nuclear, Particle and Astrophysics	3	3	54	3	15	60
	PH6CRT12- Solid State Physics	4	3	72	3	15	60
	PH6CBT0X *-Choice BasedCourse	3	3	54	3	20	80
	Core Practical III: PH6CRP03 Electricity, Magnetism and Laser	2	2	36	3	10	40
	Core Practical IV: PH6CRP04 Digital Electronics	2	2	36	3	10	40
	Core Practical V: PH6CRP05 Thermal Physics, Spectroscopy and C++ programming	2	2	36	3	10	40
	Core Practical VI: PH6CRP06 Acoustics, Photonics and Advanced	2	2	36	3	10	40

Semiconductor Physics							
PH6PRO01 – Project and Industrial Visit	-	1	-	-	20	80

Choice Based Course

Paper Code	Semester	Paper Title
PH6CBT03	VI	Computational Physics

Open Course

Paper Code	Semester	Paper Title
PH5OPT02	V	Physics in Daily Life

SYLLABUS CORE PHYSICS

B.Sc. Physics Programme Model – I

Semester-I

Core Course: I   **Credit – 2 (36 hours)**

PH1CRT01: METHODOLOGY AND PERSPECTIVES OF PHYSICS

Module I

Concepts and Development Physics: **(8hours)**

Development of physics in the last century and the birth of new scientific concepts with reference to s*cientific contributions of Galileo, Newton, Einstein, J J Thomson, Curies, Rayleigh, Max Plank, Heisenberg and Schrodinger* (qualitative understanding). Contributions of Indian physicists -*C V Raman, H J Babha, J C Bose, S N Bose, M Saha, S Chandrasekhar, Vikram Sarabhai,* (Topics in this part require qualitative study only)

References:

1. Feynman lectures of Physics
2. Concepts of Modern Physics: ArtherBeisser,
3. Modern Physics: Kenneth Krane
4. Modern Physics: R Murugeshan
5. https://www.nobelprize.org/nobel_prizes/physics/laureates/

Module II   **(18 hours)**

Number systems- Decimal, hexadecimal and Binary. Conversions, Binary arithmetic addition, subtraction and multiplication. 1's and 2's complement subtraction –signed binary numbers. Signed binary arithmetic, BCD code, ASCII code, Significance of binary number system in digital electronics, microprocessors and in computers,

Introductory Vector Analysis - Applications of vectors in Physics. Differential and integral vector calculus: – The operator ∇- physical significance of Gradient, Divergence and Curl, Line integral, surface integral and volume integral of vectors

Co-ordinate systems:Cartesian Co-ordinate system, plane polar and spherical polar coordinates, cylindricalcoordinates (Basic ideas with examples in physics),

References:

6. Introduction to Electrodynamics, David J. Griffiths, Prentice Hall India Pvt. Ltd., Chapter 1
7. Mathematical Physics: Charlie Harper
8. University Physics, Roger A Freedman, Hugh D Young 14th edition
9. Digital electronics: Albert Paul Malvino
10. Digital logic and computer design – M. Morris Mano, PHI.

Module III
Experimental methods and error analysis   (10 hrs)

Experimental methods, least count of instruments, Instruments for measuring mass, length, time, angle , current, voltage. Fundamental units. Precision and accuracy of measurements, source of error in measurements, necessity of estimating errors , types of errors, reading error of instrument, calibration error, random error, systematic error, significant digits, order of magnitude and rounding of numbers, rounding error, absolute and relative errors, Errors of computation- addition, subtraction, multiplication, division, error in power and roots, Propagation of errors, analysis of data, standard deviation, calculation of mean value.

References:
1. Text book: Advanced course in Practical Physics by D Chattopadhyay- Chapter-1
2. Practical Physics, G L Squires, Third edn. Cambridge University Press.
3. The theory of Errors in Physical Measurements- J C Pal- New Central Book Agency- 2010

Semester-II

Core Course: II   **Credit – 2 (36 hours)**

PH2CRT02: MECHANICS AND PROPERTIES OF MATTER

Module I

Wave motion   **(4 hours)**

General equation of wave motion, plane progressive harmonic wave, energy density, intensity of a wave, superposition of waves, beats, transverse waves in stretched strings, modes.

Text Book: Mechanics by D.S. Mathur – Chapter 9.

Oscillations   **(8 hours)**

Periodic motion, simple harmonic motion and harmonic oscillator, energy of a harmonic oscillator, examples of harmonic oscillator – simple and compound pendulum. Theory of Damped harmonic oscillator. Theory of forced oscillator, resonance, applications.

Text Book: Mechanics by D.S. Mathur – Chapter 7, 8.

Module -II

Rotational mechanics   **(7 Hours)**

Angular velocity- angular acceleration- angular momentum- conservation- torque-moment of inertia- Parallel and perpendicular axes theorems - calculation of moment of inertia- (rod, ring, disc, cylinder, and sphere). Theory of flywheel.

Text Book: Mechanics by D.S. Mathur – Chapter 10.

Module III

Elasticity   **(10 hours)**

Basic ideas on elasticity – Young's modulus, bulk modulus, rigidity modulus, Poisson's ratio, relations connecting various elastic constants. Work done per unit volume in a

strain. Bending of beams, bending moment, flexural rigidity. Young's modulus – uniform and non-uniform bending, cantilever. I –section girders. Determination of rigidity modulus using Static and Dynamic methods.

Text Book: Mechanics by D.S. Mathur – Chapter 12, 13.

Hydrodynamics (7 hours)

Streamline and turbulent flows, coefficient of Viscosity – Determination of viscosity by Poiseuille's method. Equation of continuity, energy possessed by a liquid, Bernoulli's theorem.

Surface tension, surface energy, excess pressure in a liquid drop and bubble, factors affecting surface tension, applications.

Text Book: Mechanics by D.S. Mathur – Chapter 14.

Text books:

1. Mechanics by J.C. Upadhayaya, Ramprasad Pub.
2. Mechanics -D.S.Mathur, S.Chand.
3. Advanced course in Practical Physics by D Chattopadhyay, Central Book
4. *Properties of Matter and Acoustics by Murugeshan and K. Sivaprasath, S. Chand*

References:

1. Mechanics- Hans and Puri, TMH
2. Classical Mechanics by J.C. Upadhyaya, Himalaya Pub.
3. Classical Mechanics-Takwale and Puranik, TMH.
4. Classical mechanics- K.SankaraRao, PHI.
5. Properties of Matter by Mathur, S. Chand,
6. Mechanics by Somnath Datta, Pearson
7. Mechanics by H.D Young and R.A Freedman, Pearson.

Semester-III

Core Course: III   **Credit – 3 (54 hours)**

PH3CRT03: OPTICS, LASER AND FIBER OPTICS

Module I

Interference   **(13 hours)**

Review of basic ideas of interference, Coherent waves-Optical path and phase change-superposition of waves-theory of interference-intensity distribution. Young's double slit experiment, Coherence-Conditions for interference.

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-applications. Michelson interferometer-construction, working and just mention the applications.

Text book: Optics by N.Subramanayam, Brijlal, M.N.Avadhanulu-Chapter 14 and 15.

Module II

Diffraction   **(10 hours)**

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 transmission grating. Dispersive power and resolving power of grating.

Text book: Optics by N.Subramanayam, Brijlal, M.N.Avadhanulu-Chapter 17, 18 and 19.

Polarization   **(12hours)**

Concept of polarization – plane of polarization- Types of polarized light-production of plane polarized light by reflection-refraction. Malu's law-Polarization by double refraction-calcite crystal. Anisotropic crystals-optic axis-Double refraction-Huygens explanation of double refraction. Retarders - Quarter wave plate and Half wave plate. Production and Detection of plane, elliptically and circularly polarized light-Optical Activity- specific rotation.

Text book: Optics by N.Subramanayam, Brijlal, M.N.Avadhanulu-Chapter 20.

Module III

Laser (10 hours)

Absorption and emission of light-Absorption-spontaneous emission and stimulatedemission, Einstein relations, Population inversion- Active medium-Pumping, different pumping methods, Resonators – plane mirror and confocal resonators – Metastable state, Three level and Four level Laser systems. Ruby Laser, He-Ne laser, Semiconductor Laser, Laser beam Characteristics, coherence. Applications of Laser, Holography (qualitative study only).

Text book: Optics by N.Subramanayam, Brijlal, M.N.Avadhanulu-Chapter 22 and 23.

Fiber Optics (9 hours)

Propagation of light in a fiber -acceptance angle, numerical aperture, V-number, single mode and multimode step index fiber –graded index fiber- attenuation- application of fiber-optical fiber communication – advantages.

Text book: Semiconductor physics and optoelectronics- V.Rajendran, J.Hemaletha and M.S.M.Gibson, Unit IV-Chapter 1.

References

1. Optics, E Hecht and AR Ganesan, Pearson
2. Optics, 3rd edition, AjoyGhatak, TMH
3. Optical Electronics, AjoyGhatak and K Thyagarajan, Cambridge
4. Optics and Atomic Physics, D P Khandelwal, Himalaya Pub. House
5. Optics, S K Srivastava, CBS Pub. N Delhi
6. A Text book of Optics, S L Kakani, K L Bhandari, S Chand.
7. Optics N.Subramanayam, Brijlal, M.N Avadhanulu S Chand.
8. Semiconductor optoelectronic devices: Pallab Bhattacharya, PHI 2009.
9. Lasers and Non linear Optics, BB Laud, New Age Int Pub. 2013
10. Laser Fundamentals, William T Silfvast, Cambridge Univ Press. 2012.
11. Optoelectronics an Introduction, J Wilson & JFB Hawkes, PHI 1999.
12. Fiber Optics and Optoelectronics, R P Khare, Oxford 2012..
13. Introduction to Optics, Frank L Pedrotti, Leno M Pedrotti& Leno S Pefrotti, Pearson 2014.
14. Optical fiber and fiber optic communication system (4th edition) Subir Kumar Sarkar, S Chand.

Semester-IV

Core Course: IV   **Credit – 3 (54 hours)**

PH4CRT04: SEMICONDUCTOR PHYSICS

Module I

Semiconducting diodes and applications   **(14 hours)**

PN Junction, Depletion layer, Barrier potential, Biasing- forward and reverse, Reverse breakdown, Junction capacitance and diffusion capacitance- PN Junction diode – V-I characteristics–Diode parameters, Diode current Equation, Diode testing, Ideal diode. Zener diode and its reverse characteristics. Thermistors.

Rectification - Half wave, Full wave, Centre tapped, Bridge rectifier circuits - Nature of rectified output, Efficiency & Ripple factor-Filter circuits – Inductor Filter, Capacitor Filter, LC Filter, π Filter-Regulated Power supplies - Zener diode voltage   regulator-Voltage multipliers – Doubler & Tripler- Wave shaping circuits - Clipper-Positive, negative and biased – Clampers- Positive, negative and biased.

Text Book: Basic Electronics- B.L.Theraja Chapters 13,14,15,17

A Text Book of Applied Electronics- R.S.Sedha Chapters-11, 12, 19, 20, 33

Module II

Transistors Configurations and Feed back   **(12 hours)**

Bipolar junction transistors, Transistor biasing, CB, CC, CE configurations and their characteristics- Active, saturation and cut-off regions. Current gain α, β, γ and their relationships. Leakage currents- Thermal runaway. DC operating point and AC and DC Load line, Q-Point.

Basic principles of feedback, positive & negative feedback, Advantages of negative feedback,   negative feedback circuits – voltage series & shunt, current series & shunt.

Amplifiers and Oscillators   **(12 hours)**

Need for biasing-Stabilization- Voltage divider bias. Single stage transistor Amplifiers-CE amplifier - amplification factors. Decibel system, Variations in Amplifier gain with frequency.

Oscillatory Circuits, LC oscillators – Hartley Oscillator, Colpit's Oscillator, RC oscillators - Phase shift Oscillator. Astable and monostable multivibrator (basic idea only)

Text Book: Basic Electronics-B.L.Theraja-Chapters 18, 19, 20, 22, 24, 25, 28, 29.

A Text Book of Applied Electronics-R.S.Sedha Chapters 14, 15, 22,24, 29, 31, 32

Module III

FET, Operational Amplifier & Modulation (16 hours)

FET -characteristics, FET- Parameters. Comparison between FET and BJT. MOSFET (basic idea only)

OP-amp- Symbol and terminals. Characteristics of ideal OP-amp, CMRR, Applications - inverting, Non-inverting, Unity follower and Summing amplifiers.

Types of modulation – AM, FM, Pulse modulation and Phase modulation (qualitative study only). Amplitude modulation- modulation index - Analysis of AM wave – Sidebands –bandwidth- AM Demodulation.

Text Book: Basic Electronics-B. L. Theraja - Chapters 26, 30, 31

A Text Book of Applied Electronics-R.S.Sedha-Chapter-16, 35

References:

1. Principles of electronics, VK Mehta, S Chand

2. Basic Electronics(7[th]Edition), Malvino and Bates, TMH

3. Electronics Fundamentals and Applications- D. Chattopadhyay and P.G.Rakshit, New Age International Publishers.

4. Electronics: Fundamentals of Analog circuits, Thomas L. Floyd, David Buchla, Prentice Hall

5. Electronic Devices and Circuit Theory, Robert Boylestad, Louis Nashelsky, Prentice Hall

6. Basic Electronics, Debashis De , Pearson 2010

7. Basic Electronics, Santiram Kal, PHI 2010

Semester-V

Core Course: V   **Credit – 3 (54 hours)**

PH5CRT05: ELECTRICITY AND ELECTRODYNAMICS

Module I

Alternating Current and Network Theorems   **(15 hours)**

 EMF induced in a coil rotating in a magnetic field - AC applied to resistive, inductive and capacitance circuits - AC applied to LR and RC circuits - Analysis of LCR series circuits - LCR parallel resonant circuit – comparison - Power in ac circuits - Wattless current - choke coil - transformer on no load- skin effect.

Ideal voltage source and current source - Superposition theorem - Reciprocity theorem - Thevenin's theorem - Norton's theorem - Maximum power transfer theorem.

Text Book:Electricity and Magnetism, R. Murugeshan- Chapters 13, 30 and 18

Module II

Transient Current and Thermo electricity   **(8 hours)**

 Growth and decay of current in an LR circuit- Charging and discharging of a capacitor through a resistor - Growth and decay of charge in an LCR circuit.

Seebeck effect - Laws of thermo emf - Peltier effect- Thomson effect- Thermoelectric diagrams -Thermocouple (qualitative study) - Explanation of thermoelectric effects based on electron theory.

Text Book: Electricity and Magnetism, R. Murugeshan- Chapters 12, 8 and 32.

Module III

Electrostatics and Magnetostatics   **(20 hours)**

Fundamental theorems of divergence and curl (physical concepts) - Electric field - Continuous charge distribution- Divergence and curl of electrostatic field- Gauss's law and applications: solid sphere, infinite wire, infinite plane sheet - Electric potential - Poisson's and Laplace's equations - Potential of a localized charge distribution – Electrostatic boundary conditions- work and energy in electrostatics – The work done to

move a charge – Energy of a point charge distribution and continuous charge distribution- Basic properties a conductor .

Lorentz Force law- Biot- Savart law- Divergence and curl of B- Applications of Amperes' law: long straight wire, infinite plane, solenoid – Comparison of electrostatics and magnetostatics- Magnetic vector potential – Magnetostatics boundary conditions

Electromagnetic induction- Faraday's law

Text Book:Introduction to Electrodynamics, David J Griffiths, Chapters 1, 2, 5 and 7

Module IV

Maxwell's Equations and Electromagnetic wave propagation   (11 hours)

 Maxwell's equations - Boundary conditions for free space - Continuity equations- Poynting's theorem

Wave equations (general idea on reflection at boundary and polarization) - Electromagnetic wave in vacuum - Wave equation for E and B - Monochromatic plane waves- Energy of electromagnetic waves

Text Book: Introduction to Electrodynamics, David J Griffiths-Chapters 7,8 and 9

References:

1. *Fundamentals of Magnetism and Electricity, D.N Vasudeva - S Chand*

2. *Principles of Electromagnetics, Mathew N.O Sadiku- 4th Ed. , Oxford*

3. *Electricity and Magnetism, KK Tewari- S Chand*

4. *Electricity and Electronics, Saxena, Arora and Prakash- Pragati Prakashan*

5. *Classical Electromagnetism, Jerrold Franklin- Pearson*

6. *Electromagnetic Fields and Waves, KD Prasad- Satya Prakashan*

7. *Field and wave Electromagnetics, David K Cheng- Pearson.*

Semester-V

Core Course: VI   **Credit – 3 (54 hours)**

PH5CRT06: CLASSICAL AND QUANTUM MECHANICS

Module I

Lagrangian and Hamiltonian Formulations of Classical Mechanics   **(15 hours)**

Constraints, degrees of freedom, generalized co-ordinates, principle of virtual work, D'Alembert's principle, Lagrange's equations(no derivation required), Application of Lagrangian (Linear Harmonic oscillator, Planetary motion and Simple Pendulum only), Hamilton's Canonical equations of motion, Advantages of Hamilton's method, Applications of Hamilton's method (Linear Harmonic oscillator and Simple pendulum only).Hamilton's Principle of Least Action. Derivation of Lagrange's equation from Hamilton's Principle.

Text book: Classical Mechanics by J.C. Upadhyaya-Chapter 2 & 3.

         Classical Mechanics by G. Aruldhas

Module II

Historical development and origin of quantum theory   **(9 hours)**

Failure of classical physics- Black Body radiation-Planck's radiation law, Photoelectric effect-Einstein's explanation, Compton effect, Bohr's correspondence principle-Wave particle Dualism, Dual nature of matter- De Broglie hypothesis, Davisson-Germer Experiment, De Broglie waves, Wave packet, Group and phase velocities

Text Book: A Textbook of Quantum Mechanics- G Aruldhas-Chapter 1

General Formalism of Quantum Mechanics   **(15 hours)**

Linear vector space- Hilbert space- Orthogonality- Linear operator-Eigen functions and eigen values- Hermitian operator- Postulates of Quantum Mechanics- wave function, Operators, Expectation value, Eigen value, Time development- Simultaneous measurability- General uncertainty relation.

Text Book: A Textbook of Quantum Mechanics- G Aruldhas-Chapter 3 and 8

Module III

Schrödinger equation and its applications   **(15 hours)**

Time dependent Schrödinger equation- interpretation of wave function, Probability density, Probability current density, Ehrenfest theorem- Extension to three dimensions- Time independent Schrödinger equation- Stationary states- Admissibility conditions of wave function-general properties of one dimensional Schrödinger equation, particle in a box, one dimensional barrier problem- square potential barrier.

Text Book: A Textbook of Quantum Mechanics- G Aruldhas.

Text Book:

1. *Classical Mechanics by J.C. Upadhyaya. Himalaya Pub.*

2. *Concepts of Modern Physics- Arthur Beiser, TMH*

References:

1. *Concepts of Modern Physics- Arthur Beiser, TMH*

2. *A Textbook of Quantum Mechanics- G Aruldhas- (2nd Edition)- PHI*

3. *Classical Mechanics-Takwale and Puranik, TMH.*

4. *Classical mechanics- K.SankaraRao, PHI.*

5. *Introductory Quantum Mechanics- RI Liboff, Pearson*

6. *Quantum Physics- Gasiorowicz,John Wiely*

7. *Quantum Mechanics- Griffith, Pearson*

Semester-V

Core Course: VII   **Credit-3 (54 hours)**

PH5CRT07: DIGITAL ELECTRONICS AND PROGRAMMING

Module I

Boolean algebra and logic gates   **(9 hours)**

Basic gates NOT, OR, AND. Universal Logic Gates- NOR, NAND. XOR and XNOR Gates. Rules and Laws of Boolean algebra. Duality theorem -De Morgan's Theorems. analysis and simplification of logic circuits. Boolean equation and truth table - SOP and POS. Minterms and Maxterms. Standard SOP and Standard POS- Conversion between Standard SOP & Standard POS. Karnaugh Map (up to four variables). K map SOP minimization.

Module II

Combinational logic   **(6 hours)**

Half Adder and Full Adder, Half and Full subtractor, 4-bit parallel Adder/Subtractor. Multiplexer, De-multiplexer, Encoder & Decoder.

Sequential logic   **(13 hours)**

Flip-flops, RS, Clocked RS, Master Slave JK FF, DFF, T Flip-flop, Buffer registers- Shift register-SISO and SIPO, Counters- Binary ripple counter. D/A converters (Ladder type), A/D Converter (Counter type).

Module III

Programming in C++   **(26 hours)**

Basic C++ program structure –comments-data types-variable types-constants-operators(arithmetic, relational, logical and assignment operators)- if, if-else and else if, do while - case – loops(while, do-while, and for)-nested loops- arrays(Defining Arrays, Accessing Array Elements, Initializing Arrays)- basic ideas of functions(qualitative idea), object and classes. Programs using loops.

Text book: Object oriented programming in Turbo C++ - Robert Lafore (Galgotia Pub.)
Chapter 2, 3 and 7.

Text books:

1. *Digital fundamentals, Thomas L. Floyed (10th edition), Pearson*

2. *Digital principles and applications, Malvino, Leach and Saha (6th Edition) TMH*

3. *Digital electronics, S Salivahanan & S Arivazhagan VPH (2010)*

4. *Digital design, M Morris Mano, PHI*

References:

1. *Digital logic and computer design - M Morris Mano, PHI*

2. *Digital Electronics- William H Gothmann, PHI*

3. *Digital circuits and design- S Salivahanan and S Arivazhakan, PHI*

4. *Digital Electronics- Sedha, S Chand*

5. *Digital computer electronics- Malvino, Brown, TMH*

6. *Object oriented programming in Turbo C++ - Robert Lafore (Galgotia Pub.)*

PH5CRT08: ENVIRONMENTAL PHYSICS AND HUMAN RIGHTS

Vision

The importance of environmental science and environmental studies cannot be disputed. The need for sustainable development is a key to the future of mankind. Continuing problems of pollution, solid waste disposal, degradation of environment, issues like economic productivity and national security, Global warming, the depletion of ozone layer and loss of biodiversity have made everyone aware of environmental issues. The United Nations Conference on Environment and Development held in Rio de Janerio in 1992 and World Summit on Sustainable Development at Johannesburg in 2002 have drawn the attention of people around the globe to the deteriorating condition of our environment. It is clear that no citizen of the earth can afford to be ignorant of environment issues.

India is rich in biodiversity which provides various resources for people. Only about 1.7 million living organisms have been described and named globally. Still many more remain to be identified and described. Attempts are made to conserve them in ex-situ and in-situ situations. Intellectual property rights (IPRs) have become important in a biodiversity-rich country like India to protect microbes, plants and animals that have useful genetic properties. Destruction of habitats, over-use of energy resource and environmental pollution has been found to be responsible for the loss of a large number of life-forms. It is feared that a large proportion of life on earth may get wiped out in the near future.

In spite of the deteriorating status of the environment, study of environment has so far not received adequate attention in our academic programme. Recognizing this, the Hon'ble Supreme Court directed the UGC to introduce a basic course on environment at every level in college education. Accordingly, the matter was considered by UGC and it was decided that a six months compulsory core module course in environmental studies may be prepared and compulsorily implemented in all the University/Colleges of India.

The syllabus of environmental studies includes five modules including human rights. The first two modules are purely environmental studies according to the UGC directions. The second two modules are strictly related with the core subject and fifth module is for human rights.

Objectives

- Environmental Education encourages students to research, investigate how and why things happen, and make their own decisions about complex environmental issues by developing and enhancing critical and creative thinking skills. It helps to foster a new generation of informed consumers, workers, as well as policy or decision makers.
- Environmental Education helps students to understand how their decisions and actions affect the environment, builds knowledge and skills necessary to address complex environmental issues, as well as ways we can take action to keep our environment healthy and sustainable for the future. It encourages character building, and develops positive attitudes and values.
- To develop the sense of awareness among the students about the environment and its various problems and to help the students in realizing the inter-relationship between man and environment and helps to protect the nature and natural resources.

- To help the students in acquiring the basic knowledge about environment and the social norms that provides unity with environmental characteristics and create positive attitude about the environment.

Module I (15 Hours)

Water Resources and Its Management (3 Hours)
Water resources: Use and over-utilization of surface and ground water, floods, drought, dams-benefits and problems. Water harvesting-Importance of rain water harvesting in Kerala.

Remote sensing (3 Hours)
Remote sensing-principles, spectral reflectance of earth's surface features, Remote sensing satellites and sensors, aerial photography, Applications of Remote Sensing in environmental monitoring and assessment.

Environmental Pollution (9 Hours)
Environment and human health; Environmental pollution- Primary and secondary pollutants; Air pollution- Sources, Effects and Control/Treatment methods; Acid Rain; Ozone layer depletion; Green house gases; Global warming - Climatic effects; Water pollution- Sources, Effects and Control/Treatment methods; Groundwater pollution; Marine pollution; Soil pollution; Noise pollution- Sources and measurement indices of noise pollution, Noise exposure level and standards, Noise control measures, Impact of noise on human health, ; Environmental pollution due to environmental disasters; Consumerism and waste products; E-waste-an emerging environmental threat. Disaster management: floods, earthquake, cyclone and landslides.

Module II (12 Hours)

Waste Management (8Hours)
Waste minimization and resource conservation:- Source reduction, Recycling, Value-added products; Waste minimization promotional methods- awareness generation, control methods and economic benefits; Benefits of waste minimization; Management of solid wastes-Municipal solid wastes, Hazardous solid waste-characteristics and management of HSW, Waste treatment and disposal methods- physical, biological and chemical process.

Environment Impact Assessment and Control (4 Hours)
Basic ideas of environment impact assessment; Environment ethics; Environmental laws and constitutional provisions to control pollutions in India-The general acts; Air (prevention and control of pollution) act; Water (prevention and control of pollution) act; Wild life protection act; Forest conservation act; Environment protection acts.

Module III (13 Hours)

Non-renewable and Renewable Energy Sources (13 Hours)
Non-renewable energy sources:-Coal, Oil, Natural gas; Nuclear fission energy; Merits and demerits of non-renewable energy.
Renewable energy sources: Biomass energy- Biofuels, Biogas plant - Fixed dome type and moving drum type; Wind energy; Wave energy; Tidal energy; Hydroelectricity; Geothermal

energy conversion; Ocean thermal energy conversion; Fusion energy; Hydrogen energy-Production and storage; Merits and demerits of each renewable energy sources; Storage of intermittently generated renewable energy.

Module IV (14 Hours)

Solar energy (14 Hours)
Sun as a source of energy- Solar radiation, Solar Constant, Spectral distribution; Solar pond - Convective and salt gradient types; Flat plate collector; Solar water heater - Direct and indirect systems- Passive and active systems; Optical concentrator - Parabolic trough reflector - Mirror strip reflector - Fresnel lens collector; Solar desalination; Solar dryer - Direct and indirect type; Solar cooker; Solar heating of buildings; Solar green houses; Need and characteristics of photovoltaic (PV) systems; Solar cells - Principle, Equivalent circuits, V-I characteristics, fill factor, conversion efficiency; PV Sun tracking systems; Merits and demerits of solar energy.

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Module - V (18 Hours)

Unit 1 - Human Rights

An Introduction to Human Rights, Meaning, concept and development –History of Human Rights-Different Generations of Human Rights- Universality of Human Rights- Basic International Human Rights Documents - UDHR ,ICCPR,ICESCR.-Value dimensions of Human Rights

Unit 2 - Human Rights and United Nations
Human Rights co-ordination within UN system- Role of UN secretariat- The Economic and Social Council- The Commission Human Rights-The Security Council and Human rights- The Committee on the Elimination of Racial Discrimination- The Committee on the Elimination of Discrimination Against Women- the Committee on Economic, Social and Cultural Rights- The Human Rights Committee- Critical Appraisal of UN Human Rights Regime.

Unit 3- Human Rights National Perspective
Human Rights in Indian Constitution – Fundamental Rights- The Constitutional Context of Human Rights-directive Principles of State Policy and Human Rights- Human Rights of Women-children –minorities- Prisoners- Science Technology and Human Rights- National Human Rights Commission- State Human Rights Commission- Human Rights Awareness in Education.

Reference Books:
1. Non-conventional energy sources - G.D Rai- Khanna Publishers, New Delhi
2. A textbook of Environmental Studies- E Bharucha - University Grants Commission, 2004
3. Environmental Science: Principles and Practice- R.C. Das and D.K. Behera - PHI Learning Pvt. Ltd
4. Renewable Energy Sources and Emerging Technologies: Edition 2, D.P. Kothari K. C. Singal, Rakesh Ranjan - PHI Learning Pvt. Ltd, 2011.

5. Solar energy - M P Agarwal - S Chand and Co. Ltd.
6. Solar energy - Suhas P Sukhative Tata McGraw - Hill Publishing Company Ltd.
7. Renewable Energy, Power for a sustainable future, Edited by Godfrey Boyle, Oxford University Press, 2012.
8. Solar Energy: Resource Assesment Handbook- Dr. P Jayakumar APCTT 2009
9. A textbook of Environmental Studies- S.Satyanarayan, S.Zade, S.Sitre and P.Meshram - Allied Publishers, New Delhi, 2009
10. Remote Sensing: Principles and Interpretation, Floyd F. Sabins, Waveland Pr Inc; 3 edition (2007)

Human Rights

1. Amartya Sen, The Idea Justice, New Delhi: Penguin Books, 2009.

2. Chatrath, K. J.S., (ed.), Education for Human Rights and Democracy (Shimla: Indian Institute of Advanced Studies, 1998)

3. Law Relating to Human Rights, Asia Law House, 2001.

4. Shireesh Pal Singh, Human Rights Education in 21st Century, Discovery Publishing House Pvt.Ltd, New Delhi,

5. S.K.Khanna, Children and the Human Rights, Common Wealth Publishers, 1998. 2011.

6. Sudhir Kapoor, Human Rights in 21st Century, Mangal Deep Publications, Jaipur, 2001.

7. United Nations Development Programme, Human Development Report 2004: Cultural Liberty in Today's Diverse World, New Delhi: Oxford University Press, 2004.

Semester-V

Open Course: **Credits-3 (72 Hrs)**

PH5OPT02: Physics in Daily Life

Module I

Unit 1   **(8 hours)**

Fundamental and derived quantities. Units and dimensions,dimensional analysis, order of magnitude, significant figures, errors.

Unit 2 Light   **(12 Hours)**

Reflection, refraction, diffraction,interference, scattering(elementary ideas only) – examples from daily life – apparent depth, blue color of sky, twinkling of stars.

Total internal reflection, mirage, sparkling of diamond, primary and secondary rainbow – optical fibers. Concave and convex mirrors, lenses – focal length, power of a lens, refractive index, prism, dispersion. Human eye, defects of the eye – myopia, hypermetropia, presbyopia and astigmatism and their correction by lens.

Module II

Unit 3 Motion   **(12 Hours)**

Velocity, acceleration, momentum, Idea of inertia, force - laws of motion. Newton's law of gravitation, acceleration due to gravity, mass and weight, apparent weight, weightlessness.

Rotational motion, Moment of inertia, torque, centripetal and centrifugal acceleration- examples- banking of curves, centrifugal pump, roller coasters.

Unit 4 Electricity   10 Hours)

Voltage and current, ohms law. Electric energy, electric power, calculation of energy requirement of electric appliances – transformer, generator, hydroelectric power generation – wind power – solar power – nuclear power

Module III

Unit 5 Matter and energy (18 Hours)

Different phases of matter, fluids - surface tension, viscosity- capillary rise, Bernoulli's theorem and applications.

Heat energy, temperature, different temperature scales – degree Celsius, Fahrenheit and Kelvin.

Waves – transverse and longitudinal waves, sound waves, Doppler Effect.

Lasers, fluorescence, phosphorescence, electromagnetic waves – applications – microwave oven, radar, super conductivity.

Unit 6 Universe (12 hours)

Planets, – solar system, moon- faces of moon, lunar and solar eclipses, constellations, Different types of stars, Galaxies, black hole. Satellites, Artificial satellites, Global positioning system. Geo stationary satellite.

Reference Texts

1. Fundamentals of Physics with Applications by Arthur Beiser

2. Conceptual Physics by Paul G Hewitt

Semester-VI

Core Course: IX   **Credit-3 (54 hours)**

PH6CRT09: THERMAL AND STATISTICAL PHYSICS

Module I

Equation of state for gases   **(5 hours)**

Equation of an ideal gas, behavior of real gases, Andrew's experiment on carbon dioxide, critical state, two phase region, intermolecular forces, van der Waals equation of state, van der Waals isotherms, critical constants, limitation of van der Waals equation.

Zeroth law of thermodynamics   **(4 hours)**

Thermodynamic system, surroundings, variables, thermal equilibrium: zeroth law, thermodynamic equilibrium, thermodynamic processes, reversible and irreversible processes, equation of state, expansivity and compressibility.

First laws of thermodynamics   **(7 hours)**

Internal energy, heat, work, cyclic processes, first law, heat capacity, energy equation and difference of specific heat capacities, indicator diagram work done in reversible isothermal expansion of ideal gas, work done in reversible adiabatic expansion of ideal gas.

Heat engines and second law of thermodynamics   **(5 hours)**

Second law statements, heat engine, efficiency, Carnot's ideal heat engine, **work done by the engine per cycle**, reversibility, Carnot refrigerator, heat pump, Carnot theorem, absolute scale of temperature, Clausius- Clapeyron latent heat equation.

Text Book: Thermal and Statistical Physics, R.B. Singh, part-1 chapter 3, 4, 5 and6

Module II

Entropy   **(5 hours)**

Definition of entropy, principle of increase of entropy, entropy and unavailable energy, change in entropy in heat conduction, change in entropy in reversible and irreversible process, efficiency of Carnot cycle from TS diagram, entropy of an ideal gas, entropy and disorder.

Thermodynamic relations   **(8hours)**

Maxwell's thermodynamic relations, TdS equations, energy equation, heat capacity equations, thermodynamic functions, third law of thermodynamics.

Conduction and radiation   **(4 hours)**

Conduction, thermal conductivity, thermal conductivity of bad conductor Lee's disc experiment -thermal resistance, thermal radiation and its properties, fundamental definitions of energy flux, intensity and radiant emittance, Stefan's law, Stefan-Boltzmann law.

Text Book: Thermal and Statistical Physics, R.B. Singh, part-1 chapter7,8,10 and 11.

Module III

Statistical mechanics   **(8 hours)**

Microstates and macrostates, Phase space, density of states, mu space and Gamma space, principle of equal a priori probability, ergodic hypothesis, statistical equilibrium, ensemble,ensemble formulation of statistical mechanics, microcanonical, canonical and grand canonical ensemble, partition function, average energy of particle, equipartition theorem.

Statistical distributions   **(8 hours)**

Maxwell Boltzmann, Fermi-Dirac and Bose-Einstein statistics, distribution laws, Maxwell-Boltzmann, Fermi-Dirac and Bose-Einstein distribution.

Text Book: Thermal and Statistical Physics, R.B. Singh, part-2, Chapters 2, 3,4 and 5.

Text Book:

1. *Thermal and Statistical Physics, R.B. Singh, New Age Pub. (2010)*

References:

1. *An introduction to thermodynamics by Y.V.C. Rao (New Age Pub.)*
2. *An introduction to Thermal Physics by D.V. Schroeder (Pearson Pub.)*
3. *Heat and thermodynamics by Mark W Zemansky, Richard H Dittman & Amit K Chattopadhyay. MCH New Delhi.*
4. *Thermodynamics and Statistical physics Brij Lal, N.Subrahmanyam and P S Hemne (S. Chand &Co, Multi colour edition 2007).*
5. *Berkeley Physics Course Volume 5; Statistical Physics; Frederick Reif. McGraw Hill.*
6. *Statistical Mechanics, R.K. Pathria, Pergamon press, Oxford*

Semester-VI

Core Course: X   **Credit-3 (72 hours)**

PH6CRT10: RELATIVITY AND SPECTROSCOPY

Module I

Special Theory of Relativity   **(18 hours)**

Inertial and non inertial frames of reference- Galilean transformation, Significance of Michelson-Morley experiment, Postulates of Special Theory of Relativity, Lorentz transformation, Spatial contraction, Time dilation, composition of velocities, mass of moving particle, Equivalence of mass and energy. Introductory concept of general theory of relativity.

Text Book: Modern Physics, Kenneth S Krane.

         Concepts of modern Physics, Arthur Beiser

Module II

Atomic Spectroscopy   **(21 hours)**

Historical introduction. Electrostatic spectrum. Types of spectra. Absorption and emission of light by atoms, quantum theory, early atom models – Bohr model, electron spin and magnetic moment, Exclusion principle, Stern-Gerlach experiment, Vector atom model, quantum numbers associated with vector atom models, Total angular momentum and LS coupling, fine structure of Sodium D lines, Zeeman effect, quantum mechanical explanation for anomalous Zeeman effect, Paschen-Back effect.

Text Book: Molecular structure and Spectroscopy, G Aruldas.

         Concepts of modern Physics, Arthur Beiser

Module III

Molecular Spectroscopy   **(21 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 result, classical theory and its failure, quantum theory of Raman effect.

IR and Microwave spectroscopes.

Text Book: Fundamentals olf Molecular Spectroscopy, C.Banwell and E. Mccash.

Molecular structure and Spectroscopy, G Aruldas.

NMR and ESR Spectroscopy (12 hours)

NMR Spectroscopy- Basic principles and instrumentation- Medical applications of NMR.

Text Book: Molecular structure and Spectroscopy, G Aruldas – Chapter 10 (Sections 10.1, 10.2,10.3 and 10.19).

ESR Spectroscopy- Basic principles and instrumentation.

Text Book: Molecular structure and Spectroscopy, G Aruldas – Chapter 11 (Sections 11.1, 11.2 and 11.3).

Text Books:

1. *Molecular structure and spectroscopy, Aruldas 2nd ed. EEE.*
2. *Modern Physics, Kenneth S Krane (2nd Edition) -Wiley.*
3. *Concepts of modern Physics, Arthur Beiser (6th Edition) - SIE.*

References:

1. *Spectroscopy: Straughan and Walker –(Vol.1) John Wiley*
2. *Fundamentals of Molecular Spectroscopy: CN Banwell –(4th edition) TMH .*
3. *Introduction to Atomic Spectra, HE White, TMH*
4. *Elements of spectroscopy, Guptha, Kumar and Sharma (Pragathi Prakash)*
5. *Special Relativity- Resnick, (Wiley)*
6. *Mechanics – D.S.Mathur (S.Chand).*
7. *Mechanics by J.C. Upadhayaya (Ramprasad)*
8. *Semiconductor physics and optoelectronics- V Rajendran, J Hemaletha and M S M Gibson.*

Semester-VI

Core Course: XI   **Credit - 3 (54 hours)**

PH6CRT11: NUCLEAR, PARTICLE PHYSICS AND ASTROPHYSICS

Module I

Nuclear structure   **(10 hours)**

Nuclear composition – Discovery of neutron – Nuclear electrons - Nuclear properties: Nuclear radii – Spin and magnetic moment - Stable nuclei - Binding energy- Binding energy curve, Liquid drop model - Semi empirical binding energy formula with correction factors - Shell model - Nuclear forces- Meson theory of nuclear forces – Discovery of pion – Virtual Photons

Nuclear Radiation Detectors, Counters and Particle Accelerators   (8 Hours)

Interactions between energetic particles and matter (basic concepts only) - Ionization chamber - Solid state detectors - Proportional counter - Geiger-Muller counter - The Wilson cloud chamber - Bubble chamber - Scintillation counters - Van de Graaff generator - Linear accelerator - Cyclotron - Betatron

Module II

Nuclear Transformations   **(15 hours)**

Radioactive decay – Radiation hazards – Half life – Radiometric dating – Radioactive series - Alpha decay, tunnel theory of alpha decay, derivation for alpha decay constant - Beta decay, positron emission, electron capture, inverse beta decay – Gamma decay - The concept of interaction cross section, reaction rate – Nuclear reactions, Resonance, Center of mass coordinate system, Q value of nuclear reaction – Nuclear fission – Nuclear reactors – Breeder reactors - Nuclear fusion in stars – Formation of heavier elements – Fusion reactors – Confinement methods

Cosmic rays   **(4 hours)**

Latitude effect – Azimuth effect – Altitude effect - Primary cosmic rays – Secondary cosmic rays – Cosmic ray showers – Discovery of Positron – Mesons Van Allen belts – Origin of cosmic rays

Module III

Particle Physics   **(10 hours)**

Interactions and Particles – Leptons – Neutrinos and Antineutrinos, other leptons – Hadrons – Resonance particles – Elementary particle quantum numbers – Basic concepts of symmetries and conservation principles – Basic concepts of Quarks – color, flavor, Quark confinement –Higgs boson

Astrophysics   **(7 hours)**

Classification of stars – Hertzsprung - Russel diagram – Luminosity of a star – Stellar evolution - White Dwarfs - Chandrasekhar limit - Neutron stars - Black holes - Supernova explosion – Photon diffusion time.

Text Book:

1. *Concepts of Modern Physics, Arthur Beiser, 6th Edition, Tata McGraw-Hill publishing company*

2. *Modern Physics, R Murugeshan and K. Sivaprasath, 15th Edition (Revised) (2010), S.Chand*

References:

1. *Atomic and Nuclear Physics, S N Ghoshal, S.Chand.*

2. *Nuclear and Particle Physics S L Kakani and Subhra Kakani -Viva Books 2008*

3. *Elements of Nuclear Physics, M L Pandya and R P S Yadav, Kedar Nath Ram Nath*

4. *Modern Physics, Kennth Krane, 2nd Edition, Wiley India (Pvt) Ltd.*

5. *Modern Physics , G. Aruldhas and P. Rajagopal, Prentice-Hall India*

6. *An Introduction to Astrophysics, Baidyanath Basu, 2nd Edition, Prentice-Hall India*

Semester-VI

Core Course: XII   **Credit-3 (72 hours)**

PH6CRT12:   SOLID STATE PHYSICS

Module I

Crystal structure   **(18 hours)**

Solid state, crystalline, polycrystalline and amorphous materials, crystal lattice, periodicity, translation vectors, unit cell, basis, symmetry operations, bravais lattice in two and three dimensions, miller indices, interplanar spacing, simple crystal structures-hcp, fcc, bcc and simple cubic, Structures of NaCl, Diamond and ZnS, X-ray diffraction from crystals- Bragg's law, powder method, reciprocal lattice-properties, reciprocal lattice to sc, bcc and fcc, Bragg's law in reciprocal lattice.

Text book: Solid State Physics by Puri and Babbar- Chapter 1 & 2

Module II

Bonding in solids   **(7 hours)**

Inter-atomic forces, ionic bonding, bond dissociation and cohesive energy, madelung energy, covalent bonding, metallic bonding, hydrogen bonding, van derwaals bonding (basic ideas only).

Text book: Solid State Physics by Puri and Babbar

Free electron theory and elementary band theory   **(12 hours)**

Free electron gas in one dimension, three dimension, electronic specific heat, band theory, Bloch theorem, Kronig-Penney model (derivation not expected), energy-wave vector relations, different zone schemes, velocity and effective mass of electron, distinction between metals, insulators and semiconductors.

Semiconducting properties of materials   **(12 hours)**

Intrinsic and extrinsic semiconductors, drift velocity, mobility and conductivity of intrinsic semiconductors, carrier concentration and Fermi level for intrinsic semiconductor, carrier concentration, conductivity and Fermi level for extrinsic semiconductor. Hall Effect, Direct and Indirect band gap, Principles of LED and Photodiodes.

Text book: Solid State Physics by Puri and Babbar Chapter 5, 6 and 7

Module III

Dielectric properties of materials (5 hours)

Polarization and susceptibility, local filed, dielectric constant and polarizability, sources of polarizability, Clausius-Mossoti relation, piezoelectricity.

Magnetic properties of materials (7 hours)

Response of materials to magnetic field, classification of magnetic materials, Langevin's classical theory of diamagnetism and paramagnetism, ferromagnetism, Weiss theory, domain theory, antiferromagnetism and ferrimagnetism.

Superconductivity (10 hours)

Origin of superconductivity, response of magnetic field, Meissner effect, super current and penetration depth, critical field and critical temperature, type-I and type –II superconductors, thermodynamic and optical properties, isotope effect, Josephson effect and tunneling- SQUID BCS theory-Cooper pairs-Existence of bandgap.

Text book: Solid State Physics by Puri and Babbar Chapter 5, 6 and 7

Text book:

1. *Solid State Physics by Puri and Babbar (S.Chand)*

References:

1. *Solid State Physics, M.A. Wahab, (2nd Edition), Narosa*
2. *Introduction to Solid State Physics, Charles Kittel, (7th Edition), Wiley*
3. *Crystallography applied to solid state Physics, AR Verma, ON Srivastava, New age*
4. *Solid State Physics, AJ Dekker- Macmillian.*
5. *Solid State Physics, NW Ashcroft, ND Mermin – Cengage Learning.*
6. *Elementary Solid State Physics, M. Ali Omer, Pearson.*
7. *Solid state physics, R L Singal, KNRN &Co.*
8. *Solid state physics, S O Pillai, New age*

Semester-VI

Choice Based Course – XIV-3   **Credit-3 (54 hours)**

PH6CBT03: COMPUTATIONAL PHYSICS

Algorithms of all methods required

Module I   **(18 hours)**

Solutions of Nonlinear Equations

Bisection Method - Newton Raphson method (two equation solution) – Regula-Falsi Method, Secant method - Fixed point iteration method - Rate of convergence and comparisons of these Methods

Solution of system of linear algebraic equations

Gauss elimination method with pivoting strategies-Gauss-Jordan method-LU Factorization, Iterative methods (Jacobi method, Gauss-Seidel method)

Module II   **(18 hours)**

Curve fitting: Regression and interpolation

Least squares Regression- fitting a straight line, parabola, polynomial and exponential curve

Finite difference operators-forward differences, divided difference; shift, average and differential operators- Newton's forward difference interpolation formulae- Lagrange interpolation polynomial- Newton's divided difference interpolation polynomial

Module III   **(18 hours)**

Numerical Differentiation and Integration

Numerical Differentiation formulae - Maxima and minima of a tabulated function- Newton-Cote general quadrature formula - Trapezoidal, Simpson's 1/3, 3/8 rule –

Solution of ordinary differential equations

Taylor Series Method, Picard's method-Euler's and modified Euler's method –Heun's method- Runge Kutta methods for 1st and 2nd order

Text Books:

1. *Numerical Methods, Balagurusamy, TMH*
2. *Numerical Methods for Scientists and Engineers- K Sankara Rao- PHI*
3. *Introductory Numerical Methods, S S Sastry, PHI.*

B. Sc. PHYSICS PRACTICAL

Minimum of experiments to be done in each paper is 14.

Minimum number of experiments for appearing practical examination is 8.

Maximum possible number of repetitions must be done to reduce error in a measuring quantity.

Do calculation of percentage error for all experiments.

The S.I. units must be specified along with the results.

<u>Division of internal marks for record (maximum 4 marks)</u>

No. of Experiments	Marks
14 and above	4
12 & 13	3
10 & 11	2
8, 9 & 10	1
Less than 8	0

SEMESTER	PAPER	PAPER CODE	TITLE
1 & 2	01	PH2CRP01	Mechanics and Properties of Matter
3 & 4	02	PH4CRP02	Optics and Semiconductor Physics
5 & 6	03	PH6CRP03	Electricity, Magnetism and LASER
5 & 6	04	PH6CRP04	Digital Electronics
5 & 6	05	PH6CRP05	Thermal Physics, Spectroscopy and C++ Programming
5 & 6	06	PH6CRP06	Acoustics, Photonics and Advanced Semiconductor Physics

SEMESTER 1&2 (First Year)

Core Practical 1: PH2CRP01 – Mechanics and Properties of Matter

1. Symmetric Compound Pendulum – Determination of acceleration due to gravity (g), radius of gyration(K) and moment of inertia (I)

2. Asymmetric Compound Pendulum – Determination of acceleration due to gravity (g), radius of gyration(K) and moment of inertia (I)

3. Kater's pendulum – Determination of acceleration due to gravity (g)

4. Torsion Pendulum – Determination of rigidity modulus (n) and moment of inertia (I)

5. Torsion Pendulum (Method of equal masses) – Determination of rigidity modulus (n) and moment of inertia (I)

6. Measurement of density of a solid – Sensibility method to find mass using beam balance and screw gauge / venier calipers for dimension measurements

7. Uniform bending – Pin and Microscope – Determination of Young's modulus

8. Non Uniform bending – Pin and Microscope – Determination of Young's modulus

9. Uniform bending – Optic Lever – Determination of Young's modulus

10. Non Uniform bending – Optic Lever – Determination of Young's modulus

11. Cantilever – Scale and telescope – Determination of Young's modulus

12. Cantilever – Pin and Microscope – Determination of Young's modulus

13. Vertical oscillations of a spring – Determination of Young's modulus

14. One dimensional elastic collision – Hanging sphere method – Law of conservation of energy and momentum

15. Static Torsion – Determination of rigidity modulus

16. Flywheel – Determination of moment of inertia

17. Constant pressure head – Determination of viscosity of a liquid

18. Variable pressure head – Determination of viscosity of a liquid

19. Stokes's method – Determination of viscosity of a liquid

20. Capillary rise method – Determination of surface tension

21. Quincke's method – Determination of surface tension

SEMESTER 3&4 (Second Year)

Core Practical 02: PH4CRP02 –Optics and Semiconductor Physics

1. Liquid Lens – Determination of optical constants of a convex lens – water and mercury given

2. Liquid Lens – Determination of refractive index of a liquid – water and unknown liquid

3. Spectrometer – Prism – Determination of refractive index of material of the prism

4. Spectrometer – Hollow Prism – Determination of refractive index of liquid

5. Spectrometer – Small angled prism – Normal incidence – Determination of refractive index of material of the prism

6. Spectrometer – i – d curve – Determination of refractive index of material of the prism

7. Newton's rings – Determination of wavelength of sodium light

8. The air wedge – Determination of diameter of thin wire

9. Zener characteristics – forward and reverse – Study of dynamic and static properties

10. Transistor characteristics – Common Emitter Configuration

11. Half wave rectifier – Study of ripple factor and load regulation with and without filter circuit

12. Full wave rectifier – (center tap) – Study of ripple factor and load regulation with and without filter circuit

13. Full wave rectifier – (bridge) – Study of ripple factor and load regulation with and without filter circuit

14. FET – characteristics – Determination of parameters

15. Voltage regulator using zener diode – Study of line and load regulations

16. Clippers – positive, negative and biased – Study of output waveforms

17. Clampers – positive, negative and biased – Study of output waveforms

18. OPAMP characteristics – Study of CMRR and open loop gain

19. OPAMP – inverter, non inverter and buffer – Study of gain

20. LC Oscillator – Colpit's /Hartley – using transistor

21. Phase shift oscillator – using transistor

SEMESTER 5&6 (Third Year)

Core Practical 03: PH6CRP03 – Electricity, Magnetism and LASER

1. Potentiometer – Measurement of resistance of wire
2. Potentiometer – Calibration of low range voltmeter
3. Potentiometer – Calibration of high range voltmeter
4. Potentiometer – Calibration of ammeter
5. Tangent galvanometer – Calibration of ammeter
6. Moving coil galvanometer – figure of merit
7. Conversion of galvanometer into voltmeter
8. Conversion of galvanometer into ammeter
9. Field along the axis of a circular coil – magnetic flux variation
10. Field along the axis of a circular coil – m and B_h
11. Searle's vibration magnetometer – magnetic moment
12. Deflection and vibration magnetometer – m and B_h
13. Carey Foster's bridge – Measurement of resistivity of wire
14. LCR seriesand parallel resonant circuit analysis
15. Verification of Thevenin's and Norton's theorems
16. Verification of Superposition and Maximum power transfer theorems.
17. Laser – Grating – Determination of wavelength
18. Laser – Determination of spot size and divergence
19. Optical fiber – Determination of numerical aperture
20. Single slit diffraction using laser – Determination of slit width
21. e/m – Thomson's apparatus – Bar magnet/magnetic focusing
22. Determination of Dielectric constant of a thin sheet/ a liquid

SEMESTER 5&6 (Third Year)

Core Practical 04: PH6CRP04 – Digital Electronics

1. Realization of logic gates – AND, OR and NOT – Using diodes, transistors etc.
2. Realization of logic gates – AND, OR and NOT – Using universal gates
3. Verification of truth table of NAND, NOR, XOR and XNOR gates
4. Verification of De Morgan's theorems – Using IC 7400
5. BCD to 7 segment decoder
6. Realization of Half adder/ Full adder using gates – Verification of truth table
7. Astable Multivibrator using Transistor
8. Astable Multivibrator using IC 555
9. Monostable Multivibrator using Transistor
10. Monostable Multivibrator using IC 555
11. D/A converter using IC 741 – Using binary weighed resistor / R – 2R ladder type
12. A/D converter using IC 741
13. SR Flip Flops using IC 7400 – Verification of truth table
14. JK Flip Flops using IC 7400 & 7410 – Verification of truth table
15. Digital counter using IC 7490 / 7495 / 74194 / 74151 – Verification of truth table
16. Schmitt trigger using IC 741
17. Bistable multivibrator using IC 555
18. Multiplexer using gates
19. Demultiplexer using gates
20. Shift register – SISO
21. Shift register – SIPO
22. 4-Bit Binary to Gray conversion
23. 4-Bit Gray to Binary conversion

SEMESTER 5&6 (Third Year)

Core Practical 05: PH6CRP05 – Thermal Physics, Spectroscopy and C++ Programming

1. Thermistor – Resistance - Temperature characteristics and temperature co-efficient of resistance

2. Newton's law of cooling – Specific heat capacity of a liquid

3. Thermal conductivity of bad conductor – Lee's disc

4. Carey Foster's bridge – Temperature co-efficient of resistance

5. Study of Seeback effect/Peltier effect

6. Electrochemical equivalent of Copper

7. To determine e/k using transistor

8. Spectrometer – Cauchy's constants

9. Spectrometer – Resolving power of a prism.

10. Spectrometer – Resolving power of grating.

11. Spectrometer – Dispersive power of grating

12. Spectrometer – Dispersive power of prism

13. Computer programming in C++ – Conversion of temperature scale

14. Computer programming in C++ – Solving a quadratic equation

15. Computer programming in C++ – Generation of Fibonacci series

16. Computer programming in C++ – Conversion of a decimal number into binary number

17. Computer programming in C++ – Simple Pendulum – Calculation of 'g' from experimental data

18. Computer programming in C++ – Resistance colour code to numerical value conversion

19. Computer programming in C++ – For different initial velocity and angle of projection, find out time of flight, horizontal range, Maximum height of a Projectile

20. Computer programming in C++ – sorting the numbers in ascending and descending order

21. Computer programming in C++ – multiplication of two matrices

SEMESTER 5&6 (Third Year)

Core Practical 06: PH6CRP06 – Acoustics, Photonics and Advanced Semiconductor Physics

1. Melde's string – Determination of frequency of given tuning fork
2. Sonometer – Determination of frequency of AC
3. Sonometer – Determination of frequency of given tuning fork, unknown mass and verification of laws of strings
4. Kundt's tube – Determination of velocity of sound
5. Spectrometer – Quartz prism – Refractive indices of quartz for the ordinary and extra –ordinary rays
6. Characteristics of LED – V- I characteristic for different colors
7. Characteristics of solar cell / photodiode – V- I characteristics
8. Characteristics of Light Depend Resistors
9. Planck's constant using LED's of at least 3 different colours
10. Weinbridge Oscillator using IC 741
11. Realization of XOR and Ex NOR using transistor
12. Sweep wave generator using transistor
13. Regulated power supply using zener diode and IC 741 – Study of line and load regulations
14. Regulated power supply using IC 78XX/79XX etc – Study of line and load regulations
15. Voltage regulator using zener diode and transistor – Study of line and load regulations
16. RC coupled common emitter amplifier – Study of frequency response and bandwidth
17. Voltage multipliers – doubler & tripler
18. Wave shaping R C circuits – Integrator and differentiator
19. OPAMP – adder and subtractor
20. Amplitude modulation using transistor
21. Pulse Width Modulation using IC 555

References:

1. *Advanced course in Practical Physics by D Chattopadhyay*
2. *Practical Physics – Joseph Ittiavirah, Premnath and Abraham(2005)*
3. *Practical Physics, CL Arora, S.Chand*
4. *Practical Physics, Harnam Singh , S Chand*
5. *Electronics lab manual Vol 1 & 2, K A Navas.*
6. *A course of Experiments with He –Ne Laser – R.S Sirohi (2nd Edition) Wiley Eastern Ltd.*
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